



COLUMBIA LAW SCHOOL

SABIN CENTER FOR CLIMATE CHANGE LAW

**Compilation of Recommendations
to Reduce Greenhouse Gas
Emissions in New York State**

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Introduction by Michael B. Gerrard

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Introduction and User Guide

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The Climate Leadership and Community Protection Act (CLCPA) was passed by both houses of the New York State legislature and signed into law by Governor Andrew Cuomo in June 2019. It took effect on January 1, 2020. It requires total statewide greenhouse gas (GHG) emissions to be 40% below 1990 levels in 2030 and 85% below 1990 levels in 2050, with an aspirational goal of a 100% reduction in 2050. It is one of the strongest climate change laws in the world, and people everywhere are watching its implementation for models of what can be done elsewhere.

The CLCPA establishes a Climate Action Council of 22 members (12 of whom are the heads of state agencies) to devise a “scoping plan” for how the law will be implemented. It will form several advisory committees, and will work with special advisory groups on environmental justice and on “just transition.” A draft plan is due in January 2022. After hearings and other public consultation, a final plan is due in January 2023. By January 2024, the New York State Department of Environmental Conservation is required to promulgate regulations “to ensure compliance with the statewide emission reduction limits.” This process of requiring an agency to devise a scoping plan for implementation is modeled after California’s Global Warming Solutions Act, AB32.

Over the years many recommendations have been made as to what substantive actions New York can take to lower its GHG footprint. The purpose of this *Compilation of Recommendations* document is to assemble in one place all of the published recommendations, organized by subject matter, for the use of the Climate Action Council, its advisory committees, the state officials who will be responsible for implementing the law, and members of the environmental, environmental justice, business and other communities who will be monitoring the preparation of the scoping plan and the implementation of its recommendations.

This is the second New York Climate Action Council. The first was established by Governor David Paterson in 2009. It consisted of the heads of many state agencies. Working with several large technical advisory committees, it issued an interim report in November 2010 with a great many specific recommendations. Governor Cuomo took office two months later and the report was largely shelved, though parts of it morphed into what became the State Energy Plan. Since then many government agencies, nongovernmental organizations, business groups, academic centers, think tanks and others have issued reports with specific ideas about actions New York could take to transition away from the use of fossil fuels and to lower GHG emissions. This document has endeavored to locate these reports and set forth their recommendations.

Another effort has been based on reports issued in 2014 and 2015, [Pathways to Deep Decarbonization in the United States](#), prepared for the Sustainable Development Solutions Network and the Institute for Sustainable Development and International Relations (IDDRI) by

Energy + Environmental Economics (E3). It set forth detailed technical pathways for the U.S. to reduce its GHG emissions. Based on this report, Professor John Dernbach and I led a project that led to the publication by the Environmental Law Institute in 2019 of a large book, [Legal Pathways to Deep Decarbonization in the United States](#). This book contains more than 1,500 recommendations for federal, state and local actions to follow the pathways identified by the technical reports, as well as other actions that go beyond those reports. The book also contains detailed descriptions of the current state of the law on the matters it covers and legal analyses of its recommendations. Professor Dernbach and I then launched a project, which I describe in [this](#) article, to recruit pro bono lawyers to draft the model laws recommended by the *Legal Pathways* book. This project has also created a web site, [Model Laws for Deep Decarbonization in the United States](#), where we are posting these model laws as well as large numbers of other existing and model laws and other resources. As of this writing, 1,829 items are posted there. The *Compilation of Recommendations* document includes the relevant recommendations for state action in the *Legal Pathways* book (denoted as “LPDD Recommendations”), and links to the model laws and other resources posted on the web site (denoted as “LPDD Resources”).

This document, the *Compilation of Recommendations*, begins with a detailed table of contents. Its headings have links that will take the reader to the relevant section. After the table of contents is a list of the sources of recommendations, with links to all of them. The recommendations in the document are all keyed to their sources so the reader can find where they came from.

For each topic, where applicable we begin with a list of current New York actions, followed by the LPDD recommendations; the LPDD resources, recommendations from others; discussion and analyses of the relevant issues; and other relevant resources.

Inclusion of a recommendation in the *Compilation of Recommendations* is not an endorsement. Indeed, some of the recommendations contradict each other. Our purpose was to compile the recommendations that others have made, so that the Climate Action Council and others will have in front of them a large set of potential actions from which to choose.

We have also created a related resource, the [New York State Climate Law Tracker](#). It is a web site that monitors the implementation of the CLCPA and three other related New York statutes - the Community Risk and Resiliency Act of 2014 (CRRA), the Environmental Justice Law of 2019, and the Accelerated Renewable Energy Growth and Community Benefits Act of 2020. The web site displays the deadlines set forth in these four laws and indicates which have been met, which are overdue, and which are upcoming or ongoing. Another of our trackers, the [New York City Climate Law Tracker](#), similarly tracks implementation of the Climate Mobilization Act of 2019, including Local law 97.

The CLCPA concerns reduction in GHG emissions. The CRRA concerns adaptation to the impacts of climate change. Since this compilation is designed to assist in the implementation of CLCPA, it does not cover adaptation measures.

The *Compilation of Recommendations*, the New York State Climate Law Tracker and the New York City climate Law Tracker are living documents. If readers identify additional or new sets of recommendations, errors or omissions, or new developments, please send them to my Sabin Center colleague Hillary Aidun, hwa2108@columbia.edu.

This document is the work of three people working under my supervision. Kate Marsh and Neely McKee are students at Columbia College who spent the summer of 2020 working (remotely) for the Sabin Center creating this document, with the support of the Laidlaw Undergraduate Research and Leadership Program. Jordan Gerow is an attorney working with the LPDD project who created the Model Laws to Deep Decarbonization website, and has inserted the LPDD recommendations and resource links. I am most appreciative of the diligent efforts of Kate, Neely and Jordan in creating a document that we hope will be helpful in achieving the important and essential ambitions of the CLCPA.

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Transportation

Electric Vehicle Charging Infrastructure

New York Actions

- “In March 2020, the PSC improved its direct current fast-charging (DCFC) infrastructure program. Specifically, the Commission clarified certain rules and modified others to allow brand-specific proprietary plugs to be eligible for incentives where the charging station also makes available commonly accepted standardized plug types. The plugs must be capable of charging two vehicles simultaneously at high capacity charging speeds.” (Rhodes, 2020, 1)
- “New York State regulators approved a plan Thursday to provide up to \$750 million to bolster EV charging infrastructure and help electrify bus fleets. Why it matters: Building more charging can help spur EV deployment by helping consumers overcome "range anxiety." And replacing diesel buses helps cut carbon emissions and air pollution. How it works: The state's utilities commission greenlighted a plan under which the state's utilities would provide up \$701 million spread over five years to finance around 50,000 charging points. Over \$200 million of the financing will go to "equitable access and benefits for lower-socio-economic and disadvantaged communities." Separately, the state's environment department is using almost \$50 million from the settlement of VW's diesel scandal to finance charging as well as help school and transit bus fleets electrify.” (\$700M EV Program, 2020)
- “National Grid offers its NY customers a voluntary time-of-use rate for charging electric vehicles during the off-peak hours of 11pm to 7am. Most EVs can be programmed to charge during these hours using an onboard timer, mobile app, outlet timer, or EV charging station.” (LPDD, <https://lpdd.org/resources/national-grids-voluntary-time-of-use-rate-for-evs/>)
- “ConEdison’s SmartCharge NY program rewards off-peak charging behavior. The utility is installing 120 curbside chargers across all five New York City boroughs” (Gurman, 2019, 229)
- ConEd’s current rate case in front of the PSC proposes \$30 million in “make ready” investment for DCFC and another \$15 million to expand its SmartCharge NY program.” (Gurman, 2019, 229)
- “In February 2019, the PSC issued an order designed to support deployment of up to 1,074 DCFC across all investor-owned utilities (IOU) in the state (except the Long Island Power Authority (LIPA), which is developing a separate, but comparable program for PSC approval).” (Gurman, 2019, 230)
- “The order allocates \$72 million from utilities to implement the program which will include offering services to assess fleet electrification for owners of larger vehicles, including site feasibility and analysis for charging depots.” (Gurman, 2019, 230)

LPDD Recommendations

- "State government should allocate funding, further to existing initiatives like Charge Ready NY, and institute regulations to incentivize EV charging in residential spaces."

- "States could encourage service providers and workplace site hosts to install charging stations near them."
- "States should consider providing incentives to encourage owners of multi unit dwellings to add access to electrical outlets in parking areas."
- "State legislatures could request assistance from PUCs in promoting EV infrastructure by including EV charger costs in electric rates. This outcome should be a key consideration in the EV Charging Infrastructure proceeding at the PSC (18-E-0138)."

Relevant LPDD Database Pathways

- Expanding EV Charging Infrastructure: <https://lpdd.org/pathway/expanding-charging-infrastructure/>

EV Charging Rates and Grid Integration

LPDD Recommendations

- *"States can help to ensure that EV customers charge at optimal times by experimenting with different incentive structures that encourage off-peak charging. This outcome should be a key consideration in the EV Charging Infrastructure proceeding at the PSC (18-E-0138)."*
- *"Utilities should consider allowing ratepayers' vehicles to charge during low-demand times and discharge the power back to the grid during peak times, serving as forms of grid batteries."*
- *"The Public Service Commission could allow for incentive rates or provide other encouragement to facilitate use by the grid of electricity from EV batteries, such as is being explored in ConEd's Electric School Bus V2G Demonstration Project."*

Relevant LPDD Database Pathways

- Using EVs as a Grid Resource: <https://lpdd.org/pathway/using-evs-as-a-grid-resource/>
- EV Charging Rate Design: <https://lpdd.org/pathway/promoting-off-peak-ev-charging/>

Heavy-Duty Vehicles -- Charging and Other Infrastructure

LPDD Recommendations

- *"States—particularly those with air quality concerns related to NOx emissions—should consider funding public infrastructure projects to support battery and fuel cell HDVs."*

Related LPDD Database Pathways

- Building Necessary Infrastructure to Support Electric HDVs: <https://lpdd.org/pathway/building-necessary-infrastructure-to-support-electric-hdvs/>

Other Recommendations

- "DC Fast Charger program: would guarantee that 20% of each utility's budget under the program is directed to deployment of charging infrastructure within 10 miles of a disadvantaged community, to increase access to EV charging infrastructure and to increase electric miles driven by ride hailing services in and around those communities" (CES White Paper, 2020, 16)

- “The City should look to adopt a more targeted approach like the Make-Ready program⁴⁸ – proposed by DPS staff members to expand the EV charging network— which emphasizes the importance of partnership with utilities in order to increase financial capacity and affordability of charging infrastructure installation. According to the Public Service Commission (PSC) proposal, the Make-Ready program would support 90% of the overall cost of installation, providing a much needed incentive for property owners to install public access charging stations.” (NYC EJA, 2020, 31)
- “Increase the number of charging stations across the state to 10,000 by 2021, including access on all major travel corridors. Far more EV charging stations will be needed by 2025 and 2030—possibly more than 100,000—to support the long-term targets of 850,000 vehicles by 2025 and two million by 2030.” (Gurman, 2019, 228)
- “As more EVs hit the road, vehicle-to-grid approaches could play an increasingly important role as EV users and charging stations work with utilities to manage demand. For example, when renewables generation is low, a signal could be sent to EV owners to stop charging; they could be paid for cooperation. Moreover, it is possible to sell excess energy stored in EV batteries back to the grid.” (McKinsey, 2019, 6)

Discussion and Analysis

- “The underutilization of charging stations has led to the low penetration of EVs on the road... While NYC’s Executive Order No. 53 supports the advancement of EV chargers to supply energy for the City’s public fleet, it does not respond to the need to increase public access to charging infrastructure.” (NYC EJA, 2020, 30)
- “The National Research Council of the National Academy of Sciences has identified a dearth of charging infrastructure as a significant barrier to scaling up EV adoption. Market coordination issues (i.e., “the chicken-and-egg dilemma”) and currently low station utilization rates have made it challenging for various stakeholders—including EV charging service providers, automakers, and government agencies—to sustainably deploy charging stations.³² To enable drivers to “go electric,” an accessible network of charging stations must be available where drivers live, work, and play. Although 80% of EV charging currently takes place at primarily single-family homes, additional charging stations at multi-unit dwellings, workplaces, depots, ports, and other publicly accessible locations (e.g., highway corridors) will be needed to enable the development of a broader, more diverse EV market.” (Garcia, 2019, 129)
- “Electric vehicles (EVs) represent less than one percent of all NYC vehicle registrations today, largely owing to a lack of charging opportunities. New Yorkers will need to rely on public-access, centralized, and high-speed charging locations to support the dramatic transition to EVs that is necessary to reduce transportation GHG emissions.” (NYC 1.5C, 2017, 13)

Other Resources

Related Topics in this Document: Electric Vehicle Purchases and Incentives, Demand Management

Electric Vehicle Purchases and Incentives (Light Duty ZEVs)

New York Actions

- “NYSERDA, the state's energy policy arm, is also tasked with overseeing three environmental justice competitions. The first is a \$40 million "environmental justice clean vehicle transformation" prize that DPS staff said would seek ways to reduce harmful pollution from vehicles in frontline communities through collaborative approaches. There's also a \$25 million "clean personal mobility prize" to ensure access to clean transportation options for people in disadvantaged communities and a \$20 million pilot for medium and heavy-duty electrification prize.” (\$700M EV Program, 2020)
- “New York has made a large commitment to electric vehicles and “is striving to be ready to accommodate more than 30,000 plug-in electric vehicles by 2018 and 1 million by 2025 through Charge NY.” The sales rate will need to ramp up to about 140,000 vehicles per year and NYSERDA is currently offering rebates up to \$2,000 per vehicle.” (Getting Greener, 2019, 48)
- “New York City: In May 2019, Fleet NYC increased its commitment to EVs, setting a goal of 4,000 EVs by 2025. In August 2019, the New York City Taxi and Limousine Commission created an exemption for EVs under the cap for new for-hire licenses.” (Gurman, 2019, 229)
- “Model EV Community is an effort to identify two municipalities to create an EV ecosystem where the entire electric vehicle experience is optimized, including integrating into the electricity system and wider community; building a living lab for partners, third parties, and others to test and learn; and sharing insights and data.” (Gurman, 2019, 229)
- “Of the 13,587 yellow cabs on the road in 2015, 73% were hybrids, while just 26% of the 7,676 boro taxis (green taxis) were hybrids—a gap that can be attributed to the 2009 hybrid incentive plan.⁴⁶ The New York City Taxi and Limousine Commission (TLC) does not provide similar statistics for the more than 46,000 livery and black car vehicles on the road. A goal, announced by Mayor Michael R. Bloomberg during his final State of the City address in January 2013, for one-third of the taxi fleet to comprise EVs, resulted in a “Roadmap to Electric New York City Taxis” being released at the end of that year, but implementation of the report’s recommendations has stalled.” (S. Miller, 2018, 100)
- “ACS is expanding transportation options for front-line staff, including transitioning 40 percent of its agency fleet to hybrid and electric vehicles, as well as using car shares in place of dedicated agency vehicles. ACS is working with DOT to reduce the need to circle for parking, leading to less idle time and needless GHG emissions.” (NYC 1.5C, 2017, Agency Highlights, 40)

LPDD Recommendations

- *"State governments should consider a “cash for clunkers” program that targets the highest emission vehicles and is paid for through a carbon tax."*
- *"State governments should emulate the example of cities that have committed to alternative vehicle fleets and consider similar options based on local needs."*
- *"States should offer income tax credits for purchases of new AFVs or vehicles that are retrofitted or converted into AFVs. New York’s existing rebate could become*

competitive with leading states such as Colorado and Connecticut, which offer up to \$5,000 per vehicle."

Relevant LPDD Database Pathways

- Supporting Expanded Use of EVs: <https://lpdd.org/pathway/supporting-expanded-use-of-evs/>
- Purchasing Electric Fleets: <https://lpdd.org/pathway/purchasing-electric-fleets/>
- Zero Emission Vehicles: <https://lpdd.org/pathway/zero-emission-vehicles/>

Other Recommendations

- “Our analysis assumes a transition to a mix of plug-in hybrid, battery electric, and hydrogen fuel cell vehicles, depending on the vehicle class and application. These electric vehicles add to the State’s electricity demand, but also can enhance Pathways to Deep Decarbonization in New York State electric system reliability through temporally flexible vehicle charging patterns and utilization of vehicle batteries for grid balancing.” (NY Pathways, 2020, 22)
- “In addition to having a substantial impact on EV sales, pollution fees raise revenue to fund other policies, such as rebates for EVs or increased funding for public transit. By raising the cost of polluting and providing essential revenue to fund sustainable transportation options, pollution fees achieve multiple important policy objectives at once.” (Transforming Transportation, 2019, 10)
- “Policies like California’s Enhanced Fleet Modernization Program (EFMP)—a scrap-and-replace program similar to the federal “Cash For Clunkers” program—provide increasing rebates for lower-income drivers and remove the dirtiest vehicles from the road earlier than they might otherwise retire.” (Transforming Transportation, 2019, 16)
- “Achieve a 50% reduction in fossil fuel consumption in the City’s vehicle fleet by 2025 by continuing to upgrade and replace with clean fuel vehicles.” (NYC 1.5C, 2017, 22)
- “By designing a revenue-neutral feebate system, where the total amount offered as incentives is equal to the total amount charged as disincentives, New York could implement a program without any General Fund expense. The rebates disbursed could be slightly smaller than the fees collected, with a small amount of fees reserved each year to cover administrative costs and in case of an unexpectedly large need to pay for rebates in future years. But a vehicle purchase incentive program could also be designed to be revenue generating (e.g., gas-guzzler sales tax surcharge), or to be revenue-negative (e.g., tax credit for purchase of electric cars or a cash for clunkers program).” (CAC Report 2010, 11)
- “Develop and implement financial incentives and disincentives for desired market transformation and behavior to accelerate low-carbon-vehicle market penetration. Manufacturer competition may be the most cost-effective way to reduce vehicle cost, with battery manufacturing capacity and robust demand being dominant factors. A robust market can be encouraged through incentives, adequate charging infrastructure, and education. Policy mechanisms like a low-carbon fuel standard, vehicle purchase feebates, or other carbon pricing mechanism will be needed for EVs/PHEVs to be economically competitive in the near term.” (CAC Report 2010, 12, 22)

- “To approach the 80 by 2050 vision and goal for the whole transportation sector, 100 percent of new LDVs sold in 2035 would have to be near-zero-GHG... Toward this vision, the GHG emission standards for LDV would strengthen over time, with a 50 percent reduction in LDV GHG emissions by 2025 (for new fleet, from 2016 levels = 125 grams per mile [g/mi]); and 90 percent reduction in LDV GHG emissions by 2035 (for new fleet, from 2016 levels = 25 g/mi). The TLU vision requires a near 100 percent reduction of GHG emissions for LDV, assuming that other transportation types (aviation, heavy-duty trucks, marine, railroads) will not be able to achieve as aggressive reductions.” (CAC Report 2010, 9)

Discussion and Analysis

- “Beyond the cost barrier, the City must respond to perception challenges associated with EV access for all. Much more substantive programmatic efforts must be made in environmental justice communities that have been historically overburdened by poor air quality due to pollution from the transportation sector.” (NYC EJA, 2020, 100)
- “Car ownership rates are very low for a large portion of the state’s population, so this is not a benefit of value to many residents. Furthermore, this is an expensive GHG emissions reduction strategy. If the state is successful in getting 1 million electric vehicles on the road by 2025, there would be a net savings in GHG emissions of approximately 2.8 MMTCO_{2e}. It is unclear how much longer the New York vehicle rebate program will run, but if it covered the entire 1 million cars and those cars had a useful life ten years, then New York would spend \$2 billion to avoid 28 MMTCO_{2e}, or approximately \$71/Ton of CO_{2e}, approximately 40% above the social cost of carbon currently being employed in analysis of energy projects in New York.” (Getting Greener, 2019, 47)
- “Vehicles have long lifetimes: A typical car, SUV, or motorcycle may be operated for one or two decades; a medium/heavy truck or airplane for two or three decades; a rail locomotive or freight ship for three or four decades. Therefore, decarbonizing the transportation sector by 2050 requires phasing out sales of new, petroleum-burning vehicles almost immediately. (If a ban on new fossil fuel vehicle sales only comes into force in 2050, many polluting vehicles will still be on the roads in that year.)... Seven countries have announced bans on new fossil fuel vehicles that take effect in 2030 or earlier, and a further five countries have announced bans that come into effect by 2050 (or in the case of China, no date has yet been set).” (US Net Zero Emissions by 2050, 2019)
- “There is a more compelling economic case for electrification of the commercial vehicle sector because an argument can be made for less expensive Total Cost of Ownership (TCO) in certain defined-duty circumstances for electric versus internal combustion (ICE) or diesel engine-propelled vehicles.¹⁰ TCO takes the full range of costs over a vehicle’s entire expected life, from upfront costs through and including operations and maintenance costs (O&M), as well as lifetime fuel costs. While upfront costs are currently much higher for electric vehicles compared to diesel vehicles, this differential can be made up through demonstrably lower O&M costs (electric vehicles have far fewer moving parts and suffer significantly less wear and tear) and advantageous fuel costs (kilowatt-hours converted to an mpg (miles per gallon)-equivalent number) in certain duty cycles and geographies.” (Gurman, 2019, 228)

- “Large and sudden increases to pollution fees could hurt those with an older, inefficient vehicle and limited means to purchase a new, cleaner EV. Revenue from these fees could fund improved transit service and infrastructure, construction of charging infrastructure in disadvantaged communities, construction of affordable housing in walkable and transit-oriented locations, or subsidized electric car-sharing access to supplement transit for low-income households.” (Transforming Transportation, 2019, 16)

Other Resources

[NYSERDA Report on state of EV fleets](#)

Autonomous Vehicles

LPDD Recommendations

- *“State governments should proactively address safety standards, regulations, and liability regimes for autonomous vehicles.”*
- *“State governments should develop protocols, regulations, and incentives for autonomous vehicles to maximize GHG reduction, including the use of such vehicles in combination with trip-sharing, car-sharing, public transit, bicycling, and walking and the use of ZEVs.”*

Relevant LPDD Database Pathways

- Developing Automated Vehicle Regulations: <https://lpdd.org/pathway/developing-automated-vehicle-regulations>

Other Recommendations

- “Encourage fleet ownership of autonomous vehicles.” “Policies to discourage individual ownership and encourage fleet ownership include requiring a special license to own a driverless vehicle (similar to current commercial vehicle licensing requirements),²³ allowing only fleet operators to own and operate driverless cars, imposing high registration fees for personally owned driverless vehicles, providing lane and priority access for fleet-owned vehicles, and establishing rigorous maintenance standards that are prohibitively costly for individuals.” (Greenwald, 2019, 449)
- “Incentivizing socially optimal travel decisions. For example, an MBUF (RPA, 2017) could track each registered vehicle’s VMT to calculate an appropriate tax, based on time of day, level of congestion, vehicle occupancy (including penalties for empty miles), and geographic location. The MBUF could account for environmental impacts of different vehicle types. A locality wide transportation account could serve as payment for an individual’s rail, ataxi, and personal vehicle taxes.” (Greenwald, 2019, 449)
- “Subsidizing AVs for micro-transit service for special use (e.g., paratransit²⁴ or late-night service), could be more efficient than current options.” (Greenwald, 2019, 450)
- “Promoting AV use for first/last mile and to link to transit hubs and airports could increase overall transportation efficiency. Coordinating services and transfers between AVs and conventional transit could extend each transit stop’s accessibility, greatly

increasing potential transit ridership. Transit agencies could partner with TNCs to provide alternatives to unproductive routes or provide service across greater time spans or geographic areas (RPA, 2017). This could help attract new riders and increase public transit's utility in lower-density areas." (Greenwald, 2019, 450)

- "Priority (e.g., parking privileges, designated lanes, zones, or curbside pickup and drop-off points) could be given to higher-occupancy public and private vehicles while restricting the number of single occupancy vehicles allowed to enter a central business district." (Greenwald, 2019, 449)

Discussion and Analysis:

- "AVs' climate implications depend on personal mobility norms and vehicle standards. The interaction of AVs with the current norm of individual vehicle ownership could dramatically increase VMT. The interaction of AVs with mobility as a service could dramatically decrease them. Since emissions are equal to (a) emissions per-vehicle-mile, multiplied by (b) VMT, this section explores each of these dimensions. (a) Per-vehicle-mile emissions Individually owned driverless vehicles would likely have the same per-vehicle-mile emissions as individually owned conventional vehicles. Per-vehicle-mile GHG emissions are primarily a function of vehicle fuel efficiency (governed by vehicle fuel economy and GHG standards), and the type of fuel used. Electric vehicles (EVs) have no tailpipe emissions, but can cause emissions at the powerplants that generate the electricity they use. EVs' lifecycle GHG emissions depend on how the electricity is generated.¹² With the current U.S. electric generation mix, and under current vehicle fuel economy and GHG standards, EVs have lower average lifecycle GHG emissions than conventional internal combustion engine vehicles (ICEs), with substantial state-by-state variation" (Greenwald, 2019, 447)
- "Driverless cars could dramatically increase VMT because many people can't drive but could be driven,¹⁸ and many drivers would prefer to be driven and would be driven more than they would drive. Importantly, person-miles traveled (PMT) is a better metric of mobility than VMT, and ridesharing can increase PMT while decreasing VMT. Whether driverless cars increase or decrease VMT depends on (1) the extent of ridesharing, and (2) the extent to which driverless cars outcompete vs. complement other transportation modes." (Greenwald, 2019, 447)
- "Some driverless cars could outcompete what is now called public transit, potentially reducing its viability and increasing VMT. The rapid increase in TNC ridership in NYC in 2015 and 2016 coincided with a decline in bus and metro travel (Fulton et al., 2017). Also in NYC, half of survey respondents reported using TNCs to replace transit trips (NYCDOT, 2017). TNC users surveyed in major metropolitan areas said 39% of their trips replace driving, 15% public transportation, and 23% biking or walking; 22% would not have made the trip (Clewlow and Mishra, 2017). 94.5% of passengers surveyed in the Denver area said that they were using a TNC for their entire trip; 5.5% were connecting with another transportation mode (Henao and Marshall, 2018). Municipalities might choose to own, operate or contract for their own AV fleets (RPA, 2017) to help meet transportation needs, particularly if private TNCs substantially reduce mass transit ridership. "Last-mile" trips in AVs could increase public transit use for longer trips. One survey concluded that in major U.S. cities, TNC users reduce their bus use by 6% and

light rail by 3%, but increase their commuter rail use by 3% (Bliss, 2017). AVs could also complement or substitute for regional air service. Regional airports could become hubs for rideshared aTaxis, which could be more energy efficient than regional air service. The quality of mass transit will determine whether driverless cars are a competitor or a complement. Washington DC’s metro system lost ridership to TNCs because of the system’s performance crisis due to chronic underinvestment in rail and subway car infrastructure. TNCs could outcompete conventional transit, or motivate transit to improve its own performance.” (Greenwald, 2019, 448)

- “Research based on network analysis of vehicle trip data across the United States (Magill, 2018a, 2018b) indicates substantial opportunities for ridesharing, with an approximately 30% reduction in VMT, emissions and costs. Somewhat surprisingly, substantial potential exists not only in urban but also in rural areas, where a large fraction of trips go to the same small number of destinations.” (Greenwald, 2019, 448)
- “Vehicle automation could dramatically increase or dramatically decrease U.S. car and light truck fuel use: ranging by 2050 from a 60% decrease to a tripling. The key factors dominating the lower bound scenario are fuel efficiency improvements (from vehicle and powertrain downsizing under fleet ownership matching vehicles to the number of passengers and smoother driving) and only modest induced VMT changes. The key factors dominating the upper bound scenario are large VMT increases induced by easier travel, empty VMT and faster travel. However, empty VMT is much less likely under a fleet model.” (Greenwald, 2019, 448)
- “The California Public Utilities Commission recently approved a pilot program for AV passenger service (CPUC, 2018), but unfortunately is not permitting ridesharing. The sooner we get ridesharing experience, the sooner we can learn how to encourage it” (Greenwald, 2019, 450)
- “Tightening vehicle GHG standards is one critical option that builds on past success to limit emission increases from driverless cars. The other option – a shift from individual car ownership to driverless mobility services with ridesharing – is a major paradigm shift. We need to pursue both options - tighter GHG standards and mobility as a service with ridesharing – to ensure that transportation emissions decrease. In the best case, vehicle automation could increase mobility, improve safety, lower cost, lower stress, improve utilization of public infrastructure, reduce traffic congestion, and make fleet management companies rich, while lowering emissions and reducing energy use. In the worst case, it could make things significantly worse on all these fronts. Policy makers can influence the trajectory of this revolutionary technology to the benefit of all.” (Greenwald, 2019, 450)

Related Topics in this Document: Carpooling, Public Transit
[California Pilot AV Program](#)

Fuel Economy and Maintenance for Gasoline and Diesel Vehicles

New York Actions

- “Joined California’s adoption of stricter vehicle emissions standards.” (LPDD)

- “Emissions inspections of most light-duty vehicles (passenger cars, vans, pick-up trucks) are required statewide through NYVIP (leaves DEC website). NYVIP is a statewide program that was initially phased into the Upstate I/M area during 2004 and later expanded into NYMA in 2005. NYVIP features on-board diagnostic (OBD II) inspections. OBD II is a computer system designed by vehicle manufacturers to monitor the operation of the vehicle's power train and associated emissions control systems. Most light-duty non-diesel vehicles (passenger cars, and most SUVs, vans, and light-duty pick-up trucks) beginning with the 1996 model year are equipped with standardized OBD II computer systems. Diesel vehicles beginning with the 1997 model year are also equipped with standardized OBD II computer systems. If the OBD II system detects a problem that could result in excessive emissions, the malfunction indicator light ("MIL" or "Check Engine light") located on the dashboard will illuminate to inform the driver of a detected fault code. The NYVIP OBD II inspection pass/fail criteria are based on proper MIL function and on electronic data collected from the vehicle's on-board computer. Certain medallion taxi cabs and for-hire vehicles are subject to the New York City Taxi and Limousine Commission I/M requirements. Taxicabs in the remainder of NYS are inspected through the NYVIP program.” (Motor Vehicle Inspection and Maintenance (I/M) Programs, 1997)

Relevant LPDD Pathways

- Light Duty Vehicle Emissions Standards: <https://lpdd.org/pathway/light-duty-vehicle-emissions-standards/>

Other Recommendations

- “Advocate for stricter emissions standards at the federal level and challenge the Trump admissions attempts to prohibit stricter emissions standards from being adopted in California.” (U.S. Net Zero Emissions By 2050: Decarbonizing Transportation, 2019)

Discussion and Analysis

- “Standards only contribute a small share of emissions abatement in the net zero pathway because many of the vehicles covered by standards (on-road vehicles and rail) transition to 100% clean energy by 2050 due to the EV and hydrogen vehicle sales mandates. Standards will drive more emissions reductions if these vehicles are not using 100% clean energy by 2050, and even if the target is achieved, standards lower overall costs by reducing the amount of clean electricity generation capacity that must be built by 2050.” (U.S. Net Zero Emissions By 2050: Decarbonizing Transportation, 2019)
- “Under current federal law (the Clean Air Act), New York State cannot adopt its own CO₂ emission standards for LDVs independently. If stricter standards are adopted in California, New York has the option of adopting California’s program through a rulemaking process.” (CAC Report 2010, Chapter 7, 8)

Other Resources

See to: [California Emissions Standards Legal Challenges](#)

Bicycles and Walking

New York Actions

- “This plan represents a commitment to a dramatic increase in the cycling infrastructure DOT will be implementing citywide. And that commitment is being supported by a real increase in resources. This includes the hiring of 80 new employees, representing a nearly 75% increase in DOT staff who support bike lane infrastructure, as part of a commitment of \$58.4 million over the next five years, along with additional equipment and other resources. Implementing this plan will involve growing many parts of DOT.” (Green Wave, 2019, 7)
- “DOT illustrated a citywide vision for a fully connected Protected Bicycle Lanes (PBL) network, complemented by neighborhood routes consisting of conventional and protected infrastructure. This comprehensive plan, which represents years of work by DOT, is based on ridership trends, safety needs, stakeholder outreach, mobility and cycling studies, as well as Citi Bike and land use data. The plan seeks to cover the City with safe and comfortable bicycle infrastructure by 2030, transforming the cycling landscape to grow ridership and further advance Vision Zero. The neighborhood connections address the existing need for dedicated cycling space by primarily providing conventional bike lanes, which can be more rapidly installed in areas with limited public and political support. Special attention will be paid to Bicycle Priority Districts, 10 neighborhoods designated as such by DOT in 2017 with only 14% of bicycle lane network but 23% of fatalities / serious injuries. These local lanes will lay the foundation for future bike lane enhancements as they build support through proven demand. Comprehensive Plan Highlights • Install over 80 miles of protected bike lanes by the end of 2021 • Continue to build neighborhood networks by installing 75 miles of both conventional and protected infrastructure in Bicycle Priority Districts • Fully realized network by 2030.” (Green Wave, 2019, 8)
- “Bridges – DOT will create and improve on-street connections to/from existing bridge paths and upgrade existing infrastructure on bridges where feasible, including potentially on the Brooklyn, Queensboro, Goethals, and Harlem River Bridges.” (Green Wave, 2019, 13)
- “Bike Share Expansion – DOT will focus on areas with expected ridership growth including in the Citi Bike expansion areas and dockless project areas, encouraging mode shift and providing safety in numbers.” (Green Wave, 2019, 13)
- “Capital Projects/Greenways – DOT will work closely with the Department of Design and Construction (DDC), the Department of Parks and Recreation, and the NYC Economic Development Corporation (EDC) to build out greenway connections using capital funds, and begin a planning process to further develop the Queens Central Greenway network.” (Green Wave, 2019, 13)
- “Bike Priority Districts/Neighborhood Planning – DOT will install over 20 miles of bike lanes in Bicycle Priority Districts and other neighborhoods where infrastructure is lacking.” (Green Wave, 2019, 13)
- DOT will continue to fund and expand a companion education portion to the defensive driving and training programs at local driving schools to raise awareness about driving in

bicycle rich areas. Train the trainer programs will be offered and driving instructors will be helped to include this important awareness. DOT will also expand the citywide 7th Grade Bike Safety Program in collaboration with DOE and Bike New York going to 25 schools in the 19-20 academic year” (Green Wave, 2019, 23)

- “Improving cycling in NYC is not only about providing infrastructure to get where you want to go, but about ensuring you have a place to park when you get there. To date, DOT has installed close to 30,000 bike racks, and plans to install 1,500 racks annually. DOT is revamping the bike parking program to be community-based, featuring an interactive bike parking suggestion portal and updated maps of existing bike parking. DOT will plan for future bicycle parking through comprehensive neighborhood or corridor lens, in conjunction with the planning and installation of other street furniture such as CityBenches, StreetSeats and LeaningBars. The program will have a goal of reaching 25 neighborhoods and installing 2,000 bike parking spaces, including bike corrals, annually.” (Green Wave, 2019, 21)
- “DOT currently operates a Council-funded helmet fitting and giveaway program as well as providing helmets for students and youth. Since the launch of the program, DOT has given away over 225,000 helmets to New Yorkers, averaging 25,000 annually. DOT will continue and expand this free helmet program with 10 or more large events a year giving away at least 1,000 helmets per event with an emphasis on fitting children and youth.” (Green Wave, 2019, 23)
- “Mayor’s Office of Labor Relations is enhancing the health and wellbeing of NYC employees through its WorkWell NYC pilot program, with initiatives that often provide sustainability benefits by improving indoor space quality and encouraging walking or biking instead of taking fossil fuel-based transportation. OLR has hosted its first “Bike to Work” day to encourage staff to bike.” (NYC 1.5 2017, 35)

LPDD Recommendations

- *"State governments should modify street design standards and practices to promote non-motorized transportation, including adopting 'complete streets' laws and policies. New York's existing Clean Streets Act (2011), requiring consideration of clean streets design principles, could become the basis for a binding standard."*
- *"States should provide localities funds for technical assistance and project construction for 'complete streets,' including retrofitting existing streets to make them more inviting to cyclists and pedestrians."*

Related LPDD Database Pathways

- Walkable Development: <https://lpdd.org/pathway/walkable-development/>
- Promoting Alternatives to Car Transport: <https://lpdd.org/pathway/promoting-alternatives-to-car-transport/>
- Using Land Use Policy to Diminish Vehicle Miles Traveled: <https://lpdd.org/pathway/using-land-use-policy-to-diminish-vehicle-miles-traveled/>

Other Recommendations

- “OneNYC 2050 promises to expand the private Citi Bike network, and we recommend that it prioritize adding this service in communities of color that have been neglected,

and facilitate wider use of the Citi Bike reduced fares program for NYCHA residents and SNAP recipients.” (NYC EJA, 2020, 35)

- “Other recommendations include catching up to other large cities like Los Angeles by installing bike racks on City buses, and installing more bike racks and pumps around the City.” (NYC EJA, 2020, 35)
- “However we appreciate OneNYC 2050’s stated commitment to building more bike lanes with DOT, and recommend that more of these lanes include semi-permeable barriers, paired with other rigorous street design for cyclists and pedestrians. Furthermore, we urge the DOT to make holistic plans in consultation with residents in order to mitigate against the possibility of cycling infrastructure fueling gentrification.” (NYC EJA, 2020, 35)
- “Expand the use of green paint where bike lanes need to be reinforced, including: green skip bars across key intersections, green backed arrows at conflict points, and green bike boxes where cyclists have a safe place to wait. Integrate and install new street design treatments into our projects, including: Bike boulevards to prioritize cyclists and limit vehicles on appropriate streets, shared streets that incorporate bike safety best practices, raised crossings where cars are slowed at protected bike lanes. Increase protection and fortify lanes, including: more safety bollards at key places along protected lanes, physical protection at new places, and projects that use new barrier types.” (Green Wave, 2019, 16)
- “Implement traffic calming treatments at 50 intersections with a high number of bike injuries in 2019. Regularly install protected intersection designs in new projects and after resurfacing, where appropriate and resources allow. Implement and review “Bicycle Progression” at one location in 2019 and identify other corridors for implementation in 2020. This signal timing strategy, often referred to a “bicycle green wave,” turns traffic signals along a street to green at cyclists speeds to discourage vehicular speeding, reduce cyclist travel time and stopping, and encourage steady bicycle speeds.” (Green Wave, 2019, 16)
- “Pedestrianization’ schemes—in pedestrian-dense locations such as Lower Manhattan or downtown Flushing, for example—could be undertaken not simply to improve safety but also to encourage additional pedestrian and transit trips...Similarly, tweaks to the Zoning Resolution to create a more pleasing streetscape—such as those in the Zoning for Quality and Affordability amendments approved in 2016, which included changes intended to provide visual variety and encourage development of better retail spaces at the ground level—should be understood not just as urban design niceties but also as changes that encourage people to walk.” (S. Miller, 2018, 106)

Discussion and Analysis

- “Cyclists have been killed in accidents with vehicles at alarming rates in NYC, yet the City has not taken a proportionate response in safeguarding their lives, at times taking stances that dissuade cyclists and would-be cyclists from using this mode of transit.⁵³ In addition to traffic accidents due to unsafe driving and poor road conditions, other hazards include poor examples set by law enforcement parking in bike lanes; danger on thoroughfares such as the Brooklyn Bridge bike path due to lack of separation of

pedestrian and cyclists paths; lack of accountability for a dangerous commercial waste industry killing cyclists; and a general unsupportive ethos for cycling among many New Yorkers.” (NYC EJA, 2020, 35)

- “OneNYC 2050 also promises to improve fairness in policing practices – practices that disproportionately target low-income people of color. The City has earned revenue by ticketing cyclists for minor infractions that do not risk harm to others, and in the last year, the NYPD has issued violations to cyclists at higher rates than motorists, along with fines of similar value to motorists. The existing enforcement practices do not consider the moment-to-moment decisions cyclists must make to protect themselves, especially on roads without demarcated bike paths, while navigating regressive targeting practices of the City, and an unsupportive ethos around cycling.” (NYC EJA, 2020, 35)
- “Roger Geller for the City of Portland, Oregon, classifies people into four categories when it comes to their inclination to bicycle: Fearless, Enthused and Confident, Interested but Concerned, and No Way No How. Most policy development has focused on developing the conditions that coax people who are “interested but concerned” into bicycling by addressing their concerns with solutions—often around traffic safety, bicycle maintenance, storage, and theft. In New York, these solutions frequently take the form of protected bike lanes, traffic calming, and bike-share. There are also a range of policy changes, including bike rack installation, traffic enforcement against dangerous behavior by drivers, and bikes in buildings laws, which allow people to bring bicycles into their office and apartment buildings.” (S. Miller, 2018, 104)

Other Resources

Related Topics in this Document: Bikeways, Zoning for High Density & Mixed Use Development, Transit Oriented Development, Public Transit

Heavy Duty Vehicles

(Including Construction and Off-Road Vehicles)

New York Actions:

- “On June 3, 2020, the NYC Department of Transportation launched its Clean Trucks Program using \$9.8 million in Volkswagen Settlement funds allocated by DEC for the project. The Clean Trucks Program uses incentives to replace older, higher polluting diesel trucks with battery-electric, compressed natural gas, diesel-electric hybrid, plug-in hybrid-electric, and new diesel trucks with much lower emissions. The Clean Trucks Program will provide funding ranging from \$12,000 to \$185,000 per truck replacement depending on the fuel type. The old diesel vehicles must be scrapped to receive the incentive.” (NYSDEC, 2020)
- “15 states and the District of Columbia announced a joint memorandum of understanding (MOU), committing to work collaboratively to advance and accelerate the market for electric medium- and heavy-duty vehicles, including large pickup trucks and vans, delivery trucks, box trucks, school and transit buses, and long-haul delivery trucks (big-rigs). The goal is to ensure that 100 percent of all new medium- and heavy-duty

vehicle sales be zero emission vehicles by 2050 with an interim target of 30 percent zero-emission vehicle sales by 2030.” (NESCAUM, 2020, 1)

- “America’s largest transit bus fleet — NYC Transit — has committed to electrifying its entire fleet of more than 5,700 buses by 2040” (EDF, 2020)
- “DOT will deploy a targeted truck program to address the 30% of bike fatalities that involve trucks. To do this, DOT will work closely with partners in the trucking industry to reduce the number of conflicts between bicyclists and trucks... DOT will develop an instructional video and materials for City large fleet, private sanitation, and freight industry partners, convene a Vision Zero Truck Safety Task Force which will have improved cycling safety as a goal, and expand the “Trucks Eye View” educational program on corridors with heavy truck travel.” (Green Wave, 2019, 17)

Heavy Duty Vehicles -- Supporting Purchase of Low Emission HDVs

LPDD Recommendations

- *“State governments responsible for purchasing and maintaining fleets of vehicles, such as trash and recycling trucks, should continue to invest in the deployment of advanced technology, lower GHG-emitting vehicles.”*
- *“States could implement programs that encourage or require diesel vehicle retrofit projects to achieve a level of emissions reduction beyond that currently required by EPA.”*
- *“States in partnership with EPA and other state agencies or municipalities as well as the private sector, could partially or fully fund the cost of replacing older HDVs with newer vehicles that are more fuel-efficient and aerodynamic.”*
- *“States should consider providing economic incentives to freight carriers to encourage investment in next-generation HDVs and necessary infrastructure to reduce fleet GHG emissions.”*
- *“States should focus state HDV grant programs on funding on development, production, and deployment of advanced engine technologies and the necessary fueling infrastructure to rapidly expand access to zero- and near-zero emission technologies.”*
- *“States should further incentivize the purchase of more fuel-efficient and advanced technology HDVs through tax credits and rebate programs, similar to the NY Truck Voucher Incentive Program.”*

Relevant LPDD Pathways

- Supporting Electric HDVs through Grants, Taxes, and Rebates:
<https://lpdd.org/pathway/supporting-electric-hdvs-through-grants-taxes-and-rebates/>

Heavy-Duty Vehicles -- Mandating Use of Low-Emissions HDVs

LPDD Recommendations

- *“State governments could require local truck fleets delivering freight within the state to increase the use of lower emitting vehicles.”*

Related LPDD Pathways

- Advancing Fuel Economy Regulatory Programs: <https://lpdd.org/pathway/advancing-fuel-economy-regulatory-programs/>

Heavy Duty Vehicles -- Inspection and Maintenance Requirements

LPDD Recommendations

- “To the extent not already implemented, states with areas in nonattainment of one or more NAAQS should impose HDV inspection and maintenance programs to ensure that in-use HDV emissions do not exceed the level to which the vehicles were certified.”
- “States can voluntarily implement inspection and maintenance programs for HDVs.”

Related LPDD Database Pathways

- Inspection and Maintenance Requirements for HDVs: <https://lpdd.org/pathway/inspection-and-maintenance-requirements-for-hdvs/>

Other Recommendations

- “California Law example: requires more than half of trucks sold by 2035 to be zero-emissions and all of them by 2045.” (CA Clean Trucks, 2020)
- “In addition, in the Commercial Waste Zones Law passed in 2019, the City recommended that carting companies award bidders who display a commitment to transition to “clean” waste trucks over time. We recommend that the City specifically favor electric vehicles as opposed to false renewable energy solutions, to reduce tailpipe emissions from trucks in environmental justice communities.” (NYC EJA, 2020, 30)
- “Expansion of the Hunts Point Clean Trucks Program (expanded to NYC-wide funding in 2020) to the whole state to transition trucks from diesel fuel:
 - Offers rebate incentive funding to reduce diesel exhaust emissions by replacing older, heavy polluting diesel trucks with new battery electric, or EPA emission compliant alternative fuel (compressed natural gas, diesel electric hybrid and plug in hybrid) and diesel trucks
 - Now expanded to program-approved NYC IBZs (Industrial Business Zones)
 - Replacement trucks must be brand new, perform same function as old truck, same weight class, and located in or providing service within .5 miles of the IBZs twice per week
 - Zero Now Program - offers up to \$40,000 to transition, 5 year engine warranty, meets 2023 CARB Certifications” (Advancing Clean Air & Climate Goals With Clean Fuel Trucks Webinar, 2020)
- “In the net zero pathway, this policy specifies 50% of newly-sold, medium- and heavy-duty trucks must use hydrogen fuel cells by 2040. (This complements the 50% EV mandate requirement, fully decarbonizing medium and heavy duty new truck sales by 2040, since the net zero policy package also shifts all hydrogen production to electrolysis.) This is more aggressive than existing projections, although some groups, such as the California Air Resources Board, project a significant role for hydrogen fuel cell vehicles by 2050 in California, and most of these are likely to be medium- or heavy-duty vehicles.” (U.S. Net Zero Emissions By 2050: Decarbonizing Transportation, 2019)

- “A low-interest revolving loan program could be used to provide the necessary incentive to achieve fleet turnover in the required timeframe. New York State could offer below market interest rates and extended loan terms based on the useful life of the vehicle, reducing annual loan or lease payments. The state could also enhance the financing incentive by offering lower interest rates to incentivize fleets to purchase alternative vehicles; i.e. hydrogen fuel-cell or electric.” (CAC Report, 2010, 12)

Discussion and Analysis:

- “Non-road transportation, although difficult to quantify, represents a significant opportunity in industries in which material handling plays an important role. This technology segment is undergoing rapid development with new electric options becoming available. Some well-established examples include electric forklifts, terminal trucks, and airport ground support equipment (eGSE).” (Electrification Scenarios, 2020, 55)
- “In New York City, trucks alone account for 10% of citywide transportation greenhouse gas emissions. Most concerning, these impacts could increase as freight volumes grow nearly 70% by 2045. But climate pollution is not the only concern. Diesel-fueled trucks and buses are a significant and dangerous source of particulate matter and nitrogen oxide pollution, which cause asthma, cancer and respiratory issues. This pollution has significant impact on the health and well-being of New Yorkers, especially in low-income neighborhoods and communities of color, which have been disproportionately burdened by diesel-fueled pollution for far too long.” (EDF, 2020)
- “Because some medium- and heavy-duty vehicles will be more difficult to electrify, we assume drop-in renewable fuels (such as bioenergy or synthesized fuels) can be used to reduce emissions. For example, advanced renewable diesel plays a key role in decarbonizing freight transportation emissions. Non-road transportation, such as marine and aviation, are decarbonized through a combination of renewable fuels and efficiency.” (NY Pathways, 2020, 22)
- “The electrification of medium-duty and heavy-duty vehicles could increase rapidly as electrification costs decrease. Although these vehicles have lower operating costs (for example, fuel and maintenance), the upfront costs for these larger vehicles are likely to be significantly higher in the near term, so adoption may be limited unless the long-term advantages and nonmarket benefits such as reduced local air emissions are targeted through policies or mandates. Although rail service is already heavily electrified in NYS, this modeling shows the potential for electrification of the rest of the MD/HDV sector, which includes bus, light commercial truck, and freight trucks.” (Electrification Scenarios, 2020, 27)
- “Clean transportation policies must be equitable. This includes distribution of both benefits (e.g., air quality and mobility) and costs. For example, policymakers can prioritize the electrification of vehicles that produce the most health-damaging emissions, especially since these vehicle types (such as buses and short-haul trucks) disproportionately emit these pollutants in neighborhoods that are largely composed of low income residents and in communities of color. Policymakers can also ensure that funds raised from pollution fees are recirculated to low income communities and communities of color in the forms of improved public transportation, EV car-sharing,

and active transportation infrastructure, for example.” (Transforming Transportation, 2019, 3)

- “Electrifying trucks and buses is an entirely different task and likely will require significantly more public funding and incentive programs than are currently available through New York State, including funds available from the Volkswagen settlement program. However, there is a more compelling economic case for electrification of the commercial vehicle sector because an argument can be made for less expensive Total Cost of Ownership (TCO) in certain defined-duty circumstances for electric versus internal combustion (ICE) or diesel engine-propelled vehicles.” (Gurman, 2019, 227)
- “Why Commercial Fleets Should Move to Electric: the duty cycle of these trucks is reliable and predictable; range is generally well within the capabilities of a battery pack’s daily charge capacity; As a result, the charging times and patterns are predictable as well, and so charging can be managed most cost-effectively, and charging infrastructure can be engineered for the specific fleet and depot location; Solar plus storage is an added feature that, while increasing capital cost, can lead to efficiencies in charging and load management that can be cost-effective; Capital and operational budgeting can be undertaken with a high degree of confidence, built around the known charging infrastructure costs and predictable electricity (charging) costs; under most circumstances, charging times can be optimized around off-peak hours; Utilization of a CaaS contract is a similar approach as using a PPA (power purchase agreement), which then lends itself to NY Green Bank’s fundamental transaction approach of project or structured finance.” (Gurman, 2019, 227)
- “Another important co-benefit is the provision of access to credit for small and large businesses, non-profit organizations (e.g., paratransit agencies), and local governments that could use this loan fund to replace and upgrade their fleet vehicles... By incorporating an explicit focus on overburdened communities and encouraging a shift to newer vehicles with lower emissions, this policy could provide significant EJ benefits, while helping to meet New York State's GHG reduction goals.” (CAC Report 2010, Chapter 7, 13)

Other Resources

Related Topics in this Document: Freight Management, Fuel Economy and Maintenance for Gasoline and Diesel Vehicle, Solid Waste Management, Green Bank

Freight Management

New York Actions

- “No matter the rail and water innovations, the vast majority of freight and delivery in New York City will continue to travel its “last mile” on city streets. The City initiated an off-hours delivery program in Manhattan, which has had some success in reducing associated congestion. Lessons learned from the Manhattan deployment could be applied citywide. Additionally, shifting many of these trips to lower-impact modes, particularly in the densest parts of the city, could be worth additional attention. UPS, for example, has piloted package delivery by cargo e-bike in Portland, Oregon. This model

could be particularly useful in New York City as well, but as discussed earlier, e-bikes are currently illegal in New York State and New York City and so their use as on-road freight delivery vehicles is prohibited.” (S. Miller, 2018)

LPDD Recommendations

- “Individual states or coalitions of states should adopt fuel-efficiency/GHG emission requirements for in-use loco-motives operating within state borders.”
- “State governments should remove infrastructure barriers that prevent double-stacking of rail containers.”

Related LPDD Database Pathways:

- Investing in Rail Efficiency: <https://lpdd.org/pathway/investing-in-rail-efficiency/>
- Investing in Freight Transportation Infrastructure: <https://lpdd.org/pathway/investing-in-freight-transportation-infrastructure/>
- Reducing Emissions at Ports and Freight Terminals: <https://lpdd.org/pathway/reducing-emissions-at-ports-and-freight-terminals/>

Recommendations

- “NYNJR should also switch to all-electric locomotives. The distance to the New York & Atlantic (NYA) Fresh Pond Rail Yard from the 65th Street Rail yard is only 11 miles. NYA is a short line railroad that provides freight service to Long Island customers over the tracks of the LIRR and operates mostly at night.” (Arden et al 2020, Port Authority's New York New Jersey Rail, LLC, 6)
- “Several countries and the state of Illinois have implemented VMT fees for trucks... such a fee should vary with weight and other attributes.” (Halfway There, 2019, 22)
- “While the Cross-Harbor Freight Tunnel is a large-scale solution to a regional problem, the City could activate its waterfronts for small-scale shipping and distribution. The City is investing in marine terminals in Brooklyn and Staten Island, but these facilities could be complemented by smaller-scale distribution ports that can take cargo from, for example, Port Elizabeth and bring it to the South Bronx or Brooklyn waterfronts, eliminating truck trips on the Cross Bronx and Staten Island expressways. In Paris, the Franprix supermarket chain, with 80 locations in the city, has begun moving goods by barge on the Seine. The barge service allows the company to avoid congestion in the city while using up to three times less energy than a truck over a comparable distance and emitting two to four times less carbon dioxide. Its drivers are now able to make more rounds, instead of driving to and from distribution centers outside the city.” (S. Miller, 2018)
- “New York State, in conjunction with a broad-based stakeholder group including State agencies and municipalities, adjoining states, the goods movement industry, and local community groups, could establish a comprehensive Goods Movement GHG Policy, with the dual goals of increasing freight efficiency while reducing GHG emissions. The comprehensive policy should identify and prioritize key freight projects such as consolidation and distribution centers (including important highway and non-highway modal connections), new intermodal yards, rail system improvements, the development and expansion of non-highway system capacity, and the operational enhancement of

existing highway systems to support local, regional, and transcontinental freight service into and out of New York State. Such projects would provide alternative off-road clean transport systems to improve goods movement, reduce congestion, and reduce emissions.” (CAC Report 2010, Chapter 7, 22)

- “Once identified, key freight projects could also be subject to an efficient permit process that considers the needs of the local community. The policy could establish state requirements for system-wide GHG analyses and green technology advancement through the State Environmental Quality Review (SEQR) and other permitting requirements; set specific performance standards to incentivize low to zero emissions truck, rail, ship, and support equipment technology; and establish freight fees dedicated to transportation system and infrastructure upgrades. Further, the plan should identify key freight corridors and connectors and establish land-use guidelines for local and regional municipalities in those corridors that are specific to freight. It should also consider rail clearance and track improvements to allow heavier loads, thereby supporting a more viable rail system and should look for other investments and incentives to support low GHG options.” (CAC Report, 2010, 22)

Discussion and Analysis

- “Applying EV requirements to non-road vehicles is more difficult. Rail can be electrified with overhead catenary wires or a third rail, obviating the need for locomotives to carry batteries. Electrified rail networks carry passengers throughout Europe, China, and Japan, and electric freight locomotives operate in Europe, Russia, and China. Electricity may not be viable for aviation or long-haul freight shipping, due to difficulties storing and carrying sufficient energy in batteries, so the EV sales mandate is not applied to these vehicles.” (U.S. Net Zero Emissions By 2050: Decarbonizing Transportation, 2019)
- “Before inbound freight gets to the last mile and after outbound freight (primarily waste products) gets past the first mile, much of it will be on rail. In some cases, where conditions for pneumatic-tube transport are favorable, even the first and last blocks will be handled by tubes, with pneumatic tubes for outbound waste fractions (as in the case of Roosevelt Island and hundreds of municipal installations in Europe and Asia) and with pneumatic/electromagnetic tubes for inbound goods. These developments also will contribute to GHG reductions from waste handling.” (B. Miller, 2019, 22)
- “For example, seamless transitions among highway, rail, water, and air modes will increasingly allow a dynamic, multimodal assignment of goods to the network; this can improve efficiency in multiple ways, including moving loads via the least energy-intensive mode that meets each load’s needs. Improved management of supply chains also can reduce and shorten freight shipments. In addition, freight energy use can be reduced by avoiding empty backhauls and increasing the truck load factor, such as through collaborative shipping arrangements. Collaborative shipping could also help increase use of rail, allowing multiple shippers to share a railcar, replacing some use of trucks. Such strategies can draw on growing applications of ICT to mobility. Another strategy is platooning with vehicle-to-vehicle communications. Two-truck platoons with a separation distance of 40–50 feet have been estimated to reduce the trucks’ average fuel consumption by 7%.” (Halfway There, 2019, 21)

- “A multi-regional approach to freight transportation creates the potential for far greater GHG emission reductions than a New York-only approach. Regional cooperation could include incentives to municipalities that commit to freight planning actions (e.g., intermodal rail yards, distribution centers, freight villages, and consolidation centers). A price for freight carbon emissions could also be established via credit auctions. Shippers, freight forwarders, and retailers would be required to hold credits to cover shipping, based on total freight VMT. Auction revenues would be reinvested in low-carbon freight system infrastructure and smart growth land use actions reducing freight VMT.” (CAC Report 2010, Chapter 7, 31)

Other Resources

Related Topics in this Document: Solid Waste Management, Heavy Duty Vehicles

School Buses

New York Actions

- “ConEdison: ConEd’s SmartCharge NY program is piloting V2G (vehicle-to-grid) capability through a five-vehicle electric school bus program in White Plains; and supporting the Metropolitan Transportation Authority’s electric transit bus pilot program.” (Gurman, 2019, 229)
- “On September 5, 2018, NYS DEC released its mitigation plan for the VW settlement. Investments in clean transportation and the electrification of vehicles has been allotted a significant portion of the funding. The DEC estimates that the projects will reduce lifetime NOx emissions by at least 4,500 tons, the equivalent of removing 65,000 automobiles off the roads per year for the next decade. Further, the replacement of buses, trucks and other equipment with electric vehicles (EVs) will reduce CO2 emissions by 130,000 tons over the lifetime of these vehicles⁹⁸. Of the 10 total eligible projects under the VW settlement, DEC earmarked 40%—approximately \$52.4 million—the largest portion of the mitigation plan, for reducing diesel emissions from buses. These funds will be made available for projects that include eligible Class 4-8 School buses, shuttle buses and transit buses. Up to 500 vehicles are anticipated to be replaced with newer diesel engines, alternative fuel, or all-electric models. The plan estimates the implementation of 100 all-electric buses and 400 new alternative fuel, electric, or diesel powered school, transit, and/or paratransit buses. Electric school buses, in particular, will be implemented within and near environmental justice communities based both on economic feasibility and community demand.” (School Bus Electrification, 2018, 15)
- “Using V2G, the school buses will be plugged into the electricity grid during the summer months, thereby supplementing the grid during peak demand. Con Edison will then pay National Express to use the buses for storing the electricity. NYC’s Office of Pupil Transportation could pursue a pilot of this sort.” (School Bus Electrification, 2018, 16)
- “New York State Energy Research and Development Authority (NYSERDA)’s Clean Air School Bus program was one attempt by NYS to mitigate the environmental and health burdens associated with diesel school buses. The program allowed different school

districts to apply for funding for bus replacements and/or retrofitting. NYSERDA targeted its funding to ensure the greatest possible emissions reductions. However, when researchers at Cornell University examined the Clean Air School Bus program, they found it lacked equity in the distribution of resources. The study showed that there was a significant correlation between socioeconomic status of the school district and its likelihood to receive funding. The study's equity evaluation factored in racial and socioeconomic variables, such as race demographics of school enrollment, median household income, the poverty index as well as school district size and population density and the air quality attainment status at the school district level. It recommended that state programs be designed to ensure equitable and fair distribution of resources to all racial and socioeconomic group." (School Bus Electrification, 2018, 15)

- "In 2001, a National Resources Defense Council (NRDC) study, No Breathing in the Aisles, estimated that 23 to 46 of every million children may eventually develop cancer from the diesel exhaust that they inhaled while traveling on a school bus. The study also found that levels of diesel exhaust inside school buses was up to 4 times higher than those in passenger cars, and that the levels were 8 times higher than a sample of average California air. This study, along with others and various grassroots movements, led to the implementation of state level and national policies regarding diesel emissions. A notable example is the passage of Diesel Emissions Reduction Act (DERA), part of the Energy Policy Act of 2005, which appropriates funds for programs that reduce diesel emissions. These policies have made some improvement in children's health and rates of childhood asthma; however they have not eradicated the problems associated with diesel pollution." (School Bus Electrification, 2018, 11)

Heavy Duty Vehicles -- Supporting Purchase of Low Emission HDVs

LPDD Recommendations

- *"State governments responsible for purchasing and maintaining fleets of vehicles, such as trash and recycling trucks, should continue to invest in the deployment of advanced technology, lower GHG-emitting vehicles."*
- *"States could implement programs that encourage or require diesel vehicle retrofit projects to achieve a level of emissions reduction beyond that currently required by EPA."*
- *"States in partnership with EPA and other state agencies or municipalities as well as the private sector, could partially or fully fund the cost of replacing older HDVs with newer vehicles that are more fuel-efficient and aerodynamic."*
- *"States should consider providing economic incentives to freight carriers to encourage investment in next-generation HDVs and necessary infrastructure to reduce fleet GHG emissions."*
- *"States should focus state HDV grant programs on funding on development, production, and deployment of advanced engine technologies and the necessary fueling infrastructure to rapidly expand access to zero- and near-zero emission technologies."*
- *"States should further incentivize the purchase of more fuel-efficient and advanced technology HDVs through tax credits and rebate programs, similar to the NY Truck Voucher Incentive Program."*

Relevant LPDD Pathways

- Supporting Electric HDVs through Grants, Taxes, and Rebates: <https://lpdd.org/pathway/supporting-electric-hdvs-through-grants-taxes-and-rebates/>

Heavy-Duty Vehicles -- Mandating Use of Low-Emissions HDVs

LPDD Recommendations

- “State governments could require local truck fleets delivering freight within the state to increase the use of lower emitting vehicles.”

Related LPDD Pathways

- Advancing Fuel Economy Regulatory Programs: <https://lpdd.org/pathway/advancing-fuel-economy-regulatory-programs/>

Heavy-Duty Vehicles -- Inspection and Maintenance Requirements

LPDD Recommendations

- “To the extent not already implemented, states with areas in nonattainment of one or more NAAQS should impose HDV inspection and maintenance programs to ensure that in-use HDV emissions do not exceed the level to which the vehicles were certified.”
- “States can voluntarily implement inspection and maintenance programs for HDVs.”

Related LPDD Database Pathways

- Inspection and Maintenance Requirements for HDVs: <https://lpdd.org/pathway/inspection-and-maintenance-requirements-for-hdvs/>

Other Recommendations

- “A cooperatively owned and operated electric school bus company could be a solution to the current state of busing. An electric school bus only co-op would be controlled by the workers at the company, with representation on the board from the families served as well as advocates in transportation, environment and education. This would allow the workers and families to have ownership of the company, thus having a say in its operations.” (School Bus Electrification, 2018, 16)

Discussion and Analysis

- “In the U.S. roughly 95% of school buses run on diesel, which means that 95% of all school buses currently on the road contribute to diesel pollution. In fact, if we were to replace all diesel school buses with all-electric models, the U.S. would eliminate an average of 5.3 million tons of greenhouse gas emissions in a single year. Over 16 years, which is the average lifespan of a school bus, electric buses could eliminate 84.9 million short tons of GHG emissions. Reducing our GHG emissions not only improves the air quality in local communities, but it also helps NYS meet its emission goals and limits our contribution to global climate change... Electric school buses are ultimately the cleanest and safest option for communities and the environment⁷⁵. We must also transition our electric grid to greener methods of generation, including solar, wind, hydropower and others, instead of coal, which is a major GHG contributor.” (School Bus Electrification, 2018, 11)

- “Electric school buses are on the rise as improvements in technology and increased market competition offer school districts more options. The initial investment costs, which may have overwhelmed many school districts in the past, no longer pose an insurmountable barrier to using electric school buses. As technology improves and the market expands, the upfront costs of electric school buses will continue to decrease. Additionally, electric school buses offer greater long-term savings than diesel buses... replacing the 95% of diesel school buses in the U.S. with electric models could save more than \$3 billion in diesel costs for U.S. school districts. Another potential benefit—which is currently being explored in California and White Plains, New York—is the possibility of using electric buses as backup batteries for the electric grid. In theory, school districts could generate revenue from electric utility companies by offering their fleets as energy storage units.” (School Bus Electrification, 2018, 12)
- “Electric buses are increasing in popularity and accessibility. In 2017, the number of electric buses grew by 83% in the U.S. and this trend is expected to continue in the coming years. Electric power is an increasingly viable option as the cost of EV battery technology decreases, thereby allowing power storage. For example, a Proterra-owned city transit bus drove more than 1,000 miles on a single charge. However, this trend in transit buses has not yet caught on for school buses. Several companies, including Blue Bird, Thomas Built Buses, IC Bus, Lion Electric Co., which is part of Lion Bus, and TransTech, are currently manufacturing electric school bus models.” (School Bus Electrification, 2018, 12)

Other Resources

Related Topics in this Document: Heavy Duty Vehicles, Integrated Grid Planning, Funding [Volkswagen Settlement](#)

Public Transit

New York Actions

- “The order allocates \$72 million from utilities to implement the program which will include offering services to assess fleet electrification for owners of larger vehicles, including site feasibility and analysis for charging depots. For buses, \$10 million is allocated to the Capital District Transportation Authority, Niagara Frontier Transportation Authority, Rochester-Genesee Regional Transportation Authority and the Westchester County Bee Line system to support electrifying 25 percent of their fleet by 2025, as Cuomo proposed in January. A pilot for a "make ready" program for medium and heavy-duty electric vehicles is allocated \$15 million, with utilities required to propose an implementation plan.” (\$700M EV Plan, 2020)
- June 11, 2020 PSC Order “It proposes a \$15 million “make-ready” pilot program for medium- and heavy-duty electric vehicles that, among other considerations, “must support a direct reduction of diesel emissions located in environmental justice communities through electrification of the medium-duty/heavy-duty vehicles and trucks.” In addition, the commission directs \$10 million toward utilities partnering with transit authorities in the state to provide make-ready bus infrastructure in depots, and

directs the establishment of a \$20 million competition to drive innovation in the medium- and heavy-duty electric vehicle sector.” (EDF, 2020)

- “As of January 2019, about half of the MTA’s fleet was diesel fueled. (The remainder was diesel hybrid and natural gas.) Most of the buses ordered during the MTA’s 2010–2014 and 2015–2019 capital programs are diesel buses. In early 2018, the MTA initiated an electric bus pilot to test operational performance and gather data to support the agency’s long-term goal of transitioning to a zero-emissions fleet by 2040. Under the current pilot, the MTA is operating five Proterra E2 Catalyst models and five New Flyer XE40 Xcelsior models for a trial period of three years. The MTA’s capital budget plan for 2020–2024—released in September 2019—calls for a \$1.1 billion investment in electric buses. The MTA estimates that this allocation would allow it to purchase 500 electric buses over the next five years. The capital budget plan states that all vehicle purchases after the year 2029 will be electric.” (Accelerating electric bus adoption in NYC Report, 2020)
- “New York is also participating in the regional Transportation and Climate Initiative, which is “a regional collaboration of 12 Northeast and Mid-Atlantic states and the District of Columbia that seeks to improve transportation, develop the clean energy economy and reduce carbon emissions from the transportation sector.” The TCI focuses a great deal of its effort on clean vehicles and fuels and ways, freight efficiency and exploring regional policy issues. Public transportation is included in that, but is not a core focus.” (Getting Greener, 2019, 47)
- “Metropolitan Transportation Authority (MTA): MTA, the largest transit agency in North America with 5,700 buses, has commenced with a program to implement an all-electric bus fleet in New York City by 2040. There are currently 10 test e-buses in operation in Manhattan, and installation started this summer on 16 in-depot electric chargers; 45 electric buses are scheduled for delivery beginning in 2020.” (Gurman 2019, 229)
- “New York Transit Authorities (Upstate): NYPA is finalizing a cooperative agreement with DEC on using VW settlement funds for electric bus chargers at upstate transit agencies (Ithaca, Rochester, Westchester, and Ulster counties). NYPA just released a request for proposals (RFP) for the first round of chargers for the upstate depots, with NYPA managing procurement and installation. New York Transit Authorities (Downstate): NYPA is assisting New York City Transit in its drive to achieve 100% electric buses by 2040 (see MTA, below), including managing the RFP for state-of-the-art overhead automated charging systems.” (Gurman, 2019, 229)
- “Roughly 90 percent of NYC’s current transportation GHG emissions come from private vehicle travel. To reduce this source of emissions, the City has committed to an 80 percent sustainable mode share by 2050, meaning four out of every five trips a New Yorker takes will be by foot, bicycle, or public transit. The City will support improvements to the subway and bus systems, create new miles of protected bike lanes, and expand bike share to double the number of active cyclists by 2020. The City will further work to limit both personal and commercial vehicle miles traveled by supporting shared mobility options, expanding smart parking policy that prioritizes access to curb space, and exploring options for low emission zones that limit access in the city for the worst polluting vehicles.” (NYC 1.5C, 2017, 11)

LPDD Recommendations

- *"State governments should pursue reforms that better link transportation and land use, including targeting transportation funding and planning resources to encourage transit-oriented development."*
- *"States should require transportation plans to establish targets for reducing GHG pollution and VMT consistent with specific goals and require tracking of progress to meet these targets."*
- *"States should add GHG assessments to their transportation planning laws and policies and reorient transportation planning to advance decarbonization."*
- *"State governments should devote a larger share of transportation funding to providing meaningful alternatives to driving, and increase funding for projects that better connect various modes in order to expand transportation choices."*

Related LPDD Database Pathways

- Reorienting Transportation Planning to Minimize GHGs: <https://lpdd.org/pathway/reorienting-transportation-planning-to-minimize-ghgs/>
- Promoting Alternatives to Car Transport: <https://lpdd.org/pathway/promoting-alternatives-to-car-transport>

Other Recommendations

- "It is critical that charging infrastructure build-out be planned in a way that enables interoperability across different vehicle fleets and classes to maximize utilization of infrastructure assets with high up-front costs." (Accelerating electric bus adoption in NYC Report, 2020)
- "Utility ownership of the bus batteries: At the end of the useful life of the buses, the utility would then be able to use the batteries for load management and grid assets. This would increase the value proposition of bus electrification, as strategically placed batteries may reduce additional infrastructure investment needs." (Accelerating electric bus adoption in NYC Report, 2020)
- "The DOT should collaborate with the MTA to leverage the success of the 14th Street Busway and conduct analysis to identify other roadways in environmental justice communities that can be redesigned to support electric bus-only routes. Electric buses would reduce environmental harm for the low-income communities of color who most utilize bus service and who live in close proximity to bus depots. The MTA operates 28 depots across the five boroughs, 75% of which are sited in communities where the majority of residents are people of color." (NYC EJA, 2020, 33)
- "Need for no fee transfer from PATH to MTA to LIRR." (S. Miller, 2018, 106)
- "While much of the current transportation policy discussion is focused on the Manhattan core, the vast majority of New York City's transportation-sector greenhouse gas emissions can be attributed to car and truck traffic outside the Central Business District. Reducing greenhouse gas emissions will require not only sustaining and building upon the VMT-reduction techniques that have proven successful in the CBD, but expanding them to outer-borough areas, which have different transportation needs and political climates than the city's core...In Manhattan, 78% of households are car-free, dropping to

59% in the Bronx, 56% in Brooklyn, 38% in Queens, and 17% on Staten Island.” (S. Miller, 2018, 98)

- “Commuter right of way elsewhere in the city, particularly in the Bronx and eastern Queens, could be better utilized to bring high-frequency service to residents of transit ‘deserts.’ These services must also be integrated in the fare payment system used for buses and subways, rather than being a premium service requiring suburban-level fares. The launch of a ‘Freedom Ticket’ pilot program (allowing one-ticket bus, subway, and Long Island Rail Road service within New York City) by the MTA is an encouraging sign.” (S. Miller, 2018, 105)
- “Create a high speed rail authority like that of California” (CA Scoping Plan, 2017, 128)
- “Achieving these goals would require funding well above what is available today. It would require increased federal resources, including a dedicated ongoing funding source for rail investments at the federal level, as well as ongoing operating subsidies to support continued service and operations. Achieving these transit goals would require a sustained long-term commitment to system planning and funding. Accomplishing these high speed rail goals would require right-of-way acquisition, legislation to allow new corridor construction in the Adirondack State Park, and interstate and international agreements.” (CAC Report 2010, Chapter 7, 20)
- “Construction of expanded subway, light rail, bus rapid transit, and high speed rail networks would promote job growth and economic development in the state in two ways. The expansion of transit systems in New York State could spur a growth in the transit- and rail-related manufacturing sectors. High speed rail that offers competitive trip times could boost economic output and prosperity by linking metro areas with robust economies to metro areas trying to create strong economies, a strategy that would expand the options of job seekers and employers. Dedicated high speed rail tracks would also free up existing rail tracks for improved freight deliveries and efficiencies by reducing congestion and competition for track availability.” (CAC Report 2010, Chapter 7, 19)

Discussion and Analysis

- “Buses are one of the city’s most significant contributors to PM_{2.5} emissions, creating environmental justice (EJ) concerns that electrification can address. Buses primarily serve neighborhoods with less access to the city’s subway network, which are largely low-income communities. These environmental justice communities are hit hard by PM_{2.5} pollution, with 1.75 times the PM_{2.5} concentration of the rest of the city and nine times the hospitalization rate due to respiratory health issues. Furthermore, 75 percent of bus depots are located in EJ communities, and bus users tend to be lower-income individuals who are disproportionately impacted by pollution in the city.” (Accelerating electric bus adoption in NYC Report, 2020)
- “Because heating of the bus interior uses nearly three times as much energy as propulsion, the battery range is still a challenge. In addition, the capacity of lithium-ion batteries declines as batteries age. At the end of life, the battery capacity is approximately 80 percent of the beginning of life capacity. This means that the battery capacity must be accounted for when planning the mileage and routes that buses are expected to serve.” (Accelerating electric bus adoption in NYC Report, 2020)

- “New York has made a large commitment to electric vehicles that will subsidize both car buyers and the construction of charging stations. This is an expensive GHG emissions reduction strategy. Greater emphasis should be placed on one of the areas that has made New York a low GHG emitting state: energy-efficient public transportation. While a hybrid or electric vehicle produces fewer GHGs than a gasoline powered vehicle, public transportation produces even less per passenger mile traveled.” (Getting Greener, 2019, 4)
- “The state is not putting enough emphasis on one of the key areas that has made New York a low GHG emission state– energy efficient public transportation. In the downstate region, bus and subway ridership is down and traffic congestion is up. While there are many reasons for this, there is a consensus building that poor service on the public transportation network is sending more people to ride hailing services. Though a hybrid or electric vehicle produces less greenhouse gases than a gasoline powered vehicle, public transportation emits even less per passenger mile traveled.” (Getting Greener, 2019, 47)
- “Maintaining fare affordability is critical to making transit accessible to everyone. Lower fares also reward transit riders for the benefits they provide to the entire transportation system by occupying less space on roadways, improving transportation safety, and reducing energy use and pollution.” (Transforming Transportation, 2019, 11)
- “Encouraging higher-occupancy transit. Subsidizing and prioritizing street space for very high-occupancy vehicles (buses and trains), particularly during peak times on congested routes, could significantly reduce VMT. Information technology enables a shift from underutilized fixed-route and fixed-scheduled transit to demand-responsive transit capable of real-time adjustments. Incentivizing public transit operators to better match passenger demand with vehicle size on lower-occupancy routes, through smaller automated vans and shared aTaxis is another option, blurring the distinction between transit and TNCs” (Greenwald, 2019, 450)
- “Virginia’s Dedicated Fund for Rail Projects: Staples Mill Station Parking Lot Expansion - With over 350,000 boardings and alightings annually, Staples Mill is Virginia’s busiest rail station, and parking was historically inadequate to handle the volume of passengers. DRPT purchased seven parcels of land around the station to more than double the number of parking spaces, improve Amtrak thruway bus operations, add an additional ingress/egress at a signaled intersection, update the parking lot to current ADA standards, and allow for more taxis. The \$3.3 million from IPROC was obligated toward construction for these improvements, and a portion of parking revenues will be provided to DRPT to offset the Commonwealth’s investment. Construction was completed two months ahead of schedule in June 2018.” (Virginia’s Dedicated Fund for Rail Projects, 2018)
- “Development of a high speed rail system that offers competitive trip times could shift travel demand from single-occupant vehicles and air travel to rail. Short-haul air travel would not be eliminated, as the need for connecting flights will likely persist but it could be dramatically reduced, freeing up congested airspace in the region. World class high speed rail in the Northeast could also create economic synergies between cities on the Eastern Seaboard. Linking cities that enjoy strong economies with cities trying to

develop stronger economies will transform the economic geography and output of the Northeast. New York State should continue all efforts to develop high speed rail along the Empire Corridor. Dedicated high speed rail tracks would also reduce congestion on existing rail lines, leading to improved and more efficient freight movement.” (CAC Report 2010, Chapter 7, 31)

- “Preliminary data and analysis conducted by the Regional Plan Association suggests that a “California-style high speed rail” in the Northeast and Empire Corridors could shift 24 percent and 17 percent of passengers from air travel to rail, respectively. New York State should continue to aggressively work with other Northeast States to undertake a major investment study of the impact of high speed rail on the Northeast and Empire Corridors. This study would forecast the economic development benefits of high speed rail on city pairs within the Northeast, changes in regional air space, GHG benefits, and mode shift toward rail.” (CAC Report, 2010, 31)
- “The Northeast Mega-region is projected to grow from a population of 49.5 million in 2000 to 58 million by 2025 and 70 million by 2050. The ability of the Northeast Mega-region to capture and sustain this population growth will depend largely on the quality of its transportation infrastructure. To continue its economic growth, the Northeast Mega-region will need to provide expanded capacity for intercity travel. Highways and airports cannot provide this capacity in a manner that meets the goals of the New York State Climate Action Plan. Dramatically increasing intercity rail capacity in the Northeast Mega-region, and reducing trip times in the process, could achieve increased mobility, economic growth, energy security, and GHG emissions reductions.” (CAC Report, 2010, 32)
- “Development of high speed rail would require ongoing, sustained funding and support to plan and develop the corridors. A separate and sustained source of federal funding for rail would be required. To attain the reliability and higher speeds suggested along the Adirondack Corridor, significant cross-border negotiations to reduce or eliminate border inspection delays (e.g., moving passenger inspections to Montreal) would be required. Further, development of high speed rail along the Adirondack Corridor would require a constitutional amendment to pursue new alignments. Moreover, providing transit services in diffuse communities, especially upstate, would likely require significant operating support to keep fares at publicly acceptable levels.” (CAC Report, 2010, 21)
- “As enumerated in the 2009 New York State Energy Plan, a new federal funding formula is needed within the next surface transportation funding bill to provide the correct incentives to states. There also needs to be significant federal investment in new low-GHG transportation modes, and an increase in federal funds for transit, rail and other modes that reduce GHG emissions. New York State should advocate for a diversification of the portfolio of revenue supporting the federal surface transportation program for a healthy transition to a low-carbon system. A federal advocacy partnership with other states could also address the need for streamlining the process to secure federal approval to expand transit systems, and linking the award of federal funds for major transportation system expansion to land use plans that support GHG emissions reduction.” (CAC Report 2010, Chapter 7, 32)

Related Topics in this Document: Transit-Oriented Development, Regional Transit, Zoning for High Density & Mixed Use Development, Transportation and Climate Initiative

[Citizens Budget Commission Report](#)

[Electrifying NYC's Buses: Lessons from Quebec](#)

Transportation Demand Management

LPDD Recommendations

- *"State governments should adopt measures to send better price signals regarding the cost of driving, including increased motor fuel taxes."*
- *"States should explore the VMT tax option."*
- *"State governments should encourage or mandate pay-as-you drive insurance policies."*
- *"States should increase the use of congestion pricing, with carefully designed charges for travel on roads, bridges, or tunnels during peak demand periods."*
- *"States should require major employers to implement programs to reduce single-occupancy vehicle trips by their employees."*

Related LPDD Database Pathways

- Reorienting Transportation Planning to Minimize GHGs:
<https://lpdd.org/pathway/reorienting-transportation-planning-to-minimize-ghgs/>

Recommendations

- "Reduce congestion and vehicle miles traveled, including by supporting improvements to the subway and bus systems, doubling the number of active cyclists by 2020 through the development of new miles of protected bike lanes and expanded bike share, supporting shared mobility options, expanding smart parking policy, and exploring the implementation of low emission zones" (NYC 1.5 C 2017, 18)
- "Effective Transportation System Management (such as high-occupancy vehicle lanes, improved traffic flow) utilizes a variety of strategies including advanced technologies, policies, and design standards. TSM strategies attempt to make travel more efficient by shortening trip lengths, reducing vehicle delay, increasing the reliability of the transportation network, and reducing idling and other transportation actions. System design complements technology actions, and includes access management and intersection improvements. Another important component is the integrated implementation and delivery of travel demand management (TDM) strategies and services (such as carpooling, van pooling, telecommuting) in New York's urban, suburban, and rural locations, built on market-based incentives and education and outreach programs to reduce, eliminate, or shorten vehicle trips. When these strategies are applied in concert, substantial gains can be achieved." (CAC Report 2010, Chapter 7, 16)
- "This may include reducing the growth rate in VMT, providing alternatives to single-occupant vehicle travel, and reducing delay and eliminating bottlenecks on the highway

system. Providing these elements may reduce GHG emissions by reducing the number of trips on the highway system and VMT per person, and by generating a significant mode shift to carbon-efficient and zero carbon modes of travel.” (CAC Report 2010, Chapter 7, 16)

Discussion and Analysis

- “Transportation demand management (TDM, 13%): TDM is an [urban mobility policy](#) representing measures to shift travel from modes with large emissions intensity (light-duty passenger vehicles, freight trucks, and aircraft) to modes with zero- or low-emissions intensity (walking, [biking](#), [buses](#), rail, and ships). Component policies include:
 - Zoning for higher density residential and commercial development near transit hubs and along major transit corridors
 - Zoning for mixed use development, so people can live near where they work
 - Promoting infill development and avoiding urban sprawl – for instance, by adopting an urban growth boundary, as is used by [all cities and metro areas in Oregon](#)
 - [Properly funding public transit](#), and adopting measures to make it an attractive, first-choice option (ensuring service is frequent and predictable, with clean and safe vehicles and stations)
 - Using congestion pricing to reduce the number of vehicles in urban centers, as used [in London](#) and scheduled to start [in New York City](#) in 2021
 - Altering building codes to specify a maximum, not a minimum, number of off-street parking spaces per new housing unit, as [London did](#) in 2004
 - Providing high-quality intercity passenger rail service (ideally fully grade-separated, high-speed rail) to reduce aircraft use
 - Providing faster permitting and better infrastructure for rail and ship freight to reduce freight truck use” (U.S. Net Zero Emissions By 2050: Decarbonizing Transportation, 2019)

Other Resources

Related Topics in this Document: Carpooling, Telecommuting, Public Transit

Telecommuting

LPDD Recommendations

- *"State governments should adopt policies promoting flexible and compressed work schedules for their employees, where appropriate, and provide information and incentives to private employers."*
- *"State governments should promote teleworking and telecommuting by offering information, technical assistance and training, funding, and targeted tax credits."*

Recommendations

- “Implement a New York State Telecommuting Project, primarily in the New York metropolitan area and secondarily on a statewide level.” (CAC Report 2010, Chapter 7, 17)

Discussion and Analysis

- “An employer that implements a program enabling employees that currently work from the employer’s office or other physical facility located in the commonwealth to telecommute shall be allowed a credit against amounts withheld from wages by this chapter for the calendar year to the extent that the credit is authorized for that employer by the department of transportation. For the purposes of this section, “telecommute” or “telecommuting” means the performance by an employee, who is a Massachusetts resident, of normal and regular work functions during the Monday through Friday work week at a location different from the employer’s office or other physical facility located in the commonwealth and that is within or closer to the employee’s residence. The department of transportation shall award the credit based on (i) the number of the employer’s employees that begin telecommuting on or after January 1 2020; (ii) the effectiveness and impact of the employer’s telecommuting program; and (iii) other standards developed by the department of transportation. The credit shall not exceed \$2,000 per participating employee for the calendar year. An employer may claim the credit on the returns due under this chapter over the course of a calendar year in a form and manner determined by the commissioner.” (Telecommuting Tax Breaks in Massachusetts, 2019)
- “EO 13693 (2015) called on federal agencies to “consider the development of policies to promote sustainable commuting and work-related travel practices for Federal employees that foster workplace vehicle charging, encourage telecommuting, teleconferencing, and reward carpooling and the use of public transportation.” It was revoked by EO 13834 in 2018.” (LPDD, Executive Order 13693)

Other Resources

Related Topics in this Document: Carpooling, Transportation Demand Management

Carpooling

New York Actions

- “As of February 2017, the City had installed car-share technology on 707 of its vehicles, an increase of 110 since the previous year. In addition, 603 employees at 55 agencies or divisions had used Zipcar vehicles offered for City use at a discounted rate in 2016. Taken together, the initiatives had more than 4,500 participating City employees and had reduced use of City-owned vehicles by over 150,000 hours a year.³⁸ In 2017, 5,600 employees participated, offsetting 280,000 hours of use of City-owned vehicles.” (S. Miller, 99)

Other Recommendations

- “Implement a Commuter and Traveler Assistance Program in upstate New York starting in 2011. This program aims to change commuter and traveler behavior by providing easily accessible information that prompts the choice to use other commute modes or carpooling, and includes other actions to maximize commuter and traveler mobility.”(CAC Report 2010, Chapter 7, 20)
- “The state could also promote the use of shared modes of transportation, such as transit, carpooling, and ride sharing, by expanding available information about these services through improved communications technology. The appropriate mix of technology and real-time information could provide the kind of comparative data on costs or saving that would enable workers, residents, and visitors to make more informed choices when they select a particular mode or combinations of modes for work trips and discretionary trips.”(CAC Report 2010, Chapter 7, 20)

Discussion and Analysis

- “The Clean Mobility Options for Disadvantaged Communities pilot projects address the barriers and transportation needs of low-income residents and those living in disadvantaged communities. The City of Los Angeles received a \$1.7 million grant to start a zero-emission car share pilot project, BlueLA, to operate in four Los Angeles disadvantaged communities. This BlueLA project will ultimately deploy 100 electric vehicles (EV) and 200 EV chargers. BlueLA additionally offers reduced rates for low-income households earning less than US\$35,000 per year. Other expected benefits include: • 2,313 MTCO_{2e} GHG reductions • 3,519 pounds NOX reductions • 447 pounds PM_{2.5} reductions” (EQuality, 2020, 65)
- “Ridesharing (carpooling) with individually owned vehicles has been little used (Porter et al., 2013) because of the low probability of two individuals regularly going on round trips to and from the same place at the same time. TNC-offered ridesharing is significantly less constrained because it is arranged dynamically by trip segment. The chances that rides can be shared for trip segments are substantially better than for round trips, and enormously better than for daily commutes or multiple-stop trips. Through information technology, TNCs can discover, offer, and promote common trip opportunities with reduced fares. Centrally owned and managed fleets have an economic incentive to encourage ridesharing to attract cost-conscious riders and maximize their asset utilization. Thus, fleets offering mobility services have both a greater opportunity and a greater incentive to promote ridesharing than individuals do.” (Greenwald, 2019, 447)
- “Knowledge about ride-sharing opportunities is limited to those who use TNCs, which is less than two percent of the travel market, and even here data are sparse. One survey (MAPC, 2018) found that people prefer to travel by themselves: only one-fifth of TNC customers opt for a truly shared ride (e.g., UberPOOL), and the majority of TNC rides are single-passenger. Via, with its “We ride together” slogan (Via, 2018), is the only ride-hailing company started and branded as a ridesharing business. It recently added an option to ride solo, but over 95% of its customers choose ridesharing (Gold, 2018). In New York City, 67% of Via trips are shared vs. 12.5% for Uber and 18.9% for Lyft (NYCTL, 2018). Via’s success may be attributable to its good routing algorithm that

makes ridesharing convenient, and because it provides drivers with a financial incentive to do shared rides (The Rideshare Guy, 2018).” (Greenwald, 2019, 447)

Other Resources

Related Topics in this Document: Electric Vehicles

Aviation

New York Actions

- “Airports: At JFK, NYPA is creating a charging hub of ten 150 kw DCFCs, as well as working with the Port Authority and Jet Blue to electrify ground support vehicles such as baggage tugs. Rapid charging of baggage vehicles has been implemented: JFK—American, 105 vehicles; LGA—Delta, 15 vehicles; Westchester, 25 vehicles; Albany—Delta, 9 vehicles; and Stewart, jet bridge electrification, consisting of seven gates equipped with auxiliary power and pre-conditioned air units.” (Gurman, 2019, 229)

LPDD Recommendations

- “States should consider carrying out a full review of all the taxes and charges placed on the aviation industry with the explicit objective of considering whether they are adequate in light of aviation’s climate impact.”
- “States should raise aviation fuel taxes to the extent they can while complying with FAA rules.”

Related LPDD Database Pathways

- Aviation Carbon Charges and Fuel Taxes: <https://lpdd.org/pathway/aviation-carbon-charges-and-fuel-taxes/>

Other Recommendations

- “The International Civil Aviation Organization set the first-ever CO₂ standards for aircraft in 2017, and the International Maritime Organization’s energy efficiency standards for oceangoing vessels went into force in 2013. As a member of these groups, the U.S. could push these bodies to enact strong, well-designed standards. Congress could direct EPA to adopt and enforce the standards set by these organizations, as well as to apply our own standards for domestic aviation.” (Federal Policies for Net Zero, 2020, 13)
- “Reducing aircraft emissions may be accomplished by strengthening international aircraft fuel economy standards, reducing air travel, and development and deployment of aviation biofuels.” (U.S. Net Zero Emissions By 2050: Decarbonizing Transportation, 2019)

Discussion and Analysis

- “Non-motor vehicles create another major obstacle to the decarbonization of the transportation sector. These vehicles include airplanes, boats, and trains. In recent years,

they have represented about one quarter of all transportation sector emissions. Of this non-motor vehicle fraction, airplanes make up the lion's share of emissions in New York—75 to 80% in recent years. As domestic and international air travel increases, airplanes are projected to account for 85% of non-motor vehicle GHG emissions by 2035. Currently, there are few commercially viable technologies to decarbonize airplanes, outside of mode-shifting to other forms of transportation (e.g., Amtrak). In order to achieve higher levels of economy-wide emission reductions, more investment will be needed to develop low-carbon alternatives that move people across long distances.” (Transforming Transportation, 2019, 15)

- “New Jersey’s proposed AB 4392 (2018) would have raised airline fuel taxes \$0.04 per gallon on fuel purchased in New Jersey airports offering more than 20,000 commercial flights a year, using that revenue to fund train service extensions. The projected spending target may have been illegal under the FAA’s requirements to spend airport fuel taxes on airport expenses, codified at FAA-2013-0988.” (LPDD, New Jersey’s proposed AB 4392, <https://lpdd.org/resources/new-jerseys-proposed-ab-4392/>)
- “There are several options for introducing a progressive element in the tax system covering aviation:
 - Introduce a tax rate that increases with each subsequent flight a passenger takes;
 - Add a percentage to the current APD which increases with each subsequent flight;
 - Add a percentage to ticket prices which increases with each subsequent flight;
 - Apply a uniform tax increase to all flights, but exempt the first flight from tax.
- ... A progressive levy applied as a percentage on ticket prices - is recommended and examined further by this study. Basing a levy on ticket prices has a major benefit: Ticket prices are correlated with environmental impacts because they contain a significant fuel cost component, and with the income of passengers because passengers with higher income purchase more expensive tickets. Hence adding a percentage levy to ticket prices will generally provide a larger price incentive for flights with larger environmental impacts and for passengers with larger incomes.” (LPDD, Proposal for a Frequent Flyer Levy, <https://lpdd.org/resources/proposal-for-a-frequent-flyer-levy/>)

Other Resources

Related Topics in this Document: Shipping

Shipping

LPDD Recommendations

- “States could formulate their own GHG standards for shipping and submit them to EPA for approval or, alternatively, set in-use requirements without EPA approval.”
- “States should consider enacting procurement rules to ensure that any goods they procure are shipped in an energy-efficient manner.”

Related LPDD Database Pathways

- Fuel Taxes for Shipping: <https://lpdd.org/pathway/fuel-taxes-for-shipping/>

- State In-Use Rules: <https://lpdd.org/pathway/state-in-use-rules/>

Other Recommendations

- "By 2030, all commercial watercraft in New York State, including but not limited to ferries, tugboats, and Hudson River barges and freighters, must be zero-emission vessels. The bill would exclude ocean-going vessels such as cruise ships, container ships, and other ocean-going ships. Boats and ships servicing offshore wind farms must not emit emissions while in New York waters (within three nautical miles of the coast). In addition, the bill could include an economic nudge, via tax policy or other means, to encourage private citizens to purchase zero-emission boats." (Arden et al 2020)
- "Denmark has an all-electric ferry that has a range of 25 miles, can carry 200 passengers and 30 vehicles. NY can use this same technology to make short-distance ferries like across Lake Champlain and to Fire Island zero-emissions. NYC Metropolitan ferries like Staten Island and Ellis Island are harder to electrify because they stay at the docks for less time, and they would need to recharge between every trip. One solution to this problem would be induction charging but that is much more expensive than regular charging and would need to be shared between ship companies because of the cost. Commercial operators in the canal systems are an ideal candidate for zero-emissions technologies because they are limited to 10mph which is feasible for a zero-emission system. Commercial fishing: Hard to regulate because of the various operating requirements, probably unfeasible to be entirely zero-emission by 2030." (Arden et al, 2020)
- "Charging Infrastructure: A common charging standard will be needed to facilitate zero-emissions commerce on the Hudson River and on New York State canals because independent companies will need to share common charging stations. By contrast, tugboats that operate only in New York Harbor, ferries, wind farm workboats, and cruise lines could implement dedicated charging stations. The New York State Canal Corporation is a subsidiary of the New York Power Authority (NYPA). The New York State Energy Research and Development Authority (NYSERDA), working with NYPA, could take the lead in setting an appropriate standard, conferring with interested parties and other states.¹⁰ NYPA could take the lead in installing, or arranging the installation, of charging stations. NYSERDA should publish a standard no later than 2027." (Arden et al, 2020)
- "I propose adoption of a trading system based on a market price for carbon-dioxide equivalent (CO₂-eq) emissions. Early adopters of zero-emission vessels would gain CO₂-eq credits or "marine allowances" based on the GHG emissions avoided. The allowances would be earned based on average emissions avoided, calculated for various classes of vessels per operating hour. Operators still reliant on diesel engines would then need to purchase these allowances, again based on their operating hours. The EU has implemented the world's most extensive emissions trading system, the European Trading Scheme (ETS). The current spot price for one metric ton of CO₂-eq is around €25, or \$27.50. However, the bill should use a U.S. reference price for carbon. The price of carbon in RGGI's most recent auction, held in September, was \$5.20 per short ton (\$5.61 per metric ton). A third reference price is that of the Western Climate Initiative

(WCI), the cap-and-trade system that California, Nova Scotia, and Quebec use. WCI may be a more appropriate benchmark than RGGI because WCI is far more comprehensive. RGGI only pertains to power plant emissions, accounting for 15% of NY GHG emissions.¹⁵ By contrast, WCI covers emissions from power plants, industrial plants, and road transportation, accounting for approximately 80% of all GHG emissions. The November price for an allowance was \$17.00 per metric ton.” (Arden et al, 2020)

Discussion and Analysis

- “Ferry service provides numerous benefits for both commuters and the environment. Accessible, affordable public transportation decreases commuters’ reliance on cars, cutting their travel expenses and carbon footprint. In New York State, transportation-related emissions account for a third of total state emissions each year. Motor vehicles alone in NYC contribute roughly 11% of local particulate matter pollution and 28% of nitrogen oxide emissions. Providing opportunities for commuters to avoid their cars can improve New York’s air quality... The 2019 New York City Mobility Report states that while ferry commuting is the preferred method of transit for 0.2% of New Yorkers, the number of commuters is rising with increased and faster service, line service extensions, and marketing campaigns. Currently, there are 127,000 daily ferry riders across all lines.” (Boats, 2020)
- “However, ferry service is not environmentally risk-free. In NYC, NO₂ levels in open areas near ferry terminals are more than 50% above the standard established by the EPA. In a 2016 review of the ferry system, Economic Development Corporation spokesperson Ian Fried said that the additional pollutants would not negatively impact the city as a whole, because ferry ridership gets New Yorkers out of their cars and trucks.” (Boats, 2020)
- “It should be possible to retrofit electric propulsion systems in many existing boats. In 2014, New York State converted a 1928 tugboat with a 1980s era diesel engine to all-electric propulsion. The Canal Corporation uses the tugboat, a dredge tender, for Erie Canal maintenance. New York State anticipates \$117 million in revenues during FY19-20 from Regional Greenhouse Gas Initiative (RGGI) auction revenues.⁹ New York State spends these funds on projects to mitigate climate change. The government could choose to make low-interest or zero-interest loans to tug boat and barge owners to help them purchase new vessels or retrofit existing ones. Alternately, the government could develop a program with banks where the banks make the loans but the government partially subsidizes them or covers the risk of default. In my view, this is the preferred approach. New York State would need to set aside funds to cover risk-adjusted forecasted losses. In addition, via grants, New York State could choose to fund the difference in price between a traditional diesel-fueled vessel and a zero-emissions vessel. However, if the payback in most use cases is attractive, i.e. five years or less, then this program may not be necessary. New York State could choose to fund dedicated charging stations at the marinas of tugboat and barge operators and/or to fund public charging stations.” (Arden et al, 2020)
- “The Circle Line's longest cruise is its famous 2.5-hour cruise that circumnavigates Manhattan. According to various accounts, the perimeter of Manhattan is (via walking) 32 miles. If the Circle Line travels 40 miles in 2.5 hours, its average speed is 16 mph or 14

knots. Although this use case requires further investigation, switching to zero-emission propulsion by 2030 appears to be feasible. Dinner cruises take two or three hours. However, the distances covered are small. The boats largely stay within the confines of the East River, Hudson River, or the New York Harbor. In 2019, a number of excursion vessels or "party boats" started operating out of the Brooklyn Army Terminal. They were formerly based out of Sheepshead Bay. Assembly Member Steven Cymbrowitz long advocated for their removal from Sheepshead Bay, arguing that the boats and their customers were too disruptive for a residential neighborhood. Similarly, a number of Sunset Park residents are worried about the effect of the boats moving to their neighborhood. Zero-emission vessels, which are quieter than conventional vessels, may address some of their concerns." (Arden et al, 2020)

- "Plug in stations designed to "eliminate 1,200 tons of carbon dioxide, 25 tons of nitrous oxide and tons of hazardous particulate matter spewed out each year by cruise ships idling off Brooklyn's coast. Have been extremely slow to implement; no plan to further expand past Red Hook site. When not using shore power, a single cruise ship docked for one day can emit as much diesel exhaust as 34,400 idling tractor-trailers." (Collins, 2020)

Other Resources

Related Topics in this Document: Aviation, RGGI

Tolls and Pricing

New York Actions

- "A recent positive step was the adoption of congestion pricing in the New York City Central Business District, which is expected to reduce personal vehicle use in Manhattan and spur additional use of public transit. Governor Cuomo announced in January 2018 that the Metropolitan Transportation Authority would begin piloting an all-electric bus program as a means of further driving down GHG emissions." (Getting Greener, 2019, 48)
- "London has instituted and New York City is planning a fee to drive downtown on weekdays, and many toll roads have dynamic tolls based on demand, in part to keep traffic flowing." (Halfway There, 2019, 20)

LPDD Recommendations

- *"State governments should adopt measures to send better price signals regarding the cost of driving, including increased motor fuel taxes."*
- *"States should explore the VMT tax option."*
- *"State governments should encourage or mandate pay-as-you drive insurance policies."*
- *"States should increase the use of congestion pricing, with carefully designed charges for travel on roads, bridges, or tunnels during peak demand periods."*
- *"States should require major employers to implement programs to reduce single-occupancy vehicle trips by their employees."*

Related LPDD Database Pathways

- Reorienting Transportation Planning to Minimize GHGs:
<https://lpdd.org/pathway/reorienting-transportation-planning-to-minimize-ghgs/>

Other Recommendations

- “Implement congestion pricing in the New York City metro area as previously proposed by New York City starting in 2015. Implementing a congestion pricing program in the New York metro area could reduce VMT and provide revenue for TSM and TDM activities by requiring a fee for vehicles to enter designated parts of the New York metropolitan area. Legislation would be needed to permit this strategy but is estimated to reduce VMT within the cordon area in New York City by approximately 6%, with additional VMT reduction in the greater metropolitan area due to reduction in trips to and from the City.” (CAC Report, 2010 17)
- “New York State could also implement emissions-based registration fees and tolling based on a vehicle’s GHG emissions per mile, providing further incentives to buy and operate low GHG vehicles and potentially raising revenue for other transportation GHG reduction programs.” (CAC Report, 2010, 10)

Discussion and Analysis

- “Congestion pricing and VMT fees charge drivers for some of the congestion, infrastructure, and land use costs they impose. Congestion pricing focuses on reducing traffic in city centers, thus opening up road space for public and active forms of transportation. VMT fees assign infrastructure maintenance costs to drivers, usually proportionally to the degree to which each driver is using roadways. Both policies encourage more efficient transportation modes.” (Transforming Transportation, 2019, 10)
- “Tax incentives for TNCs that encourage ridesharing and for riders who rideshare could help reduce VMT. For example, in March 2018, New York began levying a surcharge on taxi, for-hire, and ride-share trips in Manhattan below 96th Street: \$2.50 for each taxi trip, \$2.75 fee for each privately-operated for-hire trip, and a \$0.75 fee for each ride-share trip, and the tax excludes personal vehicles. This policy is directionally correct but flawed because the combined surcharge for a trip with four ridesharers would be higher than for a solo taxi trip. Washington DC is also considering a surcharge but is thus far not planning to favor ridesharing over solo trips (Siddiqui, 2018). Policy makers could discourage low-occupancy AV use through VMT fees.” (Greenwald, 2019, 449)

Other Resources

Related Topics in this Document: Transportation Demand Management, Electric Vehicle Purchases and Incentives, Autonomous Vehicles

Land Use and Local Government

Zoning for High-Density & Mixed-Use Development

LPDD Recommendations

- “State governments should offer more generous financial incentives and technical assistance to promote infill, renovation, and redevelopment.”
- “Localities should alter or eliminate sprawl-inducing zoning provisions, such as minimum lot and house sizes, and revamp zoning and building code requirements to promote more compact, mixed-use development.”

Related LPDD Database Pathways

- Encouraging Density through Zoning -- <https://lpdd.org/pathway/encouraging-density-through-zoning/>
- Zoning for Density -- <https://lpdd.org/pathway/zoning-for-density/>
- Walkable Development -- <https://lpdd.org/pathway/walkable-development/>
- Using Land Use Policy to Diminish Vehicle Miles Traveled -- <https://lpdd.org/pathway/using-land-use-policy-to-diminish-vehicle-miles-traveled/>
- Promoting Alternatives to Car Transport: <https://lpdd.org/pathway/promoting-alternatives-to-car-transport/>
- Using Land Use Policy to Diminish Vehicle Miles Traveled: <https://lpdd.org/pathway/using-land-use-policy-to-diminish-vehicle-miles-traveled/>

Other Recommendations

- “The State of New York could assist and incentivize municipalities in designating, planning, zoning, and developing/re-developing priority growth centers. This could happen through a combination of State assistance and State incentives, such as shifting State resource allocations towards identified priority growth centers, which could be in urban, suburban, or rural areas. The priority growth centers would be encouraged to have compact, mixed-use, walkable/bikeable development in existing centers of activity, whether urban centers or hamlets and village centers.” (CAC Report 2010, Chapter 7, 24)
- “Programs could encourage states to prioritize the provision of their own state funds to those municipalities that take specific actions to encourage low GHG land use. Municipalities that commit to certain land use planning actions (e.g. sustainable planning, zoning, transit-oriented development) could get priority for a range of state and federal funding. Funds (potentially from a GHG auction resulting from a regional initiative for transportation and GHG emissions, described below) would be reinvested in smart growth economic development projects in communities, and communities would be eligible for funding based on their commitments to climate change and other adaptation methods. States could work together to identify and publicize best options.” (CAC Report 2010, Chapter 7, 30)
- “New York State could accomplish this through incentive programs such as: Accelerating and prioritizing permit and SEQRA review for smart growth projects, without compromising outreach to, and input from, underserved populations or EJ areas;

Ensuring affordable housing options within priority growth centers; Providing priority infrastructure funding (transportation, water, economic development, schools, housing) for Smart Growth; Incorporating principles of strategic land conservation and green infrastructure into open space preservation funding, plans, and documents; Providing public accessibility to parks and green spaces, both within and outside priority growth centers; Assisting with alternative local funding mechanisms, such as Tax Increment Financing; Further rewarding such smart growth development as described above if it comports with a regional land use and/or transportation plan; and Using regional transportation and land use planning to encourage development patterns that achieve prescribed transport-based GHG emission reductions.” (CAC Report 2010, Chapter 7, 24)

Discussion and Analysis

- “Mixed-use and transit-oriented zoning is essential to enable walking, biking, and public transit. Mixed use buildings in concentrated areas reduce the distances between residents and the jobs and services they rely on, which makes walking and biking more feasible. Zoning for transit-oriented development while maintaining affordability gives more people convenient access to transit and makes more of the places they need to go accessible by transit.” (Transforming Transportation, 2019, 11)
- “Catalyzing university and college resources to create greater town land use synergies with surrounding neighborhoods and municipal centers.” (CAC Report 2010, Chapter 7, 28)
- “Compact, mixed use developments, which could be encouraged through Location-Efficient Land Use, offer significant co-benefits from improved air quality, better mobility through access to additional travel options such as public transportation, walking, or biking, reduction in building energy use (compact land use is generally associated with lower building energy use per square foot), and enhanced quality of life.” (CAC Report 2010, Chapter 7, 29)
- “Considering the limitations of State incentives and assistance (vs. mandates for example, which this policy doesn’t include), the scenario of having 50 percent of all new construction occur in priority growth areas is very aggressive, but potentially feasible, given the long timeframe. Achieving these results would require a sustained long-term State commitment to promoting priority growth centers with assistance and incentives.” (CAC Report 2010, Chapter 7, 25)
- “However, land use changes are particularly difficult to prescribe in New York State. New York State can offer incentives to municipalities and regional planning organizations to incorporate priority growth centers, but the State ultimately does not have the authority to create them itself, due to home rule. Incentives will have to be designed carefully to attract local authorities to update and alter their land use plans. Land use patterns are difficult to change once established, and changing incentives and local regulations could lead to significant property value shifts, raising values in denser areas and reducing values in sprawling neighborhoods.” (CAC Report 2010, Chapter 7, 26)

Other Resources

Related Topics in this Document: Transit-Oriented Development

Transit-Oriented Development

LPDD Recommendations

- *“State governments should devote a larger share of transportation funding to providing meaningful alternatives to driving, and increase funding for projects that better connect various modes in order to expand transportation choices.”*
- *“State governments should modify street design standards and practices to promote non-motorized transportation, including adopting “complete streets” laws and policies.”*
- *“State governments should offer more generous financial incentives and technical assistance to promote infill, renovation, and redevelopment.”*
- *“State governments should pursue reforms that better link transportation and land use, including targeting transportation funding and planning resources to encourage transit-oriented development.”*
- *“States should add GHG assessments to their transportation planning laws and policies and reorient transportation planning to advance decarbonization.”*
- *“States should require transportation plans to establish targets for reducing GHG pollution and VMT consistent with specific goals and require tracking of progress to meet these targets.”*
- *“State governments should modify street design standards and practices to promote non-motorized transportation, including adopting “complete streets” laws and policies.”*
- *“States should provide localities funds for technical assistance and project construction for “complete streets,” including retrofitting existing streets to make them more inviting to cyclists and pedestrians.”*

Related LPDD Database Pathways

- Walkable Development: <https://lpdd.org/pathway/walkable-development/>
- Reorienting Transportation Planning to Minimize GHGs: <https://lpdd.org/pathway/reorienting-transportation-planning-to-minimize-ghgs/>
- Using Land Use Policy to Diminish Vehicle Miles Traveled: <https://lpdd.org/pathway/using-land-use-policy-to-diminish-vehicle-miles-traveled/>

Other Recommendations

- *“Reducing parking requirements frees up more space for people. Vehicles take up valuable space— parking mandates subsidize this cost by artificially increasing the supply of parking. Requirements for extensive parking also raise development costs, create sprawl that makes walking and biking more difficult, and favor motor vehicle travel over public transportation.” (Transforming Transportation, 2019, 11)*
- *“Paved surfaces should be minimized, and where they are necessary, created with light-colored and preferably porous pavement.” (Heat Waves, 2018, 543)*

- “Implement parking pricing practices in New York urban areas using smart parking meters in central business districts starting in 2011.” (CAC Report 2010, Chapter 7, 17)
- “The State of New York could incentivize and promote local planning, zoning and development/re- development that minimizes the distance between locations of daily destinations through targeted density and mixed land uses; infill development/adaptive reuse (commercial, retail, residential); retrofitting sprawl development to achieve greater density, mix of land uses, inter-connectivity and walkability; affordable housing opportunities; close proximity between jobs and transit; and close proximity between affordable housing and low-/moderate-income jobs. As distinguished from TLU 9— Priority Growth Centers, this policy could occur by taking a micro-planning approach by creating specific, people-friendly/oriented network/land use connections.” (CAC Report 2010, Chapter 7, 28)
- “New York State could begin developing a Location-Efficient Mortgage program, modeled on the Housing Finance Agency/State of New York Mortgage Agency Mortgage Insurance Fund agreement with the MTA to provide additional incentive for affordable housing near transit.” (CAC Report 2010, Chapter 7, 28)
- “The State could provide favorable tax incentives, priority infrastructure funding, and technical assistance/planning grants for the planning, zoning, and development/redevelopment of: transit villages in close proximity (one-half mile, as a general rule) to transit stations (rail, bus, ferry); targeted compact, mixed-use development within walking, biking and short-car-ride distance of a transit station; and pedestrian-/bicycle-friendly access to transit. New York State could also develop parking policies and alternative funding mechanisms for parking that support TOD/transit-supportive development (TSD).” (CAC Report 2010, Chapter 7, 26)
- “New York State could offer: Continued development and expansion of existing technical assistance and public education around TOD; Sales tax exemptions and/or income tax credits for retail within one-half mile of a transit hub in an area appropriately planned and zoned for TOD; Priority state and local assistance for projects within a TOD; Additional location efficiency incentives if TODs reduce transportation and/or parking costs due to location efficiency; Assistance and incentives for Transfer of Development Rights initiatives that transfer development away from open space that serves maximum carbon sink and sequestration benefits and toward TOD; Agreements established by the state housing agencies to maintain the long-term affordability of affordable housing within TOD/TSD as a condition of receiving state affordable housing assistance; Rewards/incentives for communities with adequate TOD/TSD ordinances.” (CAC Report 2010, Chapter 7, 26)

Discussion and Analysis

- “While expanded mass transit, improved pedestrian and cycling infrastructure, and transit-oriented development reduce CO₂ emissions and improve livability, without safeguards they may gentrify communities and displace lower-income residents. As policies are deployed to encourage low-carbon transportation, policymakers may also need to implement parallel policies for affordable housing and rent stabilization to ensure access to livable communities.” (Transforming Transportation, 2019, 17)

- “Changing land use patterns and supply of alternative transportation modes can change the relative convenience of driving, walking, biking, and taking transit. To accomplish this, New York can implement two categories of policies: those that provide more transportation options and those that create disincentives for driving by charging vehicles for the costs they impose on society.” (Transforming Transportation, 2019, 11)
- “However, the City’s transportation and climate plans do not establish a measuring stick against which its efforts to reduce VMT—the most significant driver of greenhouse gas emissions reductions since 2005—can be judged. Despite the direct relationship between VMT and the triple threats of congestion, traffic fatalities, and pollution, the City of New York does not set a specific VMT reduction target for the purposes of transportation management, traffic safety, or reduction of greenhouse gas emissions.” (S. Miller, 2018, 106)
- “Research both nation-wide and in New York City shows that off-street parking at home, which is mandated for most new construction in New York City, encourages those who have it to make journeys to work by automobile.” (S. Miller, 2018, 106)
- “Cleaner and more efficient electricity generation reduced greenhouse gas emissions from subways and commuter rail, but the bulk of citywide transportation emissions reductions, approximately 72%, came from a reduction in per-capita VMT. In other words: Transportation greenhouse gas emissions dropped in New York City mostly because New Yorkers were driving less.” (S. Miller 2018, 96)
- “In recent decades, improvements to NYC’s transit networks have occurred incrementally and often are deprioritized in favor of more acute state-of-good-repair work. In order to achieve a large-scale shift to sustainable transportation modes, the City and State must accelerate upgrades to enhance the quality, reliability, capacity, safety, and extent of our subway, bus, ferry, and rail networks. Improvements have historically not kept pace with growth and must be accelerated to achieve GHG reduction goals.” (NYC 1.5C, 2017, We Can’t Do It On Our Own, 30)
- “Without significant changes in land use patterns in New York State, the level of TOD and TSD in this policy option and those related to transit, HSR, and freight will be difficult to achieve. Further, traffic congestion and heavy traffic areas are significant environmental burdens on EJ communities across the state. Efforts to increase efficiencies and strategically promote the use of mass transit can help to ameliorate these impacts.” (CAC Report 2010, Chapter 7, 28)
- “In developing parking pricing programs, particular care should be given to implement the program so that it is not counter-productive to the State’s smart growth efforts; i.e., that it does not discourage use and enjoyment of downtown areas. For existing employer-provided parking, the State could implement a parking cash-out program with a tax credit for employers as an incentive for their participation; and for new parking in developing areas, the true cost of parking should be reflected in municipal development policies and zoning ordinances.” (CAC Report 2010, Chapter 7, 19)

Other Resources

Related Topics in this Document: Zoning for high-density & mixed-use development, Public Transit

Buildings and Energy Efficiency

Standards for New Buildings

New York Actions

- “NYSERDA’s New Construction Program (NCP) offers technical support and incentives to owners and developers of ground-up new construction or substantial renovations across all sectors.²⁷ NYSERDA project managers and expert consultants work with building owners and their design teams to analyze efficiency opportunities during the design phase as well as guide installation, commissioning, and verification during and after construction. Additional support is available for projects that are designed for deep energy savings, net zero energy, and projects incorporating smart building technologies.” (NY to Zero, 2019, 35)
- “The Net Zero Portfolio Support program assists large real estate portfolio owners, across all sectors, in developing performance standards and institutional mechanisms to enable the design, construction, and operation of net zero energy buildings. NYSERDA will provide up to \$250,000 for the development of protocols, guidance documents, employee and contractor training procedures, peer design review, prototype designs, details, and specifications, or other similar activities that apply to all future new construction or gut renovation projects.” (NY to Zero, 2019, 36)
- “The Buildings of Excellence program will promote multifamily projects that have very low energy consumption and carbon emissions, as compared to a code compliant building, and exhibit architectural and urban design quality and innovation through multiple rounds of competitive awards. Projects must demonstrate design and construction methods are replicable and can achieve broad-based adoption by both developers and consumers. Projects must also demonstrate how they provide superior financial benefits for owners and provide healthy, safe, and otherwise outstanding living environments for occupants. Selected projects will be eligible to receive up to \$1 million in direct funding as well as support for initiatives focused on broad marketing and public awareness.” (NY to Zero, 2019, 35)
- “The City will work with the New York City Council to adopt “stretch” versions of the energy code in 2019 and 2022 which could realize a 20 percent and 40 percent energy intensity reduction, respectively, over current construction standards for new and substantially renovated buildings. Beginning in 2025, all large new buildings would be required to build to very-low energy design targets. Energy design targets for new construction provide basic metrics of efficiency that a building must meet and do not prescribe methods, giving developers flexibility to reach targets. This approach can achieve significantly greater energy reductions than incremental energy code updates to specific measures. Benefits include bolstering long-term affordability of new buildings through reduced operating costs, further developing the workforce to provide energy

efficiency retrofits in existing buildings, and creating healthier indoor and outdoor spaces.” (NYC 1.5C, 2017, 10)

- “The City will launch a Commercial Property Assessed Clean Energy (C-PACE) program to finance clean energy and energy efficiency upgrades at more favorable terms. Paired with a building energy performance mandate, a PACE program in NYC has the potential to finance \$100 million annually in energy efficiency and clean energy projects. Benefits include providing an affordable pathway for building owners to implement deep energy reductions and deploy clean energy technologies.” (NYC 1.5C, 2017, 10)
- “The City is committed to helping building decision-makers pursue energy efficiency and clean energy projects. The NYC Retrofit Accelerator and Community Retrofit NYC programs currently assist decision-makers of over 4,000 buildings in identifying energy and water saving retrofit opportunities and connecting to financial and technical resources. The NYC Carbon Challenge voluntary leadership program is working with more than 100 companies and organizations that have committed to 30, 40, or 50 percent reductions in GHG emissions. The City will work to expand these and launch a new program to support the real estate industry to implement low energy design for new construction and substantial renovations. The City will release a free planning tool for high performance energy retrofit strategies for existing large buildings to achieve deep energy reductions. Benefits include lowering building energy costs for owners and residents, improving housing quality for tenants, improving skills of the workforce, and improving air quality for all New Yorkers.” (NYC 1.5C, 2017, 11)

LPDD Recommendations

- *“State legislatures should follow the lead of states like California, Hawaii, and Washington in developing advanced building and energy codes that significantly reduce the energy used by new buildings.”*
- *“State energy, commerce, or other appropriate agencies should promote voluntary programs, such as LEED for Homes and Energy Star for homes that recognize buildings for meeting energy-efficiency goals.”*
- *“State legislatures should require new buildings to obtain a construction permit or obtain a certificate of occupancy before construction can begin, and, as a condition of obtaining the permit or certificate, require them to meet an ‘energy-efficiency coefficient.’”*
- *“State legislatures should require that a minimum percentage of energy for large new buildings be derived from renewable energy, either generated on-site, obtained through a power purchase agreement, or evidenced by certified renewable energy credits, unless the building meets stringent low-energy usage criteria such as that for certified passive buildings.”*
- *“State energy, commerce, or other appropriate agencies should provide information on methods of minimizing the cost of Zero Energy Buildings (ZEBs).”*
- *“States should revise building and energy codes to provide developers of a new building with a significant head start on LEED certification by specifying energy performance requirements that will lead to LEED points.”*
- *“State legislatures or governors should establish state ZEB goals, such as California’s goals under California’s Building Energy Efficiency Standards.”*

- “State legislatures should adopt a price for carbon either through a carbon tax or through cap-and-trade systems that include new buildings.”
- “State legislatures should adopt building or electrical code standards that support the use of on-site energy storage to allow more-efficient usage of renewable energy generated on-site at new buildings.”

Related LPDD Database Pathways

- Clean Building Incentive Programs: <https://lpdd.org/pathway/clean-building-incentive-programs/>
- Improving State and Local Building Energy Codes: <https://lpdd.org/pathway/improving-state-and-local-building-energy-codes/>
- Zero Energy Buildings: <https://lpdd.org/pathway/zero-energy-buildings/>
- Natural Gas Bans in New Buildings: <https://lpdd.org/pathway/natural-gas-bans-in-new-buildings/>

Other Recommendations

- “Develop a roadmap for a statewide carbon neutral building stock which incorporates deep efficiency, more efficient heating and cooling technologies, and grid-connected capability.” (Clean Energy, 2020, 18)
- “New York is among the leaders in its pursuit of NZE building through energy code policies. After over a decade of policy and market strategies around NZE, most recently California’s Title 24-2019 residential energy code set the standard for requiring net zero or nearly net zero homes in all new construction starting in 2020. This includes requirements for on-site solar installations along with very high performance systems and envelopes. Washington State also passed a law in 2009 that essentially requires net zero energy codes for all buildings by 2031, and its energy code is on a path to meet that statutory mandate. New York is accelerating savings through energy codes with the development of a stretch energy code (intended to be implemented Statewide by 2023) and with the transition to a carbon-based code metric. Together, New York policies will help drive maximum carbon savings available through the State’s energy code.” (NY to Zero, 2019, 25)
- “A Zero Emissions Building Code requires buildings not emit greenhouse gases from on-site sources. Through these requirements, as grid energy increasingly gets cleaner and local renewable energy sources are developed, new buildings will begin to rely exclusively on clean energy. By sequencing them with adoption of residential codes in 2025 followed by commercial codes in 2028, insights and momentum can be carried forward, easing the challenge of the commercial sector.” (CA Building Roadmap, 2019, 3)
- “Implement advanced energy codes for new buildings in 2019, and achieve very low energy design targets in all new buildings and major renovations in subsequent code cycles” (NYC 1.5C, 2017, 16)

Discussion and Analysis

- “Improving new building and equipment efficiency is the last critical piece to building decarbonization. The net zero policy pathway includes ambitious efficiency improvements for building envelopes (i.e., foundation, walls, roof) as well as all new

equipment and appliances by 2050 – anywhere from 11% to 40% depending on the component. Together, these efficiency gains abate a cumulative 250 Mt CO₂e. Abatement from efficiency standards may seem low here because buildings transition to 100% clean electricity by 2050 in this scenario. Efficiency standards will drive greater GHG reductions if buildings fail to meet this ambitious target, and even if the target is reached, efficiency standards lower overall costs by reducing the amount of electricity generation capacity that must be built by 2050.” (U.S. Net Zero Emissions By 2050: Decarbonizing Buildings, 2019)

- “New buildings have a critical role to play in reducing GHG emissions. New and substantially renovated buildings that require low levels of energy will prevent future GHG emissions, reduce the need for energy efficiency retrofits, and provide ancillary benefits that increase market transformation for retrofits in existing buildings.” (NYC 1.5C, 2017, 10)
- “Clean energy and energy efficiency building upgrades require upfront capital to unlock energy savings and reduce GHG emissions. Traditional financing terms often do not match the longer payback period of clean energy or energy efficiency upgrades, which prevent owners from pursuing projects that could result in long-lasting operational savings. PACE is a financing mechanism that treats clean energy and energy efficiency upgrades as a public benefit – like a new sewer, water line, or road – and allows upgrades to be financed through property bills with no money down. PACE has been used to finance projects with higher upfront costs and longer payback periods by underwriting to energy savings.” (NYC 1.5C, 2017, 10)

Other Resources

Related Topics in this Document: Standards for existing buildings, building automation systems, building heating systems

[Most NY recent stretch code advancement, Net Zero & High Performance Buildings Report](#)

Standards for Existing Buildings

New York Actions

- “NYSERDA's Multifamily Performance Program provides support to Affordable Buildings to complete whole building upgrades that target a minimum of 20% source energy savings. Incentives: Incentives ranging from \$700-\$1,500 per apartment unit depending on expected percent savings, which include an available performance payment once savings are demonstrated.” (Retrofit Accelerator, 2020)
- “NYSERDA's Multifamily Performance Program's High-Performance Component targets a minimum of 40% source energy savings and a source Energy Use Intensity (EUI) score of 100 for affordable building owners. To help reach the EUI score, building owners are encouraged to tap into additional NYSERDA incentives available to integrate on-site generation, including solar, wind, and combined heat and power, into their upgrade plans. Incentives: Incentives are \$3,500 per apartment, which include an available performance payment once savings are demonstrated.” (Retrofit Accelerator, 2020)

- “Con Edison's Commercial & Industrial Program offers incentives for installing energy efficient technologies for all gas customers through custom and prescriptive rebates. Equipment rebate. \$2/therm up to 50% of project cost.” (Retrofit Accelerator, 2020)
- “National Grid - High Efficiency Commercial Gas Equipment Incentives - National Grid's primary commercial program provides incentives for high-efficiency gas equipment, controls and insulation to reduce the cost difference compared to standard efficiency equipment as well as no-cost installation of water saving products. Incentives: Up to \$12,000 prescriptive rebate on heating equipment or custom incentives up to 50% of project costs to a maximum of \$100,000” (Retrofit Accelerator, 2020)
- “NYSERDA's Industrial and Process Efficiency (IPE) program offers performance-based incentives to help manufacturers, data centers, and other production facilities implement energy efficiency and process improvements to increase output and improve processing as efficiently as possible. Incentives: Performance-based incentives with a minimum of \$25,000 and maximum 50% of project cost up to \$2 million per company” (Retrofit Accelerator, 2020)
- “NYC Department of Housing Preservation and Development's (HPD) Preservation Finance programs provide financing to facilitate the physical and financial sustainability and affordability of privately owned multifamily buildings throughout New York City. In addition, HPD recently launched the Green Housing Preservation Program to provide no- and low-cost financing for energy efficiency and water conservation improvements, along with moderate rehabilitation work, for small- to mid-sized multifamily buildings that are greater than 5 units and less than 50,000 square feet (approximately 50 units).” (Retrofit Accelerator, 2020)
- “NYC Housing Development Corporation's (HDC) Program for Energy Retrofit Loans offers financing for energy efficiency improvements and fuel conversions for multifamily properties currently in HDC and HPD's portfolio. HDC is a public benefit corporation created by the New York state legislature to provide financing for multifamily affordable housing.” (Retrofit Accelerator, 2020)
- “NYC Climate Mobilization Act - The NYC Climate Mobilization Act is a package of bills which represent a path for NYC to reach carbon neutrality by 2050. The centerpiece of the law is Local Law 97, which requires buildings over 25,000 square feet to cut climate emissions 40% by 2030. This requirement covers approximately 50,000 existing residential and commercial buildings and nearly 60 percent of the city's building area – 3.15 billion square feet.” (Clean Energy, 2020, Policy Framework, 5)
- “Establishes emissions caps for buildings over 25,000 square feet. This bill also establishes the Office of Building Energy and Emissions Performance.” (Climate Mobilization Act 2019)
- “The Net Zero Energy for Economic Development Program is a multi-round competition that provides eligible New York State commercial, industrial, and institutional applicants with incentives for the construction of, or renovation to, existing buildings designed to achieve NZE performance. All projects must demonstrate that they will help achieve the goals of their Regional Economic Development Council's Strategic Plans or State Priority Areas. Incentives are available for the incremental cost of design, construction, and installation of all technologies (as compared to the cost to build/renovate to a code compliant standard) utilized to achieve NZE performance. Funding to support the

planning and design for community and campus scale net zero development and redevelopment will be added to the program in 2019.” (NY to Zero, 2019, NYSERDA Programs, 35)

- “NYStretch Energy Code-2019 (NYStretch) is NYSERDA’s latest voluntary, locally adoptable stretch energy code, drafted with guidance from a 25-member advisory group composed of public and private stakeholders. A stretch code is a code adopted by a jurisdiction that “stretches” beyond the State energy code as an alternative local option for new construction. NYStretch Energy Code-2019 is roughly 10% to 15% more efficient than the residential provisions of the 2015 International Energy Conservation Code (IECC) and the commercial provision of ASHRAE 90.1-2013. NYSERDA’s goals for this effort are to produce a stretch code that lowers energy use and GHG emissions associated with new and existing buildings and provide a set of building regulations that are: Readily adoptable with minimal changes by local governments and written in enforceable language, coordinated with the New York State Uniform and Energy Codes, Approximately a cycle ahead of the current New York State Energy Code in its requirements, Cost-effective and regionally appropriate and Mandatory Statewide beginning with the 2022 code cycle” (NY to Zero, 2019, 30)
- “The goal is to optimize energy efficiency, district thermal energy, and renewable energy generation among multiple buildings so on-site renewable energy can offset the energy use at a district scale. NYSERDA is working with districts, communities, and large-scale redevelopments, including the Western New York Manufacturing Zero Energy District, through its Net Zero Energy for Economic Development program. This large scale NZE district development is the first of 10 projects in the program and was funded in December 2018.” (NY to Zero, 2019, Leading with Districts, 11)
- “Beginning with the affordable multifamily sector, RetrofitNY is catalyzing the creation of low-cost, standardized, scalable solutions, and processes to bring existing buildings to NZE or near-zero performance levels, saving money for owners and tenants while improving the quality of life for residents. Through multiple rounds of competitive awards, RetrofitNY is working to bring a large number of affordable housing units to or near-net zero energy use by 2025 and provide new business opportunities in New York. RetrofitNY collaborates with a variety of industry stakeholders, including property owners and developers, solution providers, lending organizations, and regulators to develop innovative solutions for multifamily housing renovations that will also serve as a template for other building sectors. RetrofitNY is transforming the building renovation industry through these key actions: Aggregate demand among building owners, harnessing their collective market power, Mobilize the building industry to develop innovative technical solutions to substantially improve affordable housing buildings while residents continue to live in their apartments, engage with manufacturers to help drive innovation, availability, and cost compression of relevant technologies, Work with financial organizations to fund projects by capturing energy savings and Engage regulatory agencies to help facilitate widespread adoption” (NY to Zero, 2019, NYSERDA Programs, 34)
- “The 80x50 Buildings Partnership is a collaboration between leading New York City stakeholders to develop smart climate change policies. The result of eight months of discussion and 85 meetings, the “Blueprint for Efficiency” provides a practical policy

framework to reduce emissions in large buildings by 2030, as well as the infrastructure to deliver improvements at scale through 2050. Twenty-one detailed proposals shape this world-leading energy performance policy, including:

- Require each building sector to save 20% in source energy use from 2020 to 2030
 - Create a metric based on Energy Star calibrated to NYC specific building data
 - Regulate all energy sources together, with smaller reductions required of more efficient buildings
 - Include flexible compliance pathways, such as green power purchase and efficiency credit trading
 - Dramatically expand support and financing to help owners comply with particular focus on sectors that need more help
 - Encourage electrification
 - Focus first on less efficient buildings
 - Require less of rent-stabilized housing to limit owner passthrough of costs in rent hikes” (NY to Zero, 2019, 9)
- “NYCHA is creating healthy and comfortable homes to withstand the challenges of climate change and is participating in the NYC Carbon Challenge, which commits NYCHA to a 30 percent reduction of GHG emissions by 2027. In order to meet this target, NYCHA is reducing energy use per square foot 20 percent by 2025 and installing 25MW of solar capacity by 2026. In existing multifamily buildings, NYCHA is installing LED lights, upgrading ventilation, modernizing heating and hot water systems, and piloting new distributed generation technology. These efforts are integral to NextGeneration NYCHA, the Authority’s 10-year strategic agenda to preserve public housing.” (NYC 1.5C, 2017, Agency Highlights, 33)
 - “City operations account for 5 percent of citywide GHG emissions. In 2015, the City committed \$2.7 billion to retrofit City-owned buildings. The City must accelerate the pace of deep energy retrofits throughout its portfolio to achieve citywide climate goals and lead by example. This year, the City will launch a new program to prioritize buildings across agencies in which to implement a range of energy conservation measures at scale. The City will also commit agencies to achieve an additional 20 percent energy reduction across their portfolios by 2025. Benefits include reducing operating expenses for the City, improving air quality and health, and demonstrating leadership to influence market transformation.” (NYC 1.5C, 2017, 9)
 - “New York should aggressively update and consistently enforce the State Energy Conservation Construction Code (SECCC or State Energy Code), and provisions of the Uniform Fire Prevention and Building Code (such as water conservation) that have an energy impact. In addition to the State-mandated base code (SECCC), local municipalities should be given the choice to adopt a State-set stretch code,⁶ as recommended in the 2009 State Energy Plan. The prescriptive SECCC should increasingly become performance-based and include sustainable and whole building design provisions through the adoption of International Energy Conservation Code (IECC), the International Green Construction Code, and the National Green Building Standard (International Code Council [ICC] 700). To facilitate code compliance, the State should establish a flexible framework by 2015 that allows municipalities, which often lack the necessary resources or expertise, to enforce codes through inter-municipal

and county-level agreement or through the services of privately operated, accredited or licensed third-party oversight entities. Third-party certification, training, and project-certification fees could help fund code compliance activities.” (CAC Report 2010, 6, 14)

LPDD Recommendations

- *“State governments could integrate certification of existing buildings for decarbonization with energy benchmark-ing, energy audit or usage disclosure, or retrofiting regulations.”*
- *“State government should consider measures to encourage fuel switching to electricity in partnership with electric companies, further to the efficiency and heat pump investments adopted by the PSC in Case 18-M-0084 (‘Order Authorizing Energy Efficiency and Building Electrification Portfolios through 2025’).”*
- *“State governments should further encourage the use of PACE programs for financing energy-efficiency improve-ments in commercial buildings.”*
- *“States should consider adopting policies that retrofit and electrify their existing buildings, both owned and leased, to achieve deep decarbonization.”*
- *“States should enact laws requiring that building owners who presently use fossil fuel for space and water heating must retrofit their buildings by electrification if a federal mandatory law is not obtainable.”*
- *“States should require an energy audit upon the sale or rental of existing homes and commercial properties if the federal government fails to do so.”*
- *“State legislatures should adopt mandatory retrofit laws for energy conservation and decarbonization in existing commercial and residential buildings if the federal government does not do so.”*

Related LPDD Database Pathways

- Fuel Switching: <https://lpdd.org/pathway/fuel-switching/>
- Building Energy Performance Standards: <https://lpdd.org/pathway/building-energy-performance-standards/>
- Retrofitting Existing Buildings: <https://lpdd.org/pathway/retrofitting-existing-buildings/>

Other Recommendations

- "Implement long-term energy intensity requirements in existing buildings; Accelerate deep energy retrofits to achieve a 20% deeper reduction in energy consumption in City-owned buildings by 2025; Continue progress toward New York City Housing Authority’s (NYCHA) climate commitments, including 20% reduction of energy use per square foot by 2025; Advocate for incentives to support deep energy retrofits focusing on preserving affordability; Provide energy use information to more building owners, managers, staff, tenants, and residents, including by requiring energy disclosure at point of sale and energy grades for large buildings; Help a broad range of building decisionmakers implement energy efficiency and clean energy projects, prepare the market for substantial improvements in the energy code, and recognize NYC industry leaders” (NYC 1.5C, 2017, 2020 Climate Actions, 16-24)

- “Develop and publish Carbon Neutral Buildings Roadmap.” (Clean Energy, 2020, Greenhouse Gas Emissions Reduction, 10)
- “Develop a long-term roadmap for advancing all-electric clean homes and buildings in New York consistent with the goals of a carbon-neutral economy.” (Clean Energy, 2020, Electrification of Buildings, 35)
- “Help communities across New York implement their own sustainability and clean energy goals, including coordinating with NYC on Local Law 97.” (Clean Energy, 2020, Greenhouse Gas Emissions Reduction, 10)
- “Empire Building Challenge - to demonstrate scalable and replicable solutions for high profile commercial and multifamily buildings” (Clean Energy, 2020, Energy Efficiency: Highlighted Programs and Initiatives, pg. 19)
- “The Netherlands’ building decree (Bouwbesluit) (Netherlands): In 1992, the Netherlands implemented the first Bouwbesluit, a decree affecting a wide range of issues related to construction, including environmental impacts, health and safety. In 2018, this legislation was the first in the world to impose limits on embodied carbon emissions from buildings. Key characteristics: All new residential and office buildings must account for embodied carbon emissions and 10 other impact categories (including health impacts) using an LCA based on the national methodology since 2013. The LCA calculation is reduced to a single metric, pricing all impact categories of the LCA. The final figure is thus expressed in euro/m². For carbon, a price of €50 per tonne is applied. Since January 2018, the mandatory environmental impact cap for offices and residential buildings has been set at 1 euro/m²/year.” (Embodied Carbon, 2019, 50)
- “GOAL 1: Customers, builders, contractors and policy-makers are aware of and demand building decarbonization measures. GOAL 2: Customers receive a good value from adopting building decarbonization measures. GOAL 3: Building decarbonization provides a better value to builders and contractors than fossil-fuel heating. GOAL 4: Supply-chains and delivery agents are able to meet rising demand for carbon-free building technologies with a quality product. GOAL 5: Policies are aligned to maximize customer awareness of and interest in building decarbonization, the customer, builder and contractor value proposition, and the industry’s ability to meet rising demand.” (CA Building Roadmap, 2019)
- “DOE is continuing to implement projects that reduce consumption of fossil fuels, including system optimization, weatherization, capital replacements of inefficient and obsolete building systems, and optimized facilities operations and maintenance. DOE accounts for over 25 percent of the City’s demand response program and will continue to enroll all viable buildings within its 1,400 buildings, install solar PV where feasible, and implement an energy analytics platform. SCA is implementing compliance with Local Law 31 of 2016, which requires newly built or majorly retrofitted City buildings to be designed to a very low energy target. SCA is increasing student capacity by building new schools that provide safe, attractive, and environmentally sound spaces through capital improvements for the roughly 1,400 existing NYC public school buildings. SCA is also partnering with other NYC agencies to realize best design, construction, and procurement practices.” (NYC 1.5C, 2017, Agency Highlights, pg. 35)
- “A whole-building, integrated analysis approach will be used to identify efficiency measures that could be installed in existing buildings to achieve the economic potential,

including building envelope, lighting, HVAC (heating, ventilating and air conditioning), insulation, monitoring or control systems, plug-load, and CHP (combined heat and power). Onsite renewables providing a portion of the buildings' electricity load, industrial process efficiency and building commissioning would be incentivized through other RCI policy actions. R&D incentives would accelerate the development and commercialization of new, lower cost, higher performance products and technologies... The policy incentive structure is in the form of loans and direct payments to buy down the cost of installed efficiency measures. Funds for the incentives will be provided by Efficiency and Clean Energy Fund (RCI-1) and other sources, such as federal and foundation grants, and corporate contributions. Participants in the incentive programs would provide co-funding for their projects. ” (CAC Report 2010, 6, 19)

- “In low-income, high-density communities, where problems with basic maintenance and upkeep of residential buildings are not uncommon, it will be even more challenging to ensure that building owners invest in code-mandated improvements. Targeted mechanisms for incentivizing action in these communities may be needed... Consistent with the “ability to pay” relief mechanism outlined in RCI-7, the State could explore establishing tandem scaled incentives for owners of existing buildings and affordable housing that face extreme financial hardship upgrading their buildings. ” (CAC Report 2010, 6, 20)
- “Existing buildings would be subject to energy efficiency upgrades, and the corresponding code compliance requirements, through the following: Building Commissioning, Benchmarking, and Upgrades (RCI-8) mandated benchmarking requirements, which may be triggered at the time of sale of a building or in conjunction with periodic energy audits, as well as Voluntary building renovation or alterations, which may be triggered when a building owner applies for a building permit.” (CAC Report 2010, 6, 15)

Discussion and Analysis

- “Recent studies of energy efficiency in subsidized housing found these properties to be far less efficient than similar market-rate housing, which suggests that significant opportunities exist to improve the quality of the low-income housing stock.” (Kontokosta et al, 2020, 310)
- “Drive deeper levels of efficiency and carbon savings in buildings using a variety of strategies including peer-based challenges, support of long-term energy planning within the capital improvement cycle, and development and demonstration of new solutions to deliver higher performing/healthier buildings... In partnership with utilities, launch a comprehensive building electrification initiative with consumer incentives and market support to move New York toward all-electric homes and buildings and accelerate transition away from natural gas and fossil fuel... Support statewide improvement in energy efficiency through improved appliance standards and adoption of advanced building codes, with a goal of establishing a statewide mandatory net zero-carbon building code by 2031.” (Clean Energy, 2020, Energy Efficiency, 18)
- “Retrofits are another important way to accelerate building stock turnover by increasing the efficiency of existing buildings. Most of the buildings that will still be standing in 2050 have already been built – but high costs dissuade owners from making efficiency

upgrades that carry significant GHG abatement potential. A program offering financial incentives for retrofits, ideally targeting between 1% to 2% percent of U.S. homes and commercial buildings per year, is an ambitious but reasonable goal in line with targets in global building efficiency leader Germany. In the net zero policy pathway, retrofitting roughly 1% of homes and 1.5% of commercial buildings each year abates a cumulative 850 Mt CO_{2e}.” (U.S. Net Zero Emissions By 2050: Decarbonizing Buildings, 2019)

- “States like Massachusetts and Maine are also implementing policies to accelerate building electrification and reduce natural gas consumption in buildings. This trend could accelerate as more and more states and cities set 100% clean electricity targets, which is at odds with continued natural gas pipeline expansion.” (U.S. Net Zero Emissions By 2050: Decarbonizing Buildings, 2019)
- “Fundamental energy efficiency policy needs to be strengthened at the State level, and only then can the City implement its own actions to unlock opportunities. As stated earlier in this article, the lack of aggressive statewide energy efficiency policies, such as those in California, Massachusetts, and Rhode Island, is a barrier to reaching 80x50. Without high-performance buildings optimizing their own energy use, repurposing Con Edison’s distribution grid to support electrification (and reduced reliance on fossil fuels to provide heat and hot water) will be impossible. And the government of City of New York, despite its best efforts, does not have enough control over the policy tools that must be used to foster meaningful progress on energy efficiency.” (Kass, 2018, 55)
- “Energy efficiency is also crucial to decarbonizing the grid. Energy-efficient retrofits of existing buildings and highly efficient new buildings lower the city’s overall grid load. Some advanced energy efficiency measures—such as controls with information and communication technology—effectively turn buildings into battery storage, and manage demand over the course of the day and the seasons, balancing the grid and reducing peak periods. Without substantial energy efficiency, 80x50 is not attainable... The City’s sphere of influence over the energy system is limited. State-level directives are needed to incentivize Con Edison to invest in behind-the-meter energy efficiency just as it does with grid infrastructure. REV is intended to advance energy efficiency, but its current implementation trajectory is not sufficient to achieve the levels of efficiency needed to reach 80x50 in New York City. State policies in Massachusetts, Rhode Island, and California, for example, call for utilities to achieve 2.5% to 3.0% year-over-year load reductions through energy efficiency, and this is enforceable by way of specific targets in utility regulations. New York has no such targets or mandates. The Clean Energy Standard assumes energy efficiency will contribute to the State’s 50% by 2030 target—at a rate of about 1.5% in incremental reductions each year. Utilities, however, do not have distinct energy efficiency goals beyond short-term, modest “Energy Efficiency Transition Implementation Plan” requirements established by the New York State Public Service Commission (PSC) for the changeover to REV.¹⁰ Energy efficiency is critically important to the grid, particularly because of the demands the grid will face with the anticipated and potentially dramatic growth of electricity use in building heating systems and transportation over the coming decades.” (Kass, 2018, 45)
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- “In NYC, fossil fuels burned in buildings for heat and hot water are the biggest source of GHG emissions, accounting for 39 percent of the citywide total. The burning of these fuels also contributes to air pollution that causes asthma, bronchitis, and premature death, particularly among children and seniors. Reducing on-site fossil fuel use and requiring today’s worst performing buildings to operate efficiently is a prerequisite to achieving the City’s climate goals. The City will pursue legislation to require that all large buildings limit fossil fuel use below intensity targets by 2030 and 2035. This is the single largest action the City will implement to reduce GHG emissions and will affect over half the built floor area in NYC. This action will also require setting energy intensity requirements that take into consideration impacts on utilities, specific tenant uses, and economic activity. Benefits include avoiding 40 premature deaths and 100 emergency room visits annually through air quality improvements and creating 17,000 construction-related jobs by 2030.” (NYC 1.5C, 2017, 9)
- “As the State designs its incentive structure, it is encouraged to consider the savings to the end-user, the societal benefits of reduced GHG reductions as well as the co-benefits to New York, such as reduced energy demand, offsetting the need to site and build energy infrastructure, and reduced health care costs associated with improved air quality. This policy could have a direct positive co-benefit on jobs based on energy audits and increased installation and maintenance of energy efficiency measures. Properly installed energy efficiency measures, in accordance with a whole building approach, can also help building owners reduce their energy bills and increase occupant comfort.” (CAC Report 2010, 6, 21)
- “The State Energy Code should accommodate all building types and apply energy efficiency performance thresholds that are appropriate to an aggregated building classification framework, e.g., residential, commercial, institutional, versus industrial buildings, and new versus existing buildings. The State should also explore requiring

government owned and operated buildings to meet this policy’s scenario. To avoid discouraging building renovations, the State should consider establishing a regulatory “ability to pay” relief mechanism that adjusts the required level of "incremental" retrofit when owners of existing buildings and affordable housing have demonstrated that they would suffer extreme financial hardship through satisfaction of the required retrofit work.” (CAC Report 2010, 6, 16)

Other Resources

Related Topics in this Document: Standards for New Buildings, Building Automation Systems, Building Heating Systems

[NY PACE Program](#), [NY Executive Order 88](#)

Smart Thermostats

New York Actions

- “Con Edison also offers increased incentives on Smart Thermostats to residents who live in the Brooklyn Queens network... rebates on smart thermostats” (Retrofit Accelerator, 2020)
- “The ConEdison Smart AC program provides technology that allows customers to remotely control their room AC's through an app to earn rewards for reducing usage during peak hours. Incentives: Get \$25 or more in rewards by enrolling a standard window air conditioner, and \$95 or more by enrolling a Wi-Fi air conditioner.” (Retrofit Accelerator, 2020)
- “State senate Bill 1617: Provides residential electric customers with an option for greater control of the cost of such service by installing real time smart meters; establishes sales, rental and service providers to be certified by the public service commission.” (S1617 2019)
- “Advanced Metering Infrastructure (AMI) Rollout. In 2015, Con Edison announced a \$1.3 billion investment in an installation of five million smart meters across its customer portfolio by 2022. The new meters, combined with the explosion of software interfaces using the higher-resolution customer data, bring tremendous opportunities. AMI will facilitate more demand response and new forms of energy efficiency, and has the power to integrate battery storage and distributed solar. The propagation of smart meters and their data will also improve customer experience, and create more value for residents and businesses considering clean distributed energy solutions.” (Kass, 2018, 48)

LPDD Recommendations

- *“The State should adopt incentives that enable customer behavior/investment choices, including decoupling, customer demand response, and deployment of smart metering, as several utilities are currently exploring through demonstration projects under the Reforming the Energy Vision proceeding, including Smart Home Rate demonstration projects.”*
- *“State PUCs should authorize utilities to install smart meters.”*

Related LPDD Pathways

- Smart Meters: <https://lpdd.org/pathway/smart-meters/>
- Time of Use Rates: <https://lpdd.org/pathway/time-of-use-rates/>

Other Recommendations

- “After a series of pilots, California’s PUC adopted a decision (2018) guiding the state’s three major investor-owned utilities to roll-out time of use rates across the state. The move is expected to affect twenty million consumers.” (LPDD <https://lpdd.org/resources/california-time-of-use-puc-decision/>)
- “Install smart meters and feedback tools; e.g., in-home displays, to convey price and consumption data, and implement rate structures, potentially including critical peak pricing or peak-time rebate programs, that encourage reductions in peak usage and shifting of usage to off-peak hours, along with public education and outreach programs.” (CAC Report 2010, 6, 31)

Discussion and Analysis

- “A simple example of an intelligent efficiency measure is a learning thermostat (e.g., Nest or ecobee) that monitors home temperature and occupancy, weather, and other parameters and finds ways to improve heating and cooling system operation after learning a household’s patterns (e.g., when people are home and which temperatures they like).” (Halfway There, 2019, 8)
- “Consumers Energy, a Michigan-based utility, Google and Uplight will provide Google Nest thermostats to up to 100,000 households, while automatically enrolling these customers in a demand response program to shift energy use from peak summer hours. It is the largest such program in the United States. Households that aren’t eligible for a Google Nest Thermostat E can receive a free Consumers Energy Care Package, which includes four LED bulbs and three night lights, and are enrolled in the Peak Time Rewards program, which encourages customers to shift their energy use away from peak times, typically 2-7 p.m. weekdays in the summer. This offer is part of Consumers Energy’s Clean Energy Plan, which aims to eliminate coal and achieve net-zero carbon emissions.” (LPDD, Michigan Smart Thermostat Giveaway, <https://lpdd.org/resources/michigan-smart-thermostat-giveaway/>)

Other Resources

Related Topics in this Document: Building Energy and Emissions Disclosure

Green, White and Cool Roofs

New York Actions

- “The Green Infrastructure Grant program provides grants for private property owners in combined sewer areas of New York City for design and construction of green infrastructure systems to manage 1 inch of storm water runoff from the contributing

impervious area. Grants fund the design and construction costs with a minimum of \$35,000.” (Retrofit Accelerator, 2020)

- “During the Bloomberg administration the City established the NYC CoolRoofs program, which provides select buildings with cool roof installations at no cost or low cost, with priority given to not-for-profits and affordable housing. The City should fund an expansion of the program to include more roof types and capture more homes in heat vulnerable and EJ communities by: (i) including pitched roofs (currently the program seems to be limited to roofs that are “flat” even though Local Law 94 of 2019 established reflectance requirements for roofs with a pitch over 17%); (ii) expanding beyond roofs in good condition to include those where the City could provide the additional service of remediating simple blisters, cracks, or peeling paint at no cost or low cost prior to applying the cooling coating; and (iii) ensuring that the program is available for roofs constructed from the full range of materials to which the cool roof coating can be applied (bitumen, EDPM rubber, and smooth aluminum have been mentioned as acceptable materials, but the full range of practicable materials is unclear). Additionally, the Department of Buildings could be required to document the presence, or lack thereof, of a cool roof whenever conducting an inspection of such roof, and if present, the materials used should be documented as well. Tracking cool roofs will help the City target resources, enforce existing requirements, and measure the effectiveness of this program in reducing the heat island effect.” (Securing Our Future, 2020, 52)
- “New York City’s Climate Mobilization Act is an umbrella term for a set of laws, including Local Laws 92 and 94 (established through Int. 0276 and Int. 1032), which require certain existing building roofs must be covered in green roofs or PV, including certain new construction. Local laws 92 and 94 of 2019 established NYC’s green roofs requirements. New buildings and existing buildings undergoing major renovations in specific occupancy groups defined in the New York City Building Code are required to have a 100% of the available roof space as a sustainable roofing zone. A sustainable roofing zone is covered in a green roofing system and/or solar panels and/or wind turbines. Currently, only 1 in one thousand buildings have a green roof in New York City.” (Climate Mobilization Act 2019)
- “SBS is developing the workforce needed to achieve 80 x 50 and delivering on the mayor’s promise to train 3,000 workers with new skills needed for the emerging green economy through a partnership with the NYC Green Jobs Corps and the Buildings Construction Trades Council. Through the NYC CoolRoofs initiative, SBS is providing local job seekers with training and work experience in the installation of energy-saving reflective rooftops. SBS is committed to expanding services for immigrant populations and women entrepreneurs as well as increasing equitable access to economic opportunities for New Yorkers in need of services.” (NYC 1.5C, 2017, 35)

Related LPDD Pathways

- Green Roofs Policies: <https://lpdd.org/pathway/green-roofs-policies/>
- Green Roofs: <https://lpdd.org/pathway/green-roofs/>

Recommendations

- “The City Council will consider legislation expanding reflectivity or “cool roof” requirements to reduce the urban heat island effect. More cool roofs will lower the amount of heat absorbed by the roofs of buildings, helping the roof structure to last longer while also reducing the indoor temperature and the amount of energy used to cool a building. Legislation could broaden the applicability of the current law and narrow the existing exceptions. Specifically, pursuant to Local Law 21 of 2011, new buildings and existing buildings, where a roof covering has been altered or replaced, must comply with the Building Code’s reflectivity (i.e., cool roof) requirements. This could be expanded to extend roof reflectance requirements to buildings where other exterior work is occurring. Furthermore, the current law includes surface area exceptions that could be reduced or eliminated. For example, the current law does not apply to existing buildings where the area of the roof being recovered or replaced is less than 50% of the roof area and less than 500 square feet. Existing exemptions could also be narrowed for roof materials made of glass, metal, clay, concrete tile, plastic, or rubber, as many of these materials can be developed to incorporate levels of reflectance with a cooling effect.” (Securing Our Future, 2020, 51)
- “The City’s bus stops present opportunities to cool passengers and beautify neighborhoods. For example, green roofs and the vegetation comprising such roofs, help to combat the urban heat island effect by providing greenery that lowers surface and air temperatures. Recently, the City of Utrecht in the Netherlands announced that bus stops will be receiving green rooftops covered in succulents, which supports pollinator populations, and are also capable of storing rain water, capturing dust particulates from the air, and providing cooling. Philadelphia has also implemented a similar project. New York City should pilot the use of green roofs on bus shelters. The City should also greenscape neighborhoods by installing tree pits and planting trees near bus stops to provide shade to riders where a bus shelter is not available.” (Securing Our Future, 2020, 61)
- “To lower the urban heat island effect and reduce energy demand, states and cities should require cool roofs, green roofs, or solar panels for new buildings and reconstructed roofs where the geometry of the architecture allows it. Incentives such as tax credits should be provided to help owners retrofit existing buildings.” (Heat Waves, 2018, 543)

Discussion and Analysis

- “Green roofs have vegetation that absorbs rainwater, provides insulation, and combats the heat island effect. Urban environments generally have higher temperatures than surrounding areas. Since green roofs add substantial weight to a building’s structure, one must always hire a Professional Engineer or Registered Architect to perform structural analysis to determine if the existing roof can support the added load without modification.” (Rogovich, 2019)
- “Regionally, additional GHG reductions can be achieved through direct investment in local building retrofit programs that can pay for cool roofs, solar panels, solar water heaters, smart meters, energy efficient lighting, energy efficient appliances, energy efficient windows, insulation, and water conservation measures for homes within the geographic area of the project.” (CA Scoping Plan, 2017, 124)

Other Resources

Related Topics in this Document: Standards For New Buildings, Standards For Existing Buildings

Solar Hot Water

LPDD Recommendations

- “State Legislatures or local governments should enact mandates for low-carbon hot water systems appropriate for their regions, or, alternatively, for zero-energy buildings.”
- “As an alternative to mandates, the state or local governments should fund incentives to decarbonize hot water delivery, such as NYSERDA’s expired PON 3221, through a variety of technologies appropriate to their regions and grid demands.”

Related LPDD Database Pathways

- Low Carbon Hot Water Systems: <https://lpdd.org/pathway/low-carbon-hot-water-systems/>

Other Recommendations

- “Implement dual purpose building envelope integration - Solar thermal module is fully integrated into a roofing panel or other building element. Eliminates redundant installation labor. Protects components. Improved aesthetics. Maximizes absorber area.” (Martin, 2018)
- “Example: Velux Collectors: Roof-integrated design, Partial integration, Structure and appearance similar to skylight, Removes roof covering but mounts above roof deck., Piping and electrical connections under the collector for protection and aesthetics” (
- “Recommendations: More Support for Solar Pool Heating. Promote use in agricultural and industrial applications (Crop drying, dairies, ag building heating, breweries, commercial laundries, canneries, various industrial processes. Promote uses with diversity (e.g. multi-family, institutional).” (Martin, 2018)

Discussion and Analysis

- “To provide heat supply after sunset, molten salt thermal storage is also required. Molten salt’s maximum working temperature of 560°C defines the upper practical limit for industrial use.⁶² Next-generation molten-salt technology must exceed 800°C for many industrial applications. Even when thermal storage is available, the reliability of CSP would be hampered by seasonal variation. The CSP is operating with essentially zero operating cost and can keep producing value for 30-plus years if designed and operated properly. Fuel costs are effectively zero for CSP and the CSP levelized cost of electricity (LCOE) systems’ costs have continued to drop, suggesting possible future applications in low-medium temperature systems (e.g., petrochemicals), provided such facilities are located in appropriate solar resource geographies.” (Low Carbon Heat, 2019, Solar Thermal, pg. 28)

- “Challenges to solar water heating: More “sustainable” water heating options, Rapid cost reductions for PV, Persistently low natural gas prices, Roof space and Fewer incentive and rebate programs” (Martin, 2018)
- “Solar water heating can be an effective and efficient option for many applications, but not necessarily the best solution for all applications in situations and is no longer the only “green” solution on the market.” (Martin, 2018)
- “Dual Purpose: Daylighting - Application seeks to extend the purpose of fenestration to include solar thermal collection. Different designs impede opacity to different extents. Balance between functions of solar thermal, solar control and daylighting. Some employ active controls to switch between functions. Utilize common elements between skylights and glazed collectors.” (Martin, 2018)
- “Dual Purpose: AC System Integration Geothermal systems have long used a desuperheater to extract heat from geothermal loops to heat water. Systems like the this Fire and Ice System seek to do the same with solar. Integration between complimentary systems allows for use of thermal energy that would otherwise be lost.” (Martin, 2018)
- “New form factors and geometries are breaking the mold. Brings new value propositions and solutions to old problems. Open up new applications for solar water heating. Advanced materials and technologies are breathing new life into “traditional” collector Designs.” (Martin, 2018)
- “Nanomaterials maximizing solar absorption. Advanced controls enabling load shifting, demand management, user programmability and predictive algorithms. Remote monitoring and optimization. Manufacturing methods that enhance absorber – riser tube coupling.” (Martin, 2018)

Other Resources

Related Topics in this Document: Thermal Storage

Building Heating Systems (End Use Electrification)– Electrification, Heat Pumps

New York Actions

- “A January 2020 Public Service Commission order established a target to save 3.6 TBtu by 2025 through a statewide heat pump initiative (in a collaboration between utilities and NYSERDA). There is no regulatory directive that existing equipment be a certain type. The order directed staff to finalize revisions to heat pump savings estimation approaches for inclusion in the state Technical Resource Manual, and also called for a statewide heat pump EM&V study to be completed by June 2022 in an effort to further refine savings estimation approaches. Fuel-switching policies and programs have been established through the adoption of fuel neutrality for NYSERDA’s Clean Energy Fund, which administers programs Statewide. In April 2018, NYSERDA’s New Efficiency: New York white paper and subsequent December 2018 Commission order established a fuel-neutral 2025 energy efficiency target of 185 TBtus of cumulative, site energy savings, aggregating efficiency achievements across electricity, natural gas, and delivered fuels

such as oil and propane. The order also called for a minimum Tbtu heat pump savings target and clarified that electric sales increases from heat pumps and other forms of beneficial electrification would be netted against electric efficiency achievements so that they do not count against the achievement of targets. A December 2018 PSC order also specified that in order to take full advantage of cost-effective opportunities and reduce program costs, utility programs may be extended to customers whose primary heating fuel is a delivered fuel with certain restrictions designed to ensure measurable savings (listed in p. 34 of the Order).” (Berg & Cooper, 2020, 11)

- “The PSC has clearly taken note of the urgent need to harmonize its regulation and oversight of gas utilities with the requirements of the new law: on March 19, 2020, the Commission issued an order initiating a proceeding to examine various planning and operational practices of gas utilities. The order specifically notes the need for gas planning to be better aligned with policy, including the CLCPA. Notably, however, the order does not characterize Public Service Law § 31 as a problem to be solved in that proceeding; rather, the fossil fuel subsidy arising from Section 31 is characterized as simply a feature of the statutory framework within which the Commission is operating.” (Gundlach & Stein, 2020, 22)
- “New York State will be investing over \$450 million in heat pump incentives through utilities and over \$200 million in market enabling support through NYSERDA. a complete transformation in how New Yorkers heat and cool buildings, moving from fossil fuel-based systems to all-electric clean energy homes and buildings. This new initiative, called NY-Clean Heat, will pair consumer incentives with market- enabling initiatives to deliver electrification solutions to New Yorkers. By increasing the adoption of cutting-edge clean energy technologies such as air source and ground source heat pumps, building electrification will become a critical component of the transition to a carbon-neutral economy as directed by the CLCPA. The initiative will transform the marketplace for heating in New York, and initial activities will be designed to grow the clean heat installer market and deliver a 20% reduction in installation cost by 2025, putting New York at the center of the regional market for these technologies in the Northeast. These efforts will also specifically seek to grow New York’s green economy by incorporating efforts to attract global supply chain investments in this new and significant market for the industry. The building electrification initiative will also prioritize investments in and support for low-income New Yorkers, improving energy affordability and health outcomes, and advancing the objectives of the CLCPA.” (Clean Energy, 2020, Electrification of Buildings, 34)
- “Clean Heat Regulations. In 2011, the Department of Environmental Protection issued regulations that require all buildings burning No. 4 heating fuel oil to convert to a cleaner fuel (natural gas, ultra-low sulfur No. 2 oil, biodiesel, or steam) upon boiler or burner retirement or by January 1, 2030, whichever is sooner.” (Retrofit Accelerator, 2020)
- “NYSERDA - Ground Source Heat Pump Rebate Initiative, NYSERDA's Ground Source Heat Pump Rebate Initiative provides rebates for the installation of these systems in residential and multifamily buildings. Incentives: Rebates from \$1,200-\$1,500 per ton, depending on cooling capacity (above or below 10 tons of capacity).” (Retrofit Accelerator, 2020)

- “The Con Edison Multifamily Program offers cash incentives for installing energy efficient technologies for all gas customers with buildings that have 5 or more units through custom and prescriptive rebates.” (Retrofit Accelerator, 2020)
- “National Grid's Multifamily program provides incentives for high-efficiency gas equipment, controls and insulation to reduce the cost difference compared to standard efficiency equipment as well as no-cost installation of water saving products. Incentives: Up to \$12,000 prescriptive rebate on heating equipment or custom incentives up to 50% of project costs to a maximum of \$100,000” (Retrofit Accelerator, 2020)
- “National Grid's Gas Conversion program makes it easy to switch to natural gas. Equipment rebates for high efficiency heating systems and water heaters as well as other energy saving upgrades once conversion is complete” (Retrofit Accelerator, 2020)
- “Through the Ground Source Heat Pump Rebate initiative, NYSERDA is making funding available for the installation of this cutting-edge, renewable energy technology. This initiative will provide funding to eligible Ground Source Heat Pump (GSHP) designers and installers approved by NYSERDA, who provide customers with multiple benefits at lower costs and reach communities where this clean technology could otherwise be unaffordable. The rebate is available on a first-come, first-served basis, and separated into two tiers based on system size. Designers and installers will receive the rebate upon completion of installation of the project” (NY to Zero, 2019, NYSERDA Programs, 36)

LPDD Recommendations

- *“The state should enact laws, such as the Senate’s pending S. 8201 (2019), requiring that building owners who presently use fossil fuel for space and water heating must retrofit their buildings by electrification if a federal mandatory law is not obtainable.”*
- *“If a state’s utility regulation does not allow power purchase agreements for supplying new buildings with renew-able energy, state legislatures should amend the utility regulation to authorize such purchases to facilitate move-ment to low-carbon electrification for heating and hot water as part of the net-zero building process.”*

Related LPDD Database Pathways

- Providing Financial Incentives for the Installation of Distributed Energy Resources: <https://lpdd.org/pathway/providing-financial-incentives-to-distributed-renewables/>
- See <https://lpdd.org/resources/maines-ld-1766/>. Maine’s [LD 1766 “An Act To Transform Maine’s Heat Pump Market To Advance Economic Security and Climate Objectives.”](#) establishes the Heating Fuels Efficiency and Weatherization Fund, which has the goal of installing 100,000 heat pumps in Maine by 2025.

Other Recommendations

- “Taxation of fossil fuel heating: A tax on fossil fuel use for heating is applied. The level of the tax steadily increases over time between 2020 and 2050 and is broadly proportional to the ambition of the carbon prices applied in the carbon price policy and as such by 2050 varies between 4 (Natural gas) and 7 (Coal) euro cents / kWh. ... Taxation of fossil fuel heating imposes higher costs directly on household fuel use, which on average lower income households spend a higher share of their income on. However, over time, it

incentivises switching to more efficient heating systems reducing the burden of the tax over time.” (EQuality, 2020, 24)

- “Home Comfort - to develop standardized envelope solutions to improve energy performance and make homes heat pump ready” (Clean Energy, 2020, Energy Efficiency: Highlighted Programs and Initiatives, 19)
- “Support development of innovative solutions to electrify and reduce the heating and cooling loads of buildings through advanced heating & cooling solutions and advanced building cladding, including phase change materials, and healthy, pollutant-free insulation.” (Clean Energy, 2020, Clean Energy Economy, 22)
- “Clean Heat Community Engagement and Assistance — Provide support to communities and local groups to stimulate adoption of heat pumps along with building envelope solutions, while leveraging local labor.” (Clean Energy, 2020, Electrification of Buildings, 35)
- “Clean Heat Supply Chain Development — Support development activities to draw larger HVAC companies and general contractors into the heat pump business and grow businesses that are selling/servicing heat pumps.” (Clean Energy, 2020, Electrification of Buildings, 35)
- “Rhode Island’s Power Sector Transformation Initiative has produced high-level recommendations regarding beneficial electrification. National Grid’s 2019 Annual Energy Efficiency Plan (Docket 4888) supported the conversion of electric resistance, oil, and propane customers to cold climate heat pumps (natural gas to electric conversions were not included). However, the PUC ruled in late 2019 that it was not proper to deploy a heat pump program to incentivize fuel switching using the electric efficiency systems benefit charge because it does not benefit the electric system (Docket 4979). The PUC disallowed the incentive for fuel switching but did allow it for non-fuel switching applications of heat pumps, e.g., customers who were using electric resistance heating. The state’s Energy Efficiency Resources Management Council developed priorities for the triennial review of the Least Cost Procurement standards that include provisions that the PUC should consider programs that are explicitly designed to reduce emissions, along with complementary efforts like moving to MMbTu calculations.” (Berg & Cooper, 2020, 12)
- “LD 1766, signed in 2019, establishes the goal of installing 100,000 heat pumps in Maine by 2025. The state has recently started counting fuel-switching saving from unregulated fuels in 2020. Efficiency Maine has an objective to make energy efficiency programs available to users of all fuel types (HP1128). Funds are also made available through RGGI, which supports switching from fuel oil to air source heat pumps.” (Berg & Cooper, 2020, 10)
- “Hybrid dual-fuel heating systems (for example, an ASHP configured to continue operating in conjunction with supplemental heating from natural gas, fuel oil, or biomass on the coldest days) can potentially reduce extreme winter peak demands from electric resistance supplemental heating.” (Electrification Scenarios, 2020, 30)
- “Building envelope improvements can reduce the cost and size of ASHP equipment and may in some cases eliminate the need for supplemental resistance heating, which is a key driver of winter peak energy use.” (Electrification Scenarios, 2020, 30)

- “Force new customers to choose. PSL § 31 could be amended so that a new customer could avoid paying for a utility connection for one form of service—e.g. gas or electric—but not both. This would preserve the commitment to socialize some of the cost of connecting new customers to a collective energy system, while partly curing the mandatory subsidization of fossil fuel infrastructure by requiring prospective customers to consider and bear a fuller share of the costs of their own energy choices. In practice, we would anticipate that in such a regime most residential customers would elect (or already have) a subsidized connection to the electric system—which we know is capable of delivering greenhouse gas-free energy—but would think harder before investing their own capital in gas line extensions that might have a limited operational horizon or future usefulness due to the CLCPA.” (Gundlach & Stein, 2020, 41)
- “Cease requiring utilities to shift infrastructure extension costs. PSL § 31 currently embodies the idea that utilities of various types are to extend existing infrastructure as needed to meet requests for service from new customers, and that those utilities should socialize at least part of the cost of all such extensions. Section 31(4) specifically authorizes utilities to charge customers for such costs above a threshold amount, but not for the costs of the first hundred feet of an extension. In practice, the costs not charged to customers are never revealed—neither to the prospective customer nor to the general public. Amending PSL § 31 to allow (but, notably, not require) utilities to charge prospective customers for the full cost of all line extensions would end the practice of shielding prospective customers, other ratepayers, and the public from knowledge of the costs of infrastructure extensions required to support customers’ access to energy networks. This change would, however, result in differential treatment of existing and prospective customers, the former having been relieved of the cost of the first 100 feet of infrastructure extensions and the latter potentially being required to bear it. Such an approach would likely give rise to concerns about fairness as between existing customers, whose access to energy networks was paid for by others, and prospective customers, who would be required to bear the costs of such access themselves.” (Gundlach & Stein, 2020, 40)
- “Clarify that it is energy and heating service—and not specifically gas service—that is in the public interest. The following changes to PSL 30 would, consistent with the neutrality principle described in section 4, remove an important source of bias favoring incumbent technologies available to provide energy services (including heating) to residential customers: This article shall apply to the provision of all or any part of the gas, electric, or steam or other thermal energy service provided to any residential customer by any gas, electric or steam and municipalities corporation or municipality entity. It is hereby declared to be the policy of this state that the continued provision of all or any part of such gas, electric and steam service to all residential customers’ continued access to energy and heat, without unreasonable qualifications or lengthy delays, is necessary for the preservation of the health and general welfare and is in the public interest.” (Gundlach & Stein, 2020, 39)
- “Section 7 presently provides no substantive counterweight to PSL §§ 30 and 31’s clear mandates and little guidance to the Commission—or to any court asked to decide whether a given Commission decision conforms to Section 7’s requirements. As such, although Section 12 of the CLCPA provides for judicial review of actions (or failures to

act) taken under the CLCPA, even a suit brought under Section 12 to enforce the Commission’s procedural obligations under Section 7 does not by itself appear able to prevent the Commission from authorizing a gas corporation to continue to expand distribution infrastructure to serve new customers and to recover the cost of such expansion from other customers in the manner required by PSL § 31. At most, a court’s decision could compel the Commission to explain how a decision to continue to authorize cost recovery for such expansions relates to the CLCPA emissions reduction targets and specify alternatives and mitigation measures identified. It follows that, whatever potency Section 7 might eventually be interpreted to have, it cannot presently resolve the tensions described above.” (Gundlach & Stein, 2020, 25)

- “Heat-Pump-Ready Buildings — Build markets for insulation and air sealing services to accompany new heat pump solutions, to reduce thermal load and peak energy demands and increase home comfort. Review natural gas policy structure to ensure that alternative heating solutions can compete on a level playing field. Build market capacity, expand product availability, and drive cost reductions in electrification solutions such as air source and ground source heat pumps.” (Clean Energy, 2020, Electrification of Buildings, 35)
- “Develop an aggressive, national level campaign among policy makers to emphasize the need for massive increases in sales volumes for heat pump technology...Deploy a building electrification professional designation.” (CA Building Roadmap, 2019 12)
- “The City needs to extend its “lead by example” efforts to electrification retrofits of heating systems in City government buildings. If fossil fuel-fired boilers and steam heating systems are going to be replaced with air source heat pumps and other electrically powered equipment, the City should be the first to do it at some scale in its own buildings. NYCHA’s residential towers, and the City’s firehouses, schools, and office buildings offer a large and diverse portfolio in which to: (1) push manufacturers of the heat pump units to improve unit specifications for retrofit applications; (2) model the retrofit deployment process; and (3) assess the energy load, demand, and costs impacts associated with operating an electrically heated building.” (Kass, 2018, 55)
- “Catalyze adoption of high-efficiency electric heat and hot water systems paired with appropriate efficiency measures in buildings through policies and programs” (NYC 1.5C, 2017, 2020 Climate Actions, 20)

Discussion and Analysis

- “Programs to date emphasize the residential sector. While commercial applications are often eligible, they are usually not targeted; even where targeted, the emphasis is on smaller buildings. More can be done in the commercial sector, as will be discussed in an ACEEE report to be published in the fall of 2020. However, only very limited analyses on commercial-sector opportunities are available (e.g., see Kim et al. 2017), making it difficult for program implementers to identify and promote the best electrification opportunities in the commercial sector.” (Space Heating, 2020, 21)
- “A few other issues arose in our research. For example, while all of the programs encourage weatherization to help reduce heating loads and costs, only about one-third of programs require it. However, quite a few programs are exploring approaches to improve weatherization uptake before or at the time of heat pump installation. Furthermore, a

limited number of cold-climate ducted heat pump products with a large heating capacity are on the market, making it difficult to serve existing homes with high heating loads (e.g., inefficient homes in cold climates). Several programs noted that competition from natural gas programs can also present challenges; natural gas utilities do not want to lose large loads, and many of them are promoting high-efficiency natural gas furnaces. In a few cases, electrification supporters have advocated ending gas furnace incentives, but for the most part, these programs continue in order to promote condensing gas furnaces when they cost effectively save energy relative to less-efficient non condensing furnaces.” (Space Heating, 2020, 21)

- “Many of the programs target the use of heat pumps to displace both fossil fuels and electric resistance heat, but some programs target mostly one or the other. Several programs offer upstream incentives to contractors or distributors, finding that such an approach increases participation. High incentives, such as those enabled by allowing credit for fossil fuel savings and not just electric savings, also increase participation (VEIC 2018). In areas with high use of delivered fuels (fuel oil and propane), many programs target customers who use these fuels because the economics of electrification in these situations are generally better than when displacing natural gas. Probably the majority of applications involve using heat pumps while keeping fossil fuel heating systems in place. Programs in New England have found that attention needs to be paid to integrating the two systems, such as using integrated controls and/or considering thermostat locations and setting the thermostat for the backup system a few degrees lower than the heat pump so that the backup functions only when the heat pump cannot serve the full load. In regions with growing use of air-conditioning, ductless heat pumps can be a popular way to add efficient air-conditioning to homes that are difficult to retrofit with central air conditioning.” (Space Heating, 2020, 21)
- “Weatherization reduces heating loads, allowing a smaller system to be installed and making it easier for a heat pump to serve all or most of the heating load, even on cold days. Eight of the programs require weatherization as part of heat pump projects, and 15 encourage but do not require weatherization (some programs require weatherization for some but not all customers).” (Space Heating, 2020, 5)
- “A typical example is for the case of implementing all-electric ductless heat pumps for residences. This is a promising technology in terms of both the ability to perform in NYS’s harsh winters and the ease of installation. But many homeowners are unaware that a mini-split heat pump can perform space heating, instead thinking that it solely provides air conditioning. Even if they are aware of the heating capabilities, customers may be unwilling to buy them because of the limited space a single mini-split unit can condition. This limitation means that homeowners must find augmented heating solutions for the occasional uses of unconditioned spaces such as bathrooms or a small office space. For vendors, contractors, and builders, education needs to stress the importance of sizing the equipment for heating load.” (Electrification Scenarios, 2020, 42)
- “The commercialization of more efficient technologies through education, incentives, and marketing is critical to drive future increases in heat pump efficiency ratings.” (Electrification Scenarios, 2020, 41)

- “Other heat pump types, such as GSHP, have additional benefits. For example, GSHP are roughly 20% more efficient than ASHPs and consume about 70% less energy than natural-gas-fueled boilers and furnaces.³⁶ However, GSHP will likely remain more expensive than ASHPs over the study period and present additional challenges such as space requirements for drilling and installing the ground loop that make them unsuitable in many cases, including in many areas of New York City and when retrofitting existing buildings. Because this study sought to evaluate customer decision making based primarily on economics, the higher upfront and overall costs of a GSHP (without any incentives applied) meant that ASHPs were selected as the most cost-competitive electrification technology for heating. However, as noted previously, GSHP should be the subject of future studies to assess the overall customer, societal, and electricity system benefits that could be realized were this technology to be adopted in all areas in which it is reasonably feasible.” (Electrification Scenarios, 2020, 40)
- “The shift to electrification is most pronounced in space and water heating, which in turn will lead to the emergence of a “winter peaking system” in New York, where electricity demands are highest in the winter (today’s system demand is highest in the summer due to air conditioning loads). The magnitude of the new winter peak depends on the types of appliances that are sold and the pace of adoption, but can be mitigated by investment in ground-source heat pumps; investment in R&D to increase cold-weather performance of cold-climate airsource heat pumps; and onsite combustion backup systems using fossil fuel, bioenergy, or synthesized fuel such as hydrogen. Our study assumes that a balanced portfolio of electric space heating systems – including cold climate airsource heat pumps with and without onsite combustion backup, as well as ground-source heat pumps – would be deployed.” (NY Pathways, 2020, pg. 25)
- “New York’s PSL and CLCPA are in tension. On the one hand, the PSL states that gas service is in the public interest and ensures that customers may receive gas service (including free infrastructure additions), and that gas corporations may recover from customers the costs of providing that service, as well as earn returns on capital invested.” (Gundlach & Stein, 2020, 12)
- “Any finding that a per-customer right to have additional gas infrastructure constructed on their behalf, at no cost to them, is in the public interest must be predicated on the understanding that gas infrastructure expansion is itself in the public interest, or at least not contrary to the public interest. It would seem that in the 1980s, both the Legislature and the Public Service Commission shared this understanding. Another provision in Part 230 indicates that in 1986 the Commission saw gas infrastructure as being not just in the public interest and a good use of ratepayer funds but something that ought to continue indefinitely.” (Gundlach & Stein, 2020, 18)
- “In areas where gas service is already available, Section 31 of the Public Service Law in effect creates an entitlement, with respect to any prospective new residential customer, to have built on their behalf, free of charge, up to 100 feet of gas line (or electric line), from the main to the building for which service is being requested...the regulation has created a per-customer entitlement for the utility to build on their behalf up to 100 feet of main and appurtenant facilities as well as 100 feet of service line. Moreover, in practice, these per customer entitlements (100 feet of main each) can be pooled where multiple customers jointly request gas line extensions, allowing for significant line

extensions, far in excess of the 100 feet from the gas transmission line contemplated in the statute, to be performed at the utility company's expense." (Gundlach & Stein, 2020, 16)

- "Without regulation and innovation in refrigerant management and low-GWP refrigerants, increased reliance on heat pumps could result in a substantial increase of emissions of chemicals used in refrigerants, such as hydrofluorocarbons (HFCs). Additional analysis is needed to fully quantify this potential increase in emissions and characterize HFC mitigation opportunities in detail. Driving a shift to low GWP refrigerants will provide the highest GHG reduction benefit in the large-scale adoption of heat pumps." (NY Pathways, 2020, 26)
- "Variable-refrigerant flow (VRF) heat pump technology is common in residential and commercial buildings in Asia and Europe but relatively new to the United States. VRF heat pumps work on the same principle as a ductless multi-split system, but the term VRF heat pumps typically refers to units with larger capacities and that are used in the commercial HVAC market. Unlike a conventional HVAC system, which supplies conditioned air through central ducts or water through pipes to heat or cool spaces, VRF technology transports heat via refrigerant through internal piping to smaller heat exchangers mounted in the conditioned space. There are multiple indoor units, and each indoor unit serving a conditioned space connects to the outdoor unit separately through refrigerant lines. The outdoor unit that contains the compressor and the heat transfer coil controls the refrigerant flow to each indoor unit separately based on the load in the space." (Electrification Scenarios, 2020, 40)
- "For NYS single-family and low-rise multi-family residential buildings, replacing window AC with ductless multi-split systems can reduce emissions by approximately 80% under assumed emissions factors and generation mix. Ductless multi-split systems have the lowest lifecycle costs for those building types among electric, gas, and oil solutions analyzed. However, this does not hold true for larger building types such as high-rise multi-family homes and large offices because the equipment costs scale higher than the energy needs of those buildings." (Electrification Scenarios, 2020, 40)
- "Variable-capacity heat pumps (VCHPs) reduce cycling using inverter-compressors. VCHPs provide continuously variable output that more closely matches the heating and cooling demands of a home. They can also provide more heat efficiently at lower ambient temperatures than traditional heat pumps, reducing the supplemental heat requirement. Knowledge of these advanced features is inconsistent among many HVAC contractors, installers, and customers, which presents market barriers. Other factors such as the higher initial cost and the outdoor space requirements for installation also contribute to marketing challenges. For example, VCHPs (and ASHPs) require about 10 ft² for the outdoor component and roughly 2 ft of clearance around it to maintain unobstructed airflow. Furnaces do not have these external space requirements. In addition, the forced air is directed from the indoor unit to the conditioned space through ducts, so to realize the efficiency gains of a VCHP, the duct system needs to be well insulated and sealed to minimize heat transfer out of the ducts to the unconditioned space (or heat transfer into the ducts in cooling mode). Furthermore, as with ASHPs, if the VCHP is sized only for the cooling load and not for the heating load, supplemental heating will be needed in a cold climate like NYS." (Electrification Scenarios, 2020, 39)

- “Unlike a furnace, ASHPs must be outside, presenting space challenges for a crowded city like New York City. Specific challenges arise when the outdoor component of an ASHP is covered by snow, which obstructs airflow. The solution is to place the outdoor equipment in a covered space. Finally, lifecycle cost analysis (described later in this section) of ASHPs determined that a central AC system and gas furnace are more cost-effective in NYS than an ASHP for a single-family home. An ASHP is comparable in lifecycle cost to a central AC and oil furnace system and less expensive for the equipment lifetime than a window AC and oil boiler.” (Electrification Scenarios, 2020, 39)
- “Peak management has the potential to not only reduce peak demand, but also to smooth demand shapes, reducing the overall variability of demand—which has important implications for the supply side of the electricity system.” (Electrification Scenarios, 2020, 31)
- “Electricity is projected to play an expanded role in residential water heating, drying, and cooking. This assessment finds rapid growth in the market penetration of heat pump water heaters. Approximately 17% of NY homes currently use electricity for water heating, although very few of these use heat pump water heaters, which today are more efficient but more expensive up front than conventional electric resistance water heaters. As equipment costs of heat pump water heaters decline over time, the Baseline scenario projects that nearly 30% of residential customers could adopt heat pumps for water heating. Because the more efficient heat pump water heating technology displaces electric resistance as well as natural gas and other non-electric fuels, the net impacts on electricity demand for residential water heating remain roughly flat over time despite growing housing stock.” (Electrification Scenarios, 2020, 25)
- “The air-source heat pump (ASHP) is the primary electric heating candidate technology considered for widespread customer adoption in NYS in this study. This study finds that the adoption of ASHPs for space heating in NYS is projected to be limited and occur gradually absent specific regulatory interventions due to the cold winter climate and lags related to behavioral and structural factors such as stock turnover.” (Electrification Scenarios, 2020, 24)
- “The language in Sections 30 and 31 of New York’s Public Service Law provides for equivalent treatment of electric and gas service; neither section specifies that gas should be privileged over electricity for any particular use. However, various aspects of the existing utility law and regulatory practice effectively tilt the field in favor of gas for applications where gas has been adopted at some point, an effect that is amplified by existing buildings’ configurations and customary practices in new construction. The result is a strong bias in favor of continued and constantly expanding use of gas for various applications, even where electricity could perform the same function at the same or lower overall cost.” (Gundlach & Stein, 2020, 16)
- “In new buildings, they are cheaper than gas systems to install, but retrofitting existing buildings for electric heat can be expensive. On average, heat pumps are more efficient than natural gas boilers. However, right now, natural gas is cheaper than electricity, so that efficiency doesn’t always translate into cost savings, unless the customer is switching from a more expensive fuel like oil or propane. Also, even the best-designed heat pumps can lose efficiency in extreme cold, so in some parts of the country switching to heat pumps would cause huge spikes in electricity demand on the coldest winter days. That

electricity will have to be both affordable and reliable in order to make sure people don't freeze to death... E3 also recently suggested to a New York state climate council that in the coldest parts of the state, customers may wish to maintain backup gas systems even if they switch to heat pumps." (Grist, 2020)

- "The 100-foot rule, which provides ratepayer-subsidized gas infrastructure free to building owners, is a strong incentive for the expansion of gas infrastructure investments in New York State. If the Commission seeks transparency, equity and a way to minimize infrastructure investments, it will be important to understand the true and full costs of this fossil fuel subsidy. We, the undersigned organizations support the April 30, 2020 filing by NY-GEO regarding the 100-foot subsidy. The filing requests the Commission to develop and quickly implement a standardized format for utilities to report their costs for providing the subsidy required by the 100-foot rule. In its filing NY-GEO gave what it considered a conservative estimate of the 5 year cost to ratepayers of the 100-foot rule subsidy as nearly \$1 Billion. In the "background" statement in its order opening this proceeding, the Commission calls on utilities, ...to meet current customer needs and expectations in a transparent and equitable way while minimizing infrastructure investments and maintaining safe and reliable service. Additionally, planning must be conducted in a manner consistent with the recently enacted Climate Leadership and Community Protection Act (CLCPA)." (Bill Nowak, Gas Expansion Subsidy 2020)
- "The largest sources of emissions within existing buildings are space and water heaters. These are appliances that are typically powered by fossil fuels and last between 8 and 20 years, providing scarce opportunities to impact whether a customer chooses a like-for-like fossil fuel replacement or an electric alternative... In its 2018 analysis, the California Energy Commission found that "to decarbonize heating demands in buildings through a transition to electric heat pumps, without requiring early retirements of functional equipment, this transition must start by 2020 and achieve significant market share by 2030... new heat pump sales must represent no less than approximately 50% of new sales of HVAC and water heating equipment by 2030." (CA Building Roadmap, 2019, 6)
- "The economics of decarbonizing California's buildings depend heavily on one key factor: avoiding the cost of serving buildings with fossil fuels, especially natural gas in new construction. While cooking, clothes drying, and fireplaces may make marginal contributions to overall emissions, electrification of these measures must be accomplished to achieve desired cost savings." (CA Building Roadmap, 2019, 7)
- "Steps towards electrification also involve removing systemic bias preventing electrotechnology adoption that are often good intentioned around energy efficiency goals but self-defeating in the long term. Examples include providing incentives on high-efficiency gas furnaces but no such incentives on heat-pumps or policies that discourage electric utility load growth of any type." (350 PPM Pathways, 2019, 67)
- "For buildings, converting from natural gas to electric heat pumps could be controversial, too, because the up-front costs are high and the logistics are difficult—doing so would require swapping out boilers in millions of homes and businesses." (McKinsey, 2019, 5)
- "Most of those emissions are associated with space heating and cooling and water heating. Most space heating and water heating is provided by fossil fuels, while most space cooling is powered electricity. NYSERDA has estimated that in 2018 557 TBtu was

consumed for space heating. If it were possible to convert all the space heating load to the efficiency of heat pumps and meet that load with electricity, this would result in an additional electric demand of approximately 39,800 Gwh or an approximately 25 percent increase in electricity consumption compared to 2016 levels.” (Getting Greener, 2019, 35)

- “For situations where heat pumps are assumed to displace part of the site heating load – modeled as ASHPs in retrofit situations as well as all ductless minisplit installations – the counterfactual heating efficiency factors have been updated to a mix of existing conditions and compliance with current Federal Standards. This reflects the assumption that in these cases the existing heating equipment would continue to be used as backup/ peak heating throughout part of the heat pump lifetime, with new conventional backup/ peak heating equipment being installed halfway through the heat pump lifetime. Existing condition efficiencies are currently modeled conservatively at the level of the Federal Standards preceding the current ones. The net efficiency factor applied in the analysis to part-load displacements is thus the average of the current and the preceding Federal Standards. Further research will allow existing conditions to be modeled more accurately to reflect actual typical efficiencies of heating equipment currently in use.” (Heat Pump Potential, 2019, 3)
- “For ASHPs in new construction, assumed sizing of 5 tons for single family (as opposed to 4 tons for GSHPs) reflects the expectation that an ASHP would need to be 25% larger than a GSHP to serve the full site heating needs without conventional backup heating equipment, due to lower efficiency factors during cold weather. In existing building retrofit situations, central ASHPs for single family are assumed at 3 tons and serve the majority of the heating needs with the exception of peak heating periods when the conventional heating system is assumed to take over. Mini Splits in single family residential sites are sized at half the ASHP size (1.5 tons) and assumed to be operational in half the home, serving a corresponding portion of total annual load.” (Heat Pump Potential, 2019, 7)
- “Planning how to cut building energy consumption and change the types of systems that provide space and water heating to buildings on a massive scale cannot happen without close integration with electric system planning and regulation, much of which is not led by City government but by State regulators and the private sector.” (Stigge & Hinge, 2018, 127)
- “Aside from minor efficiency approaches in water heating, the only strategy that results in significant greenhouse gas reductions is converting to electric-driven heat pump water heaters... the cost burden cost of this strategy will be borne by those who pay the electric bills in the buildings that convert from fossil fuels to electric heating and hot water.” (Stigge & Hinge, 2018, 124)
- “A healthy mix of innovative technologies was discussed in the Roadmap, but some stakeholders had actually hoped to see more. Ground source heat pumps (sometimes known as “geothermal”), cogeneration (on-site electricity and heat production), district energy (microgrids, neighborhood heating or cooling systems), and advanced lighting controls (motion sensors, daylight controls, individual bulb control, automated shades, etc.) are all innovative building technologies that were included in the Roadmap.” (Stigge & Hinge, 2018, 127)

- “New gas, oil, or steam equipment currently has slightly lower up-front costs than heat pump water heaters, though that may change over time and could create an opportunity for the City or electric utilities to provide incentives for switching to electric heating. Some retrofit configurations may have spatial planning challenges as some heat pump equipment tends to be larger than steam- or gas-fired equipment and would need to reject heat to outdoor air. Installing new electrical circuits or condensate drains could incur substantial costs.” (Stigge & Hinge, 2018, 123)
- “It is not possible to reduce greenhouse gas emissions by 80% without eliminating fuel oil and natural gas combustion from a large portion of the heating and hot water boilers that are common in New York City’s residential building stock...The Roadmap anticipates getting 50–60% of buildings to switch to electric-driven heat pumps to meet the 80% reduction target. Smaller residential buildings may have fewer technical challenges for conversion to electric-driven heating, but larger residential buildings will struggle to find space for both heat pump conversion equipment as well as air based heat sources.” (Stigge & Hinge, 2018, 121)
- “Natural gas is also the primary energy source for heating and hot water systems in buildings throughout New York City—particularly in the heating of multifamily apartments and single-family homes. As with power plants, the rise in natural gas use to provide heat and hot water in buildings has been heralded as “clean heat” with the City’s successful efforts to phase out the dirtiest forms of fuel oil used in New York City buildings. Finding alternatives to natural gas for building heating and power generation is integral to current plans to reach 80x50, but this is also a paradox for energy planners. Curbing the use of natural gas will be a monumental challenge for the City of New York, Con Edison, National Grid, and State utility regulators and policymakers. In terms of building heating, the main option would be to electrify heat and hot water systems, although some solar and geothermal opportunities exist and will expand somewhat in the coming decades. The primary electric heating technology that will work in the city—air source heat pumps—is now used in some new construction projects, but the technology is not currently an affordable retrofit solution for the millions of square feet heated by fossil fuel-burning boilers and furnaces. If a technology emerges that allows a large portion of the City’s heating systems to be electrified, there will be substantial impacts on the City’s overall electricity load profile, especially when combined with the trend towards electric motor vehicles. A major investigative effort around building electrification technologies and their grid impacts should be launched as a collaboration involving City government, regional planners, state policymakers, utility regulators, and the utilities themselves. This idea is further explored later in this article.” (Kass, 2018, 45)

Other Resources

Related Topics in this Document: Standards For New Buildings, Standards For Existing Buildings, Special Issues For Rural Housing, Cooking - Electrification, District Energy, Combined Heat And Power

Cooking – Electrification

New York Actions

- “One final cost factor worth examining is the impact on Con Edison and National Grid’s local natural gas distribution networks in New York City. Depending on the degree of building heating system electrification, the erosion of the heating gas user base will have a negative impact on remaining users. The fixed costs of maintaining two systems will remain, with far fewer heating gas consumers. Cooking gas customers and the enduring heating users will face substantial cost increases. A similar pattern has been seen over the last few decades with Con Edison’s steam system; rates have increased tremendously as large numbers of customers dropped off the network.” (Kass, 2018, 49)

Related LPDD Database Pathways

- Natural Gas Bans in New Buildings: <https://lpdd.org/pathway/natural-gas-bans-in-new-buildings/>

Other Recommendations

- “Canada recently strengthened outdoor nitrogen dioxide standards and indoor guidelines to better protect health. Guidelines can be set by the US EPA and local and state policymakers and air districts to protect the most sensitive populations. This is a critical first step.” (Gas Stove Conversion, 2020)
- “State and local policymakers can provide financial incentives, such as tax credits or rebates, to enable lower-income households to add plug-in induction cooktops or switch to electric. Sacramento Municipal Utility District (SMUD), for instance, is currently offering its customers a \$100 to \$500 rebate for installing an induction stove.” (Gas Stove Conversion, 2020)
- “The Massachusetts Medical Society recently formally recognized the health risk of gas stoves, becoming the first medical body to do so and committing themselves to educate others about the issue. Health professionals play an important role in raising awareness and encouraging families to minimize risk.” (Gas Stove Conversion, 2020)
- “Homes with oil-fired boilers, where heat pumps are not attractive in the short term for technical or financial reasons, should switch to wood pellet boilers.” (Denmark Report 2030, 2017, 27)
- “These years many central Danish CHP plants are switching from coal to bio- mass, partly as a result of the exemption from tax on biomass. This will result in a significant increase in the use of imported biomass in the form of wood pellets and wood chips. While this helps to meet the target for renewable energy, it is also important that the biomass is produced in sustainable ways, ensuring that its application in fact contributes to reducing greenhouse gas emissions at global level.” (Denmark Report 2030, 2017, 17)

Discussion and Analysis

- “There are clearly climate and economic arguments for electrifying buildings, but there is also a profound health imperative. According to new research from MIT, the combustion emissions from the building sector now contributes to the largest share (37 percent) of

premature deaths associated with air pollution, compared to other sectors like transport, industry, and power generation. The opportunity is ripe for lawmakers and regulators to turn their attention to safeguarding public health by reducing building emissions and to focus on creating healthier homes when rebuilding from the current crisis.” (Gas Stove Conversion, 2020)

- “The indoor environment, where we spend 90 percent of our time, can be more polluted than the outdoors. Gas stoves are a primary source of combustion (burning) pollution inside the home. Cooking on gas can spike emissions of nitrogen dioxide and carbon monoxide to levels that would violate outdoor pollutant standards. This finding is underscored by new modeling from researchers at the University of California Los Angeles (UCLA). Homes with gas stoves can have nitrogen dioxide concentrations that are 50–400 percent higher than homes with electric stoves. The US Environmental Protection Agency (EPA) recently strengthened its assessment of nitrogen dioxide, finding a causal relationship between short term exposures and respiratory effects.” (Gas Stove Conversion, 2020)
- “Certain populations are more susceptible to the risks of gas stove pollution. Children are more vulnerable to air pollution due to several factors including their developing lungs and smaller body size. Children in a home with a gas stove have a 24–42 percent increased risk of having asthma. Lower-income populations and communities of color may be disproportionately impacted, with risk factors including increased exposure due to smaller and older homes and higher rates of asthma.” (Gas Stove Conversion, 2020)
- “If there was ever a doubt, one only needs to read the headlines related to improved air quality in the wake of Covid-19. The path toward recovery must simultaneously boost economic growth and address the indoor and outdoor pollution that impacts public health. The new UCLA report found that in California, if all residential gas appliances were changed to clean electricity, the state could monetize \$3.5 billion in health benefits every year.” (Gas Stove Conversion, 2020)
- “Electrifying buildings is a key component of local climate and health action, as it reduces both the harmful emissions and health impacts related to buildings, and can be an important job creation tool. Policymakers can act now to rectify the lack of regulation protecting people from gas stove pollution. This will require a collaborative effort from stakeholders and elevated political will from policymakers to set health-based regulation. Action is not unprecedented and can be expanded” (Gas Stove Conversion, 2020)

Other Resources

Related Topics in this Document: standards for existing buildings, standards for new buildings

[NY Plans for Natural Gas Ban](#)

[NY Times - Justin Gillis and Bruce Nilles - Your Gas Stove Is Bad for You and the Planet](#)

District Energy / Combined Heat and Power

New York Actions

- “NYSERDA has been authorized to administer a \$15 million program [PDF][Link opens in new window](#) - [close new window](#) to return to this page. to support development and

demonstration of low-carbon Clean Thermal District Systems installations. This program drives exploration of business models that can cost-effectively grow this market to scale through support for: Scoping, Design and Construction. NYSERDA intends to issue a competitive solicitation for this program in the latter half of 2020, and will conduct stakeholder engagements to gather market insights to help inform development of the solicitation.” (Clean Thermal District Systems 2020)

- “NYSERDA's Combined Heat and Power (CHP) Program provides incentives and procurement support for the installation of CHP systems up to a certain size. Incentives vary based on size of CHP system” (Retrofit Accelerator, 2020)
- “Clean Thermal District System — Test and demonstrate potentially scalable models for clean thermal district systems, using a NY-Prize style approach.” (Clean Energy, 2020, Electrification of Buildings, 35)
- “NYSERDA’s CHP program offers incentives up to \$2.5 million for systems up to 3 MW in size. In order to receive an incentive, in almost all cases systems are required to be capable of independent operation during grid outages (black-start capable), and installed to provide priority power during grid outages. NYSERDA offers bonus incentives for black-start capable CHP systems installed at critical infrastructure sites. For customers interested in installing systems less than 3 MW, NYSERDA offers a packaged CHP system catalog of modules that are pre-approved for program incentives. For projects in the 1-3 MW size range, NYSERDA allows customers to choose either the catalog approach, or a custom-designed approach. The catalog provides enhanced consumer confidence for smaller projects and helps accelerate the decision making and deployment timeframes through a catalog of pre-engineered CHP systems.” (CHP Program, 2018)
- “NYC Health + Hospitals is participating in the NYC Carbon Challenge to reduce GHG emissions 50 percent by 2025 from a 2007 baseline. It has already achieved a 24 percent GHG emissions reduction through a range of energy efficiency projects, many of which were conducted jointly with the New York Power Authority. The public health system has plans to install a combined heat and power (CHP) system at NYC Health + Hospitals/Kings County and is making plans for another CHP system at NYC Health + Hospitals/Bellevue, contributing to another 11 percent reduction in GHG emissions by 2020 while improving resiliency.” (NYC 1.5C, 2017, Agency Highlight, 36)
- “DEPARTMENT OF CORRECTION - DOC is improving local air quality, reducing energy consumption and GHG emissions, and expanding clean distributed generation. DOC’s new combined heat and power (CHP) plant on Rikers Island facility is designed to generate nearly all of the electricity and steam needed to serve Rikers Island, offsetting the electricity demand of about 15,000 residents from the Astoria power grid. Ultimately, the new plant will reduce the facility’s GHG emissions by 17 percent and NOx emissions by 37 percent, provide a savings of over \$6.9M in annual energy cost, increase reliability of the electrical and steam services on Rikers Island, improve resiliency, and create green jobs for project construction.” (NYC 1.5C, 2017, Agency Highlights, pg. 36)

LPDD Recommendations

- *“The state or local governments should add specific provisions to address geothermal and district heating technologies in their plumbing and electric codes, such as the Suffolk County Planning Commission’s Model Code for Geothermal Permitting.”*

- *“State governments should provide incentives for planned communities to install district heating infrastructure in newly built or remodeled mixed-use zones so that residential construction could take advantage of waste heat.”*
- *“States can encourage the use of combined heat and power (CHP) technologies through incentive programs and by including them within the scope of energy-efficiency resource standards, where such actions will reduce GHG emissions (and while taking care not to invest in strandable natural gas infrastructure).”*
- *“The state should include combined heat and power in the Clean Energy Standard or energy-efficiency resource standards. While the PSC has previously deferred adding combined heat and power to the CES, it has invited revisitation of this posture through triennial program review, and it is a decision ripe for reconsideration.”*
- *“State legislatures should consider vesting developers of geothermal or district heating with some measure of eminent domain authority comparable to that provided to other utilities such as natural gas line construction.”*
- *“The state should provide financial incentives for microgrid development, further to and drawing on the experience of NY Prize.”*
- *“The state should create a clearer exemption from utility regulation that permits customers and their local suppliers to own and operate generation and distribution wires (and pipes). Current regulation, at Public Service Law Section 2(13), introduces regulatory uncertainty around how geographically disperse a microgrid project may be, as well as how many (and what type of) customers it may serve, which uncertainty can only be resolved at the PSC. A clearer exemption would alleviate this regulatory uncertainty for the market.*
- *“The state should include combined heat and power in the CES or energy-efficiency resource standards. The state should provide in the CES a stronger incentive for CHP facilities that are fueled by biogas rather than natural gas.”*

Related LPDD Database Pathways

- Supporting Microgrids: <https://lpdd.org/pathway/supporting-microgrids/>
- Creating Technical Standards for Geothermal and District Heating: <https://lpdd.org/pathway/creating-technical-standards-for-geothermal-and-district-heating/>
- District Heating Systems: <https://lpdd.org/pathway/district-heating-systems/>

Discussion and Analysis

- *“Heat pumps are frequently installed to serve the needs of a single building. To leverage economy-of-scale and to expand clean energy options for customers who have insufficient footprint space to serve their own needs, heat pumps can be integrated with a network of distribution pipes to serve multiple buildings in a configuration referred to as District Thermal.” (Clean Thermal District Systems 2020)*
- District Thermal systems can address the needs of new construction projects as well as retrofits of existing buildings, and can be applicable to single-owner campuses such as:
 - colleges/universities
 - medical campuses
 - residential complexes

- or even multi-owner nodes (such as downtown corridors).” (Clean Thermal District Systems 2020)

Other Resources

Related Topics in this Document: building heating systems, thermal storage

[Combined Heat and Power in New York City](#)

Thermal Storage

Other Recommendations

- “While limited to specialty applications such as large air-conditioning and hot water systems, thermal storage will likely play a prominent role in the rollout of energy storage because it is of medium to long duration (more than 4 hours) and would generally be located in high load areas where its ability to relieve peak demand is most needed.⁶⁴” (Kanyuck, 2018, 225)

Discussion and Analysis

- “For the purpose of industrial heat, only concentrated solar power (CSP) can provide possibly high enough temperature for most industrial processes. CSP’s working principle is to reflect and concentrate solar radiation onto a small area to increase temperature and power yields. Typical projects provide about 100 MWe from a single unit (e.g., Ivanpah).⁵⁹ Project costs have exceeded \$1 billion and occupy more than 10 km² of land. One advantage solar concentrating systems have is the potential to store thermal energy—for example, in molten salt. The Copiapo project in Chile is scheduled for completion in late 2019 and has 13 hours of molten salt thermal storage. Although expensive (total costs are roughly \$2 billion), the bidding price on electricity contracts without subsidies is lower than \$0.05/kWh.⁶⁰

Land use requirements limit the viability of solar thermal for industrial applications. Solar thermal heat for 100 to about 300 MW heat flux would occupy 3,000–8,000 acres (12 to about 30 km²) of land, comparable to a typical steel plant layout (3,000 acres) and 10–40 times more than an equivalent fossil-powered thermal station (200 acres).” (Low Carbon Heat, 2019, Solar Thermal, pg. 27)

- “To provide heat supply after sunset, molten salt thermal storage is also required. Molten salt’s maximum working temperature of 560°C defines the upper practical limit for industrial use.⁶² Next-generation molten-salt technology must exceed 800°C for many industrial applications. Even when thermal storage is available, the reliability of CSP would be hampered by seasonal variation. The CSP is operating with essentially zero operating cost and can keep producing value for 30-plus years if designed and operated properly. Fuel costs are effectively zero for CSP and the CSP levelized cost of electricity (LCOE) systems’ costs have continued to drop, suggesting possible future applications in low-medium temperature systems (e.g., petrochemicals), provided such facilities are located in appropriate solar resource geographies.” (Low Carbon Heat, 2019, Solar Thermal, pg. 28)

- “Thermal energy storage systems use lower-cost off-peak power to heat or chill a medium, such as water, ice, or molten salt, which is then used for building heating and cooling to shed the corresponding electric power demand during peak demand periods.⁶¹ For example, a 1.025 MW thermal storage system with a 15-hour duration in Rockefeller Center uses a chiller to freeze ice during off-peak periods; during peak demand periods, chilled water used for building cooling is chilled using the stored ice instead of using electric chillers, thereby shedding electrical load.⁶² Currently there are approximately 4 MW of similar thermal storage systems with durations in the range of 10 to 15 hours located in Manhattan.⁶³” (Kanyuck, 2018, 225)
- “Storage of delivered electricity in the forms of ice systems for cooling and thermal storage for heating may also be effective technologies to reduce peak demand while accommodating the cross-sector migration of building heating and cooling loads.” (CAC Report 2010, Chapter 8, page 30)

Other Resources

Related Topics in this Document: Demand Management, Solar Hot Water

Modular Buildings

New York Actions

- “LMI Zero Energy Modular Homes - to develop the market for high efficiency modular homes” (Clean Energy, 2020, Energy Efficiency: Highlighted Programs and Initiatives, 19)

Other Recommendations

- “Invest in the development of carbon neutral and zero energy modular new construction as an alternative to traditional manufactured housing and an option for urban infill applications.” (Clean Energy, 2020, Energy Affordability and Equity, 31)

Discussion and Analysis

- “Modular construction is the process where buildings are made up of individual sections (“modules”), constructed in an off-site controlled manufacturing facility, and assembled together at the final building site. The modules are fabricated using standard building construction materials while leveraging assembly-line production methods. Modular constructed buildings can be leased and purchased.” (Vanguard Modular Building Systems 2015)
- “The modular construction process is often compared to building with blocks, in that each piece is constructed to fit perfectly with the next piece. The end result is a high-quality product constructed in a safe and efficient work environment. But how can a building be built to last in such a short amount of time? Steps to ensure efficiency, durability and quality control are top priority in modular builds, just as they are in traditional construction builds. Individual modules are typically built between 12’ and 14’ feet wide so they can be transported on the road to the building site. Module lengths

depend on the overall building configuration, square footage requirement, and site layout... At the same time that module construction is happening at the manufacturing facility, prep work is being done at the building site. This includes excavation, grading, foundation, and utilities. Once all the individual modules are constructed off-site, they are delivered and staged at the building set in a predetermined order to make final assembly as efficient as possible. A crane is used to place the modules and construct the complete building.” (Vanguard Modular Building Systems 2015)

- “Benefits of Modular Building Construction:
 - Less Materials Waste
 - Pre-fabrication makes it possible to optimize material purchases and usage, while minimizing on-site waste, all while offering a higher quality product to the buyer. Bulk materials are delivered to the manufacturing facility where they are stored in a protected environment, safe from theft and exposure to the environmental conditions of a job site.
 - Less Material Exposure to Inclement Weather
 - Many of the indoor air quality issues identified in new conventional construction result from high moisture levels in the framing materials. This moisture is caused by uncontrolled exposure to rain, snow, and other unsuitable weather conditions during the conventional construction process. A modular structure is up to 90% completed in a factory-controlled setting using dry materials, so the potential for high levels of moisture being trapped in the new construction is all but eliminated.
 - Less Site Disturbance
 - The modular structure is constructed off-site at the same time that the foundation and other on-site work is being completed. This efficient process reduces the impact on the surrounding environment, as well as reduces the number of vehicles and equipment needed at the site. Traffic pattern changes, airborne dust and dirt particles, distraction and displacement of site occupants, light pollution, unpleasant smells, noisy equipment, and untidy appearance on the site are all attributes of a typical construction project. Modular construction reduces these impacts significantly with a shorter site construction schedule.
 - Energy Efficiency
 - A large selection of high efficiency mechanical systems, insulation, windows, doors, and plumbing fixtures can be installed to meet your desired efficiency standards.
 - Reuse
 - When your needs change, modular buildings can be disassembled and the modules relocated or refreshed for their next use, reducing the demand for additional raw materials, and minimizing the amount of energy expended to create a new building to meet the new need.
 - Adaptability
 - Modular buildings can be designed to quickly add or remove one or more modules, minimizing costs, and disruptions to adjacent building and surroundings.” (Vanguard Modular Building Systems 2015)

Other Resources

Related Topics in this Document: Low-Carbon Building Materials

[Modular Building Construction Timeline and Comparison to Traditional Construction](#)

Tenant Programs

New York Actions

- “NYSERDA - Commercial Tenant Program: The Commercial Tenant Program helps tenants, building owners and managers design a high performance space by sharing the cost of energy analysis in tenant spaces. Incentives: Up to 100% of the cost of energy analysis for tenant spaces” (Retrofit Accelerator, 2020)
- “Commercial Tenant program - to improve interior office and leased spaces through design, proactive maintenance and operations, and actionable plans to reduce energy consumption” (Clean Energy, 2020, Energy Efficiency: Highlighted Programs and Initiatives, 19)

LPDD Recommendations

- “The state should adopt and implement specific strategies that target increased uptake of more energy-efficient home equipment technologies, including green leases (such as NYC’s Model Energy Aligned Lease Provision) and improved life-cycle cost information for retail-ers and householders.”

Related LPDD Database Pathways

- Green Leases: <https://lpdd.org/pathway/green-leases/>

Other Recommendations

- “Green leasing, also known as energy-aligned, energy-efficient, or high performance leasing, is the practice of realigning the financial incentives of sustainability or energy measures in lease documents.¹ Common commercial leasing practices often suffer from what is known as the principal-agent problem, which is when one party (the agent) performs tasks on behalf of another party (the principal), but the agent does not act with the principal’s best interests in mind. For many commercial landlords and tenants, cost structures laid out in the lease lead to the principal-agent problem and discourage landlords and tenants from investing in a more-efficient building.” (Green Lease Report, 2015)
- “Capital expenditures and capital repairs and replacements shall be included as Operating Expenses provided such capital repairs or replacements were necessitated by a change in Law occurring after the date of this Lease or were intended to have cost saving benefits over the Term and amortized costs of same over the useful life of the improvement in accordance with generally accepted accounting principles or with respect to cost savings, over the payback period of such improvement.” (Green Lease Case Study, 2013)

Discussion and Analysis

- “This study, through an analysis of current energy efficiency measures facilitated by the signing of green (or energy aligned) leases, estimates that green leases have the potential to reduce energy consumption in office buildings by 11 to 22 percent, yielding reductions in utility expenditures in U.S. commercial buildings up to \$0.51 per square foot. Green leases have the potential to provide the leased U.S. office market \$1.7 billion to \$3.3 billion in annual cost savings. The magnitude of the split incentive problem, and the commercial sector’s current failure to achieve energy efficiency at scale, presents a significant opportunity for owners and tenants to save billions of dollars through attainable changes to their lease structures and building management.” (Green Lease Report, 2015)
- “While a landlord can invest in efficient systems in order to drive down utility bills, their ability to profit from this lease structure gets hampered by methods to determine the tenant’s share of utility expenditures, as well as by slow (or nonexistent) recovery of energy efficiency capital expenses, resulting in unattractive returns. As a result, landlords with both net and modified gross leases are deterred from investing in energy efficiency. Meanwhile, buildings with a full-service lease structure face the opposite problem: while the landlord has incentive to keep energy costs down, the tenant is not penalized for profligate energy consumption.” (Green Lease Report, 2015)
- “Brandywine (building case study) utilizes two components in its lease to drive energy efficiency and data transparency in its managed portfolio. First, the company includes a clause in its standard leases that allows it to pass through the capital costs of efficiency improvements to tenants. Second, Brandywine includes a clause in new and re-negotiated leases that requires tenants to either submit monthly utility data or allows the company to install sub-meters in tenant areas if Brandywine is not already receiving such data. These measures enable the company to track energy usage, implement cost-effective energy efficiency measures, meet energy-saving targets, and save tenants money.” (Green Lease Case Study, 2013)
- “Brandywine has found that cost pass-through lease clauses eliminate the split incentive barrier in certain buildings, and that addressing data availability in the lease can help avoid data access problems later on. While these measures have helped Brandywine improve its properties’ energy efficiency, they note that lease clauses alone are not a panacea for energy efficiency challenges. Other barriers to energy efficiency remain, such as a limited ability to engage tenants, lack of information on the costs and benefits of energy efficiency, and access to capital to cover up-front costs. Smaller buildings also remain a challenge for Brandywine. Buildings that are most likely to implement this leasing clause for an energy efficiency improvement are larger buildings for which an energy efficiency investment represents larger absolute savings. Although challenges remain, Brandywine’s leasing efforts have helped put them on a path to greater energy efficiency: a path that others can benefit by following.” (Green Lease Case Study, 2013)

Other Resources

Related Topics in this Document: Building Energy and Emissions Disclosure

Appliance Standards

New York Actions

- “The Con Edison Multifamily Program offers cash incentives for installing energy efficient equipment for electric customers with buildings that have 5 or more units through custom and prescriptive rebates.” (Retrofit Accelerator, 2020)
- “The Con Edison Neighborhood Program offers free energy efficient LED lighting upgrades to residents and in common areas. Free lighting surveys may also be available. Con Edison also offers increased incentives on Smart Thermostats to residents who live in the Brooklyn Queens network. Free LED lighting, upgrades and installations, as well as rebates on smart thermostats” (Retrofit Accelerator, 2020)
- “The Con Edison Appliance Rebate program provides rebates for the installation of ENERGY STAR appliances, including room air conditioners. Rebates are available for bulk purchases in master-metered multifamily buildings, or for individual purchases by residents in direct-metered units. Incentives: \$25 cash rebate on an ENERGY STAR A/C and up to \$40 rebate on applicable ENERGY STAR appliances.” (Retrofit Accelerator, 2020)
- “The State should review the energy efficiency performance standards for products that are not federally preempted every five years and update them as needed... As specified under Article 16 of the Energy Law, the State should also continue to establish and update energy efficiency performance standards for appliances and products that are not federally preempted. For those appliances and products with federal preemption, the State should lobby the federal government to increase those performance standards.” (CAC Report 2010, Chapter 6, 15)

Appliances -- Financially Supporting Efficient Appliance Adoption

LPDD Recommendations

- “States should consider adopting legislation and programs that encourage the use of energy-efficient appliances and equipment through tax policy, financial incentives, labeling programs, and financing policies.”

Related LPDD Database Pathways

- Efficient Appliance Incentive Programs: <https://lpdd.org/pathway/efficient-appliance-incentive-programs/>
- State Financing and Tax Incentives for Efficiency Investments: <https://lpdd.org/pathway/state-financing-and-tax-incentives-for-efficiency-investments/>

Appliances -- Appliance-Specific Standards

LPDD Recommendations

- “States should enact legislation requiring the establishment of cost-effective state energy-efficiency standards for appliances and products that are not preempted by EPCA or adopt such standards by regulation if statutory authority already exists.”

- *“With respect to appliances and products that are covered by EPCA and are thus preempted, states should consider seeking waivers of preemption for products where there is a specific state justification for seeking a waiver of preemption and establishing a more-stringent state standard.”*
- *“States could work collaboratively to issue collective standards for life-cycle climate performance on consumer appliances for which no federal standard has been issued.”*
- *“Each state should develop building codes based on use of equipment that is more efficient than the minimum efficiency levels required by federal law, and ensure that the factors justifying an exception from federal preemption are reflected in the building code’s design.”*
- *“States should follow the example set by California and Vermont and adopt the federal energy-efficiency standards that have been established by DOE as identical state standards in the event that federal standards are repealed or revoked.”*

Related LPDD Database Pathways

- State Efficiency Standards for Products that Are Not Federally Regulated: <https://lpdd.org/pathway/state-efficiency-standards-for-products-that-are-not-federally-regulated/>

Appliances -- Inefficient Appliance Turnover

LPDD Recommendations

- *“Until a federal program is developed, states should develop their own “cash for clunkers” programs to accelerate the turnover of less efficient appliances and market penetration of more efficient appliances.”*

Related LPDD Database Pathways

- Adopting Policies to Accelerate Turnover and Penetration of Efficient Appliances: <https://lpdd.org/pathway/adopting-policies-to-accelerate-turnover-and-penetration-of-efficient-appliances/>

Appliances -- State EERS

LPDD Recommendations

- *“The state should design and implement effective energy-efficiency programs to achieve the annual 3% energy savings target identified by the PSC by 2025, and increase that target over time.”*

Related LPDD Database Pathways

- State Energy Efficiency Resource Standards: <https://lpdd.org/pathway/state-energy-efficiency-resource-standards/>

Appliances -- Utility Incentives

LPDD Recommendations

- *“The state should consider performance-based ratemaking designs that include incentives for superior utility energy-efficiency performance, building on the Earnings Adjustment Mechanisms developed in the Reforming the Energy Vision proceeding.”*

Related LPDD Database Pathways

- Utility Regulatory Design: <https://lpdd.org/pathway/utility-regulatory-design/>
- Rate Restructuring and Utility Reform: <https://lpdd.org/pathway/rate-restructuring-and-utility-reform/>

Other Recommendations

- “Support statewide improvement in energy efficiency through improved appliance standards and adoption of advanced building codes, with a goal of establishing a statewide mandatory net zero-carbon building code by 2031.” (Clean Energy, 2020, Energy Efficiency, pg. 18)
- “Produce industry-leading voluntary appliance standards for technologies to ensure quality, co-benefit achievement, durability and other desired factors. Reward products and manufacturers that meet the standards through bulk purchasing contracts through State procurement, incentives, recognition and other measures.” (CA Building Roadmap, 2019, 11)
- “Advocate for more stringent efficiency standards for appliances and vehicles at the regional and national levels” (NYC 1.5C, 2017, 2020 Climate Actions, 16)
- “CEC will continue to update the State’s Appliance Efficiency Regulations (California Code of Regulations, Title 20, Sections 1601–1608) for appliances offered for sale in California to establish standards that reduce energy consumption for devices that use electricity, gas, and/or water.” (CA Scoping Plan, 2017, 117)

Discussion and Analysis

- “The U.S. DOE has a strong program of appliance and equipment standards, but it is underfunded and years behind schedule in keeping standards up-to-date. This may sound like a small opportunity, but it can deliver energy savings, cost reductions for citizens, and pollution reduction. Additional funding for this critical program, along with a directive to accelerate this process would improve appliance and equipment efficiency.” (Federal Policies for Net Zero, 2020, 14)
- “California has taken steps to reduce the energy intensity of new housing stock, passed measures that require new homes be built to accommodate rooftop PV panels, and implemented building codes requiring continuous improvements in the energy efficiency of building materials and systems. However, by and large, improving energy efficiency and promoting the deployment of renewable generation systems have been the preferred to pursuing actual reductions in residential demand. In parallel, the state has also been working to promote the electrification of fossil fuel dominated end-uses. This included providing rebates for EVs, heat pumps, and various types of household appliances. If successful, these efforts are likely to greatly increase future electricity demand. It is presumed that the environmental impacts of this consumption will be mitigated by transitioning the grid to be powered by 100% renewable sources. However, the timely success of this transition is not guaranteed.” (Growing Inequities in the Residential Energy Sector, 2020)

- “Much like electric vehicles, the potential for building appliances to operate flexibly can contribute to electric system reliability. Water heaters and refrigerators have a proven ability to shift load by a few hours, thus allowing the electric system to operate more efficiently and cost-effectively. Heating systems may be able to shift load, though there are open questions about how much, how long, and at what temperatures. Advanced distributed energy storage technologies may also contribute to system flexibility.” (NY Pathways, 2020, 25)
- “In the net zero policy pathway, an ambitious sales mandate requiring all-electric new equipment and appliance standards by 2035 drives the overwhelming majority of emissions reductions in buildings – a cumulative 8100 million metric tons of carbon dioxide equivalent (Mt CO₂e) between 2020 and 2050 (Figure 4). Policy requiring new construction to be all-electric should be enacted as soon as possible to accelerate the process.” (U.S. Net Zero Emissions By 2050: Decarbonizing Buildings, 2019)
- “Achievement of the full savings potential will require various steps, including improved test procedures on some products (so that rated efficiencies better represent performance in the field, especially for “smart” products with adaptive controls); market introduction of an increased number of models at today’s highest efficiency levels; efforts by manufacturers, distributors, utilities, governments, and large customers to promote these most-efficient products; and, ultimately, rulemakings by DOE to adopt new standards that require increased but cost-effective levels of efficiency for all products.” (Halfway There, 2019, 4)

Other Resources

Related Topics in this Document: Building Energy And Emissions Disclosure, Low-flow Water Fixtures, District Energy, Combined Heat And Power, Water Leakage Controls; Water Distribution

Low-Carbon Building Materials

New York Actions

- “NYSERDA’s RetrofitNY program will accelerate the process, pace, and scale of deep energy renovations across residential and commercial sectors. Beginning with the affordable multifamily sector, RetrofitNY will drive the costs of deep retrofits down while catalyzing the private sector’s involvement, buy-in, and capacity to deliver NZE and near-zero buildings. Conceptual designs have recently been completed for the first-round pilot projects, at right. NYSERDA will intensely focus on the manufacturing supply chain for NZE retrofit components to achieve cost compression and enhance the scalability and achievability of these transformational retrofits.” (NY to Zero, 2019, Introduction, 8)
- “The design team left no corner untouched and implemented strategies including: LED classroom lighting, Ample daylighting through classrooms and hallways, High performance building envelope, Permeable paving systems for walkways and driveways, Low-energy kitchen equipment, Geo-exchange system, Solar thermal for hot water, Energy recovery and demand-control ventilation, Advanced building controls” (NY to Zero, 2019, Case Study: Kathleen Grimm School, 24)

LPDD Recommendations

- “In developing carbon markets, subnational governments could account for GHG emissions reductions achieved through materials and solid waste management.”
- “States could extend existing laws on materials, products, and waste to a broader range of materials, products, and waste categories, including construction and demolition debris.”

Related LPDD Database Pathways

- Zero Energy Buildings: <https://lpdd.org/pathway/zero-energy-buildings/>

Other Recommendations

- “All governments start to develop a strategy to achieve net zero embodied carbon, including: Targets and timelines for low carbon public procurement, Timelines for introducing mandatory LCA of buildings and infrastructure, Disclosure of environmental data for products and materials in accepted forms (eg EPDs) and Where appropriate, commitments to support research and development into net zero embodied carbon solutions” (Embodied Carbon, 2019, 46)
- “Use low carbon design guidance and calculation tools and benchmarks to evaluate each design choice in terms of upfront emission reductions and as part of a whole life approach. Apply design approaches that minimise the quantity of new material required to deliver the desired function. Prioritise materials which are low or zero carbon, responsibly sourced, and which have low lifecycle impact in other areas, including the health of the occupant, as determined through a product specific environmental product declaration where available. Choose low or zero carbon construction techniques having maximum efficiency and minimum waste on site” (Embodied Carbon, 2019, 21)
- “Engage with all stakeholders to define a clear strategy and policy path for government. A strategy should include the following elements: baseline at jurisdiction level; timeline of climate objectives with building and infrastructure sector targets including, where possible, adherence to carbon budgets; embodied carbon disclosure requirements for large public projects; policy incentives and legislation to require and support embodied carbon reductions via best practice means; and consideration of the greatest embodied carbon reduction opportunities and risks for the state, region or country related to available resources (energy supply and materials). Collaborate to create joint commitments, share knowledge and experiences with other governments at the same level (eg via intergovernmental networks, organisations and partnerships) and with other stakeholders” (Embodied Carbon, 2019, 46)

Discussion and Analysis

- “Material efficiency, longevity, and re-use (21%): A large share of industrial emissions are associated with creating materials used in products, buildings, and infrastructure, such as concrete and steel. Smart design and precise use of material (enabled by technologies such as automation and 3D printing) can produce products delivering equal or better services while requiring less material. Improved designs and materials can also lengthen the useful lifetime of buildings or products, so they don’t have to be replaced as

often. Buildings and products can also be designed to facilitate re-use by a new owner, and approaches such as vehicle sharing may enable fewer vehicles to provide mobility services for more people.” (U.S. Net Zero Emissions By 2050: Decarbonizing Industry, 2019)

- “Most existing policy measures that address embodied carbon emissions in the built environment do so indirectly from the supply side. They include energy efficiency standards for industry, taxes on energy consumption and landfill waste, and carbon trading schemes such as the Emissions Trading Scheme (ETS) in Europe. But further supply-side supportive policy measures are still needed for manufacturers to drive the necessary investment in technologies and processes. This includes innovation funding and incentives for reuse and recyclability. By contrast, demand-side levers for decarbonising the built environment, such as building codes, focus primarily on operational energy and carbon. Barriers to wider inclusion of embodied carbon in demand side policy include lack of awareness and demand but also aspects of the political framework such as policy cycles and changing political priorities. Some leading regulatory bodies have introduced embodied carbon into building codes and material specifications with varying levels of ambition or have supported voluntary incentive systems for further improvement. There are opportunities to learn from these examples and it will be very important to evaluate outcomes thoroughly in order to select the most effective policy measures. This could also inform the development of model policy toolkits that support accelerated action so that less advanced regions can replicate the success of policies and criteria from developed markets.” (Embodied Carbon, 2019, 36)

Other Resources

Related Topics in this Document: Standards For New Buildings, Standards For Existing Buildings

Consumer Awareness and Education

New York Actions

- “Community Retrofit NYC provides free educational, engineering, financial, and construction management advisory services for residential buildings 5-50 units in central Brooklyn and southern Queens to help simplify the energy and water efficiency retrofit process. Incentives: No incentive, free technical guidance.” (Retrofit Accelerator, 2020)
- “GreeNYC is New York City’s public education program dedicated to informing, engaging, and mobilizing New Yorkers to take simple, meaningful steps to reduce their energy use and live more sustainable lifestyles.” (Retrofit Accelerator, 2020)
- “The City Council will consider legislation requiring the City to establish a comprehensive plan to ensure that the cooling needs of residents are met on high heat days. This plan could include requiring the Department of Health and Mental Hygiene (DOHMH), along with OEM, to identify and adopt best practices for providing residents with information regarding the dangers of heat exposure, and sufficient advance notice of the locations and availability of cooling centers. It could also include requiring the

Office of Long Term Planning and Sustainability and DOHMH to develop measures to prevent large office buildings from overcooling in summer months and straining the grid, which can cause power outages. The City has previously done this for individual cases of heat emergencies, but should consider proactive measures in the face of rising temperatures.” (Securing Our Future, 2020, 50)

- “DOB [Dept. of Buildings] will support better communications and community engagement through the use of DOB NOW, a public facing web interface that allows New Yorkers to conduct transactions online, and through the inclusion of energy code information in project requirements for the construction industry.” (NYC 1.5C, 2017, Agency Highlights, pg. 35)
- “DEPARTMENT OF EDUCATION - DOE is broadening its outreach about energy and climate change to reach the parents and communities of its over 1.2 million students. DOE’s Office of Sustainability is increasing youth leadership around sustainability and expanding its training for educators and facilities staff.” (NYC 1.5C, 2017, Agency Highlights, 35)
- “New York Public Library acts as a platform for public awareness on climate change and environmental sustainability.” (NYC 1.5C, 2017, Agency Highlights, 36)
- “DEPARTMENT OF CONSUMER AFFAIRS - DCA is running the “Shut the Front Door!” campaign, to encourage compliance with Local Law 92 of 2015, which prohibits stores from leaving doors or windows open while air conditioning is running. As part of this effort, DCA provides educational materials to businesses to help them project cost savings and associated environmental benefits from keeping the door shut.” (NYC 1.5C, 2017, Agency Highlights, pg. 37)
- “NYC Service is partnering with City agencies and nonprofits in order to mobilize members and volunteers to address environmental issues. Environmental protection is one of NYC Service’s five city needs. Priorities and ongoing activities include community outreach on recycling and reducing waste, as well as increasing organics separation.” (NYC 1.5C, 2017, Agency Highlights, 39)
- “ENHANCED CLIMATE COMMUNICATIONS - 76 percent of New Yorkers are concerned about environmental issues but do not always know what they can do to help address climate change. All New Yorkers must take actions to achieve the City’s ambitious, but necessary climate goals. The City will engage New Yorkers in this fight, educating citizens on choices and steps they can take to reduce their GHG footprint, and sending important market signals to industries and businesses to prioritize low carbon products and goods. New Yorkers are leaders and together can achieve great things. Communication is a tool to further unlock the potential of New Yorkers and to accelerate progress toward a better and climate-ready NYC. The City will develop a climate communication campaign to raise awareness about the City’s current strategies and programs, engage New Yorkers on solutions, and advocate for important policies and issues. Benefits include accelerating GHG emissions reductions and catalyzing industries through market signals, and encouraging residents to demand climate-smart homes, energy, goods, and services.” (NYC 1.5C, 2017, Key Actions to Provide Climate Change Leadership, 15)

Customer Awareness and Education -- Active Utility Consumer Tech and Programs

LPDD Recommendations

- *“States should adopt incentives that enable customer behavior/investment choices, including decoupling, customer demand response, and deployment of smart metering.”*

Related LPDD Database Pathways

- Smart Meters: <https://lpdd.org/pathway/smart-meters/>
- Time of Use Rates: <https://lpdd.org/pathway/time-of-use-rates/>
- Utility Behavioral Efficiency Programs: <https://lpdd.org/pathway/utility-behavioral-efficiency-programs/>

Customer Awareness and Education -- Information Sharing

- *“State governments should adopt and implement specific strategies that target increased uptake of more energy-efficient home equipment technologies, including green leases and improved life-cycle cost information for retail-ers and householders.*
- *“State governments should consider using specific strategies to increase adoption of household-level renewable energy systems and purchases of products with low life-cycle emissions, such as informal marketing through neighborhoods and social networks and targeted marketing to environmentally minded consumers.”*
- *“State governments should further use, test, and evaluate specific strategies to reduce carbon emissions from the use of existing and new home equipment and buildings, including provision of monthly feedback and implemen-tation of information campaigns.”*
- *“State governments should further use, test, and evaluate specific strategies to increase the uptake of energy-efficient buildings, including energy audits of existing homes and energy rating systems for new homes.”*

Related LPDD Database Pathways

- Green Leases: <https://lpdd.org/pathway/green-leases/>
- Energy Rating Systems for New Homes: <https://lpdd.org/pathway/energy-rating-systems-for-new-homes/>
- Peer Comparison Programs: <https://lpdd.org/pathway/peer-comparison-programs/>
- Building Energy Audits: <https://lpdd.org/pathway/building-energy-audits/>

Other Recommendations

- *“Clean Energy Communities - recognizes and rewards communities for implementing clean energy actions that save taxpayer dollars, create jobs, and improve the environment” (Clean Energy, 2020, GHG: Highlighted Programs and Initiatives, 11)*
- *“Provide support for consumers in gas constrained areas of New York by providing information and assistance to adopt energy efficiency and clean heating solutions. Increase consumer awareness and provide decision-quality information on energy efficiency opportunities for building owners and tenants — capitalizing on key points in a building life cycle (e.g., tenant turnover, major renovations, property transfer).” Clean Energy, Energy Efficiency 2020, 18)*

- “Improve community-level outreach and engagement to increase access to clean energy solutions and improve energy literacy.” (Clean Energy, 2020, Energy Affordability and Equity, 31)
- “Consumer Awareness and Market Engagement for Clean Heat and Energy Efficiency – Ensure that New Yorkers are aware of clean energy alternatives for heating and cooling homes and businesses, while reducing energy waste. Build demand and reduce customer acquisition costs for heat pumps and energy efficiency.” (Clean Energy, 2020, Electrification of Buildings, pg. 35)
- “Launch a marketing campaign to raise awareness and increase interest in building decarbonization...Create a network of local governments, professional and community-based organizations to promote decarbonization, ensuring diversity in messaging and language.” (CA Building Roadmap, 2019, 12)
- “Education, Outreach and Behavior Change: The State would create market-based and educational approaches that inform end-users and encourage reduction of energy use, energy efficiency, and renewable energy... This policy option would develop methods and incentives to increase consumer awareness and understanding of the benefits of reduced energy use, and to 1) motivate people to take immediate energy efficiency action, and 2) bring about fundamental change in attitudes that will result in long-term behavior change related to energy efficiency and renewable energy.” (CAC Report 2010, 6, 28)
- “The percentage of New York school districts (K–12) reached with integrated education programs about energy efficiency and broader sustainability issues: 70 percent of public school districts by 2020; 100 percent of public school districts by 2030; 100 percent of private and at-home school systems by 2030.” (CAC Report 2010, 6, 29)

Discussion and Analysis

- “Educate policymakers and the public through information sharing and connecting individual energy use to climate impacts.” (Clean Energy, 2020, Greenhouse Gas Emissions Reduction, 10)
- “We must draw on the passion, ingenuity, and ability of New Yorkers to accelerate progress. Together, we are capable of reinventing our city to be climate-safe, more equitable, prosperous, and exciting. New Yorkers must be empowered and are an important part of the solution if we are to succeed in meeting our ambitious goals.” (NYC 1.5C, 2017, We Can’t Do It On Our Own, 30)
- “In EJ communities, in particular, stakeholders maintain that lasting behavior change emerges from sustained local dialogue and assistance provided by respected opinion leaders. Setting standards and programmatic guidelines that promote or integrate community-led capacity-building may be critical to the success of the proposed behavior change programs.” (CAC Report 2010, 6, 29)

Other Resources

Related Topics in this Document: Building Energy and Emissions Disclosure

[NYC Carbon Challenge](#), [NYC's building energy benchmarking, audits, and retrocommissioning requirements](#)

Building Energy and Emissions Disclosure

New York Actions

- “Energy and Water Use Benchmarking and Disclosure of Energy Efficiency Scores and Grades. New York City’s Local Law 84 of 2009 mandates annual energy and water use benchmarking for buildings over 50,000 square feet in gross floor area and properties with two or more buildings on a tax lot that measure over 100,000 square feet in gross floor area. In 2016, the City expanded this requirement to mid-size buildings between 25,000 square feet and 50,000 square feet (Local Law 133 of 2016). Starting in 2020, Local Law 33 mandates building owners display their energy efficiency grade, ranging from A-F, conspicuously at public entrances. The grade will be based on the rating earned using the United States Environmental Protection Agency ENERGY STAR Portfolio Manager.” (Retrofit Accelerator, 2020)
- “Energy Audits & Retro-commissioning. New York City’s Local Law 87 of 2009 requires buildings greater than 50,000 square feet in gross floor area to complete an energy audit and retro-commissioning measures once every 10 years.” (Retrofit Accelerator, 2020)
- “Sub-metering. New York City’s Local Law 88 of 2009 (LL88) requires the installation of energy sub-metering in tenant spaces greater than 10,000 square feet. In 2016, the City expanded this requirement to include sub-metering for all non-residential tenant spaces over 5,000 square feet in area (Local Law 132 of 2016).” (Retrofit Accelerator, 2020)
- “NYSERDA - RTEM, The RTEM program offers incentives for the monitoring of building energy systems in real time, including the hardware, software and ongoing consulting support required to analyze and identify operational and capital improvements to improve the performance of your buildings. Up to 30% in incentive options for RTEM system implementation and services for up to five years.” (Retrofit Accelerator, 2020)
- “NYSERDA - On-site Energy Manager: NYSEDA supports a dedicated, on-site energy manager to help commercial and industrial facilities to actively manage their energy use and lower costs through energy efficiency and optimization. Incentives: NYSEDA will share up to 75% of the cost of an on-site energy manager.” (Retrofit Accelerator, 2020)
- “The Con Edison Small Business Program provides free energy efficiency survey and installs energy efficient lighting, refrigeration and HVAC measures through custom and prescriptive incentives. Incentives: Lighting (up to 70%)*, HVAC (approx 20-50%), refrigeration (up to 70%), appliances (approx 20-50%) *Incentive based on percentage of total cost, including labor and materials” (Retrofit Accelerator, 2020)
- “Set forth in Local Law 84 of 2009 (LL84), requires property owners of large buildings to release annual energy consumption data used to benchmark building energy performance. The second, known as Local Law 87 (LL87), introduced a mandatory energy audit requirement for buildings larger than 50,000 ft². Each covered property must conduct an audit, also referred to as an Energy Efficiency Report, once every 10 years and report its findings, which include detailed energy end-use information and recommended energy conservation measures (ECMs). Roughly 10% of regulated buildings have been required to conduct an audit each year since 2013, and annual deadlines are randomly assigned based on the last digit of the property’s Borough-Block-Lot (BBL) tax parcel identifier. LL87 also requires owners to implement certain retro commissioning measures to ‘tune-up’ existing systems at the time of audit, such as to

ensure that light fixtures are clean and water pumps are operating as designed.” (Kontokosta et al, 2020, 309)

- “The Zero Energy Performance Index (zEPI) scale represents a fundamental shift in measurement of building efficiency. zEPI sets energy targets for actual energy consumption rather than using a predictive energy model of building energy performance comparing the building to code. zEPI is calculated using a building’s EUI and is adjusted based on building type and climate. zEPI is also the measure by which a building’s energy efficiency can be calculated once operational and occupied based on measured energy use data.... zEPI sets a constant goal of net zero energy and shifts the conversation from better than code to an index leading to zero, which is the kind of market shift required for buildings to achieve wide-scale zero energy and exemplary energy performance. One noteworthy function of the zEPI scale is that it allows key energy milestones, including individual project consumption and energy policies to all be represented on one scale. When the target is zero, progress and outcomes are easier to visualize and understand.” (NY to Zero, 2019, zEPI, 37)
- “DDC [Department of Design and Construction] is educating agencies about how projects can meet Local Law 31 of 2016 requirements by facilitating energy audits and energy master plans for all capital projects that significantly affect energy use and GHG emissions.” (NYC 1.5C, 2017, Agency Highlights, 34)

LPDD Recommendations

- *“State governments could integrate certification of existing buildings for decarbonization with energy benchmarking, energy audit or usage disclosure, or retrofitting regulations.”*
- *“State governments should further use, test, and evaluate specific strategies to increase the uptake of energy-efficient buildings, including energy audits of existing homes and energy rating systems for new homes.”*
- *“States should require an energy audit upon the sale or rental of existing homes and commercial properties if the federal government fails to do so.”*

Related LPDD Database Pathways

- Requiring Energy Audits and Benchmarking: <https://lpdd.org/pathway/requiring-energy-audits-and-benchmarking/>
- Energy Use Benchmarking and Auditing: <https://lpdd.org/pathway/energy-use-disclosures/>
- Energy Rating Systems for New Homes: <https://lpdd.org/pathway/energy-rating-systems-for-new-homes/>
- Building Energy Audits: <https://lpdd.org/pathway/building-energy-audits/>

Other Recommendations

- “Advance applications of “Intelligent Efficiency” — using sensors, improved analytics, communications, and streamlined M&V. Leverage comparative data and information through strategies such as building benchmarking and labeling to drive consumer adoption of energy efficiency.” (Clean Energy, 2020, Energy Efficiency, 18)

- “By 2030: ALL GOVERNMENTS: enforce embodied carbon disclosure requirements for buildings over a certain size, or infrastructure above a certain cost, as part of the construction permitting process and building codes. For private sector construction, implementation can be progressive (eg Finland’s national roadmap) – first voluntary, and then as part of regulation which makes embodied carbon disclosure compulsory” (Embodied Carbon, 2019, 47)
- “All governments implement embodied carbon targets (using appropriate benchmarks) for new public buildings, large public renovations and infrastructure with a clear trajectory towards net zero standards. Disclose lifecycle carbon measurements for public buildings and infrastructure and contribute to the collection of high quality data for benchmarking and target setting purposes.” (Embodied Carbon, 2019, 46)
- “Green building certification schemes, also known as rating tools, are used to assess and recognise buildings that meet certain sustainability requirements or standards. They can provide targets for LCA conducted during design, including limits on the amount of embodied carbon per unit of floor area or as a percentage reduction against a baseline. These schemes promote performance beyond local regulatory compliance and so serve as a useful indicator of market maturity and adoption of embodied carbon approaches. A recent report by Bionova identified 105 sustainability certifications and regulations that include direct measures for embodied carbon, with national systems in 26 countries³². LCA of buildings and infrastructure has been a part of some green building certification schemes for over a decade, notably in Germany and the USA, and has been a key driver in promoting and supporting development of LCA methodology and tools. Some schemes reward improvements against a benchmark or from a reference design. Under some schemes, such as DGNB, the scheme run by the German Sustainable Building Council, and Green Star, run by the Green Building Council of Australia, credits can be gained by conducting LCA to identify alternative solutions during early project development, since its use in these strategic planning stages is still low.” (Embodied Carbon, 2019, 30)
- “Evaluate and identify best technology and methods to identify leaks in each portion of the system.” (Methane Reduction Plan, 2017, 5)
- “The State could mandate, through legislation, that all private buildings greater than 50,000 square feet or public buildings greater than 10,000 square feet publicly report their annual energy and water benchmarking scores using the ENERGY STAR internet-based benchmarking tool (Portfolio Manager). For the aforementioned-sized “covered” existing buildings, this policy recommends the following: •Performing an energy audit every ten years by an energy auditor; Retro-commissioning and installing all energy efficiency measures identified in the energy audit that have less than a seven-year payback, within five years of completing the energy audit; Commissioning of new buildings of the aforementioned size during the design and construction process by a certified commissioning agent. The State could also mandate, through legislation, the following: Every new one- to four-family home should receive a Home Energy Rating System (HERS) rating or an equivalent energy efficiency scoring methodology from a qualified rater. Each new home should obtain a legislatively-established rating to indicate that it meets minimum energy efficiency standards. Every existing one- to four-

family home sold in the State should receive a HERS rating from a qualified rater and that the rating should be disclosed to all prospective buyers.” (CAC Report 2010, 6, 17)

Discussion and Analysis

- “Audit requirements, then, could be used to target deep retrofits, focusing on ECM opportunities that could achieve 30% or greater savings, and automated or virtual audits could replace the existing need for traditional audit mandates. Similarly, because audit policies produce significant data on building systems and operating characteristics—information that is useful for a range of city agencies, but often difficult to collect—mandatory requirements could be replaced by incentives for voluntarily reporting audit data.” (Kontokosta et al, 2020, 314)
- “The most straightforward explanation as to why LL87 audits may not be encouraging meaningful energy savings is that the audit process and reports are not of sufficient quality to reduce the uncertainty that buildings owners have regarding the cost and energy savings of particular ECMs⁵⁰. A case study of 30 commercial and residential audits conducted in buildings across the United States revealed widespread shortcomings, which included missed ECMs and overestimated savings. It is possible that the audits being produced in compliance with LL87 are similarly lacking.” (Kontokosta et al, 2020, 313)
- “In an attempt to associate the observed savings with potential retrofit actions, we estimate from the audit report data the average expected EUI improvement possible through recommended low-cost ECMs (those with payback periods of less than two years) and retrocommissioning. The expected savings from low-cost ECMs are found to be 4.56% for multifamily and 1.87% for office buildings, with retrocommissioning activities associated with approximately 2% savings in both building types. Based on the magnitude of the audit-impact coefficients, these figures suggest office buildings exhibit, on average, energy savings that are consistent with those expected from recommended low-cost measures. For residential buildings, however, as the audit coefficient is lower than that expected from low-cost ECM adoption, the impact of the mandatory audit is negligible in relation to identified savings opportunities. Finally, we link the savings associated with energy audits to a financial consideration that is often overlooked in the retrofit decision: the cost burden of the audit itself. According to the US Department of Energy, the cost of a building energy audit ranges between \$0.12 and 0.50 ft⁻² (ref. 47), whereas NYC market-specific estimates set the cost at \$0.15 ft⁻² (refs 11,48). Given the average energy savings attributed to audits from the Bayesian model discussed above, combined with building fuel mix and energy cost estimates from the US Environmental Protection Agency⁴⁹, we find that the average annual energy cost savings due to auditing for the NYC building stock are \$0.121 ft⁻² for office and \$0.038 ft⁻² for residential buildings. Therefore, especially for residential properties, the relatively high payback period of the energy audit (four years or more, on average) is an important consideration in the cost-benefit analysis of mandatory audit policies.” (Kontokosta et al, 2020, 312)
- “Energy disclosure mandates are an important first step: once the data are available, buildings can be evaluated on their energy performance and compared with their peers, which creates a ‘grading’ scheme that can help to shift individual and collective decision-making. Following this, cities can consider performance targets and provide

financial and regulatory incentives to motivate building owners to improve their energy efficiency and also ensure that regulations are in place to require poorly performing buildings to improve when owners do not respond to incentives.” (Kontokosta et al, 2020, 314)

- “A growing body of evidence suggests that disclosure policies can generate efficiency improvements. For instance, a recent study by Meng et al. revealed that LL84 produced a 6% reduction in energy use intensity (EUI) in the first three years after the policy took effect, and a 14% reduction over the first four years⁸. Papadopoulos et al. also found energy use reductions over time in the buildings covered by LL84, but identified distinct clusters of buildings that actually increased their consumption during the same time period¹⁰. A number of other studies also demonstrate that energy information disclosure impacts real-estate prices, which is assumed to reflect rental premiums, higher occupancy rates or lower operating expenses in more efficient buildings.” (Kontokosta et al, 2020, 310)
- “Benchmarking is the process of accounting for and comparing a metered building’s current energy performance with its energy baseline. Fundamentally, benchmarking involves tracking a building’s energy performance over time, including grid-purchased electricity, on-site renewable generation, natural gas, district energy, and delivered fuels at the individual building or portfolio level. Tracking building energy in this way can help identify the impacts of operational changes such as set points or lighting controls, maintenance work, or capital improvements. The practice informs decision-making for building owners and operators, portfolio holders, occupants, and policymakers that can lead to energy and cost savings. Buildings benchmarked over a three-year period showed an average of 2.4% annual savings in energy. The practice of benchmarking has been growing at a rapid pace across the market largely due to the increasing prevalence of energy disclosure ordinances. As of 2018, more than 25 cities, three states, and one county adopted mandatory benchmarking ordinances for commercial and/or multifamily buildings as shown in Figure 12. In these jurisdictions, building owners must track and report the energy use of their buildings. New York City is the only jurisdiction currently with a mandatory benchmarking law in New York State, which covers 2.8 billion square feet of building stock. Several other municipalities and the State of New York are leading by example by voluntarily benchmarking their public buildings. NYSERDA offers step-by-step guidance and template policy language to be adopted for use in other New York communities.” (NY to Zero, 2019, Benchmarking and Disclosure, 27)
- “Transitioning to a New York-based carbon metric presents some technical challenges and there are policy implications for the various options of approach. It should be the objective of the metric to influence choices for both energy efficiency and electrification that align with New York’s plans, targets, and policies. The most consequential decision in transitioning to a carbon metric is devising a standardized and consistent protocol for converting a building’s measured energy imports from and exports to the electric grid to a carbon dioxide energy equivalency (CO₂e) impact. CO₂e is a standard unit used to measure the global warming potential of all GHGs compared with the equivalent amount of carbon dioxide. In addition, calculating CO₂e for the use of natural gas in power plants and in direct onsite consumption must include many assumptions of transport,

processing leakage, and the efficiency of combustion. This work is underway. Energy and carbon will both be industry metrics in future assessments and reporting... A carbon-based strategy in New York will allow the selection of energy using component installation or replacement to be an integral aspect of building programs and regulation. This important evolution in building sector policy is consistent in large part with existing New York and New York City building-level electrification objectives and aligned with efforts to support electrification of the transportation sector.” (NY to Zero, 2019, Transitioning to a New York-based Carbon Metric, 28)

- “However, the new policy requirements could require capital commitments from building owners, and owners may have concerns with their energy usage information being made public. Coordinated with Education, Outreach, and Behavior Change (RCI-5), effective outreach to educate building owners on the programs and their benefits will be needed to effectively implement this program. Access to funding for studies and capital for the installation of energy efficiency measures are issues that should be coordinated with policies, such as Energy Efficiency Incentives (RCI2) and Tax Structure and Private Financing (RCI-4).” (CAC Report 2010, 6, 18)
- “Energy Audits and Financing — Provide consumers with decision-quality information and financing options to enable uptake of energy efficiency and heat pumps. Rate Restructuring and Flexible Metering: Building upon current initiatives, this policy option would focus on expanding use of more effective, dynamic price signals and providing in-home displays that show detailed electricity usage information to electricity customers as well as home automation, increasing customer engagement and intelligent vehicle charging. The desired result is an overall reduction in monthly electrical usage, shifting electrical usage to off-peak periods, and encourage demand response activities. Time-of-use pricing: After full implementation of the current policy of mandatory day-ahead hourly pricing for large commercial customers, explore expansion to small commercial and enact legislation that permits the Public Service Commission to implement mandatory time-of-use pricing for residential customers upon finding that it is beneficial and in the public interest to do so. Absent legislation, the State could explore voluntary residential real-time pricing options.” (CAC Report 2010, 6, 30)

Other Resources

Related Topics in this Document: Standards For New Buildings, Standards For Existing Buildings, Appliance Standards, Building Heating Systems

Government Procurement

New York Actions

- “Creating protected markets for very low-carbon goods is a fantastic way to stimulate the market for the solutions we hope to scale in the future. A federal public procurement program could set standards for cement, iron, steel, and other products used to build any infrastructure receiving federal dollars, based on the emissions intensity of those inputs. A model policy is in place in California (Assembly Bill 262), which includes suppliers’ emission intensities in government procurement decisions.²² However, a federal Buy

Clean program should build on this concept by not only setting a carbon intensity threshold for qualifying materials to discourage the worst actors, but also rewarding marginal improvement. This incentive could be structured as compliance obligations and tradable permits, as in a Low Carbon Fuel Standard,²³ or similar to a Clean Energy Standard with a carve-out where 10 to 20 percent of goods must meet an even more stringent GHG threshold. A federal program should also consider material substitution opportunities (e.g., using timber instead of steel for buildings less than 20 stories).” (Federal Policies for Net Zero, 2020, 9)

- “The public sector laid the groundwork for NZE as an early leader investing in new projects—a decade ago, the majority of NZE buildings across North America were by far publicly owned. Today that number is almost evenly split with the private sector as the benefits of NZE buildings are beginning to get the attention of business leaders. The role of public buildings is critical as they lead by example and often have high visibility in the community. Education, for example, accounts for the majority of high performance public buildings, representing approximately 60% of publicly owned NZE buildings nationwide.” (NY to Zero, 2019, The Public Sector, 20)
- “A total of 53 specifications are currently approved for use in state procurement covering approximately 94 different commodity, service, or technology products (e.g., the “Desktop and Laptop Computer” specification covers three types of devices: desktops, notebooks (including laptops) and tablets). A summary of the new specifications adopted by the Committee is provided below.” (Eo4 Progress, 2018, 34)

Recommendations

- “All levels of governments including city, state, regional and national must lead by example, implementing ambitious embodied carbon reduction targets as part of a whole life carbon approach in building and infrastructure projects. While having varying degrees of power and applicable actions, all governments have a vital role to play in stimulating and enabling market actors. Early and carefully designed policy and fiscal measures by governments are needed to remove market barriers, allow industry to prepare and ensure low and zero carbon products and projects can compete successfully in the market.” (Embodied Carbon, 2019, 45)
- “State of California Buy Clean Act (USA): The Buy Clean California Act was developed to address climate change through the power of procurement. It targets the embodied carbon of construction materials used in infrastructure projects such as roads, bridges, and public buildings. The Buy Clean California Act is the first in the nation to be signed into law. Key characteristics: Eligible construction materials are structural steel, rebar, flat glass and mineral wool board insulation. Environmental product declarations will be used to identify the GWP to produce the material. Beginning 1 July 2021, contracts will require eligible construction materials to have a GWP equal to or lower than a level established by state standards.” (Embodied Carbon, 2019, 33)
- “A second option is the creation and promulgation of low-carbon procurement policies. The history of government procurements supporting technology advances is long and successful, including clean energy options such as LEDs, biofuels, advanced battery technologies, and high efficiency solar panels. Creating government procurement mandates for low-carbon industrial products (e.g., cement, steel, plastic, glass) could

help stimulate companies by creating an early market for low-carbon industrial products. Government procurement is a particularly appealing option because governments are the primary direct or indirect purchaser of steel, cement, and fuels. Much of this procurement is associated with infrastructure projects (e.g., roads, bridges, public buildings), and initial study suggests that primary industrial products and materials represent only a small fraction of total project costs. Said differently, adding substantial costs to industrial products could affect final project costs less than 1 percent. If so, then the apparent cost to the public of procurement policies could appear small. Several US states, notably California and New York, have created initial policies and are exploring further action. At the federal level, new policies have been introduced both legislatively and through executive order. In doing so, they provide model language to consider specific cost support by creating a customer base for industries adopting low-carbon heat options. Importantly, this approach is not limited to governments. Many companies, including retailers and high technology manufacturers, have created internal policies governing the purchase of low-carbon power and greening their supply chains.¹²⁶ These policies provide clear market signals and help stimulate investment in production of low-carbon products. Expanding their policies to include low-carbon building materials and products could provide a point of entry for heavy industry to explore low-carbon heat production as a pathway to decarbonizing their product lines for customers, potentially with little or no impact on final product cost to customers.” (Low Carbon Heat, 2019, Implications for Policy, 55)

- “Procure buildings and infrastructure projects which comply with embodied carbon emission targets, based on established methodologies such as carbon budgets, material screening and LCAs – simplified or full.” (Embodied Carbon, 2019, 46)
- “Based on ten years of experience, the Interagency Committee has found that agencies with two or more of the following assets have the most successful sustainability programs. Resources, support and capacity building can go a long way toward ensuring success.
 - A full-time Sustainability Coordinator or a multi-staff coordination team with the authority to engage all levels of management and operations.
 - A sustainability plan or project list, and a robust method for completing this annual report, all of which are powerful tools for creating momentum and measuring performance.
 - Regular engagement of and training for staff.
 - Sustainability funding to implement goals.” (Eo4 Progress, 2018, 4)
- “In addition to broad policies and programs that support private sector efforts, there are several ways in which state entities can directly participate in the generation of renewable energy to support their own operations. These include building systems themselves or entering into power purchase agreements (PPAs) where a developer arranges for the design, permitting, financing, and installation of a system for little to no upfront cost, and is reimbursed through utility bill savings. Systems can be constructed on the site of a state facility, or off-site as part of a net metered or community solar system. Renewable energy credits (RECs) can also be purchased. Reporting on renewable energy is still relatively new, and each year has brought increased clarity around the terms “generation” and “use.” The Interagency Committee has determined

that calculations of renewable energy generation by state entities should include only the following: energy generated on-site and used at a state facility; energy generated off-site but dedicated to use at a state facility through remote net metering or a community energy project; or energy invested in through RECs to offset facility energy use.

Contributions from renewable energy embedded in New York's overall grid will not be counted. In this year's report, only solar energy generated through the first two methods by agencies with robust data is being reported. Improvements are being made to the reporting process to ensure more accurate data in future years." (Eo4 Progress, 2018, 21)

- "Most statewide contracts are not exclusively green, and it can be time consuming for purchasers to navigate offerings and identify green products. As consumer demand has grown, the market has responded, and more green products with high levels of performance are available than ever before. Unfortunately, however, some companies have resorted to "greenwashing," which is the making of green claims that are intentionally misleading or provide too little information to allow meaningful comparison. A number of agencies continue to report that they find it challenging to purchase green products cost effectively... OGS and DEC are working together to roll out a "GreenNY icon" to label green products that meet EO 4 approved specifications in the e-catalog. Initially, all products that are on 100% green contracts and preferred source offerings that meet EO 4 specification criteria will be labeled with the GreenNY icon. Eventually, the goal is to have all products that meet an EO 4 approved specification labeled with a GreenNY icon. The ultimate goal is to eliminate the identification of products that do not meet EO 4 specifications as "green" by vendors. Over time, this will significantly increase the ability of agencies to easily find EO 4 compliant green products, as well as help to reduce greenwashing" (Eo4 Progress, 2018, 39)
- "Leverage City-owned property and land to foster innovation in renewable energy development to mitigate climate change and enhance resiliency, air quality, and health outcomes" (NYC 1.5C, 2017, 2020 Climate Actions, 20)

Discussion and Analysis

- "Greening State government is a win-win for both the environment and the economy because it significantly reduces pollution and waste while saving taxpayer dollars. Key benefits include reducing energy use and greenhouse gas emissions, reducing materials use, reducing toxic chemical use, and conserving water and other natural resources. Each has the potential to avoid or mitigate the impacts of climate change, reduce pollution, cut waste, protect public health, maintain biodiversity, and reduce the costs of treating drinking water and managing toxic materials and waste. Government can learn from efforts in the private sector (e.g., from winners of New York State's Environmental Excellence Awards), and in turn be a model for others." (Eo4 Progress, 2018, 2)
- "Long-term success depends on changing the culture and making it as easy as possible for procurement staff to routinely consider the sustainability of goods and services during the purchasing process. The most important recent shift in this direction is OGS' establishment of the Green Procurement Team, dedicated to making it easier and more cost effective for agencies to purchase green products." (Eo4 Progress, 2018, 38)
- "This reporting year has again shown that sustainable practices do not typically cost more money and reducing energy use and waste can even save money (see table on page

v). While many energy projects require up-front, capital investment, most save money over time. Other types of projects, including reducing water and toxic chemical use, green cleaning, and green procurement, do not cost more and often yield important co-benefits, such as improved health and comfort of staff, visitors or residents. It is often easier to implement sustainability projects when they are aligned with a facility or service that is being upgraded and can better accommodate more sustainable outcomes.” (Eo4 Progress, 2018, 7)

- “Office waste accounted for only 8% of total waste generated in FY 17-18 (non-office waste was 92%). The total amount of office waste generated in FY 17-18 was 48,613 tons, a 27% increase from FY 16-17. This increase is due in part to the increase in the number of agencies reporting office waste and to the heightened emphasis of collecting and reporting disposal data. Overall, office waste generation has decreased by 20,242 tons, or 29%, since FY 09-10, an encouraging downward trend. With the adoption of waste conservation techniques, such as double-sided printing and the use of electronic documents, agencies have significantly reduced the overall amount of paper purchased and consumed. In FY 17- 18, 65 agencies reported purchasing 208,207 boxes of copy paper for \$6.8 million. 46% of these dollars went towards purchasing 100% post-consumer recycled content copy paper, and 83% went towards purchasing at least 30% post-consumer recycled content copy paper. The overall amount spent on copy paper has fallen by an impressive 53% since FY 08-09 when agencies reported spending \$14.54 million on copy paper. In addition, avoiding single-use plastic water bottles remains a high priority in New York” (Eo4 Progress, 2018, 8)
- “Experience has shown that green products are competitively priced and perform as well or better than conventional products, and in many cases can be purchased at a discount. Many green products, such as traffic safety equipment made from recycled plastic, glass beads in reflective paint made from recycled glass, and remanufactured toner cartridges, are consistently less expensive than conventional products. Many others, including 100% recycled content janitorial paper, green cleaning products, and soy-based ink, are consistently comparable in price to conventional products, and products such as green computers, lighting, solar power and zero emission vehicles can be purchased at a discount when life cycle costs and energy savings are considered” (Eo4 Progress, 2018, 31)

Other Resources

Related Topics in this Document: Air-Conditioning for Public Housing

Energy Intensive Industries

Cement

New York Actions

- NYS Low Embodied Carbon Concrete Leadership Act - still in legislature, would give a tax credit for concrete manufacturers for use of Environmental product declaration (EPD) labelled cement (<https://lpdd.org/resources/nys-proposed-low-embodied-carbon-concrete-leadership-act-2019/>)

Related LPDD Database Pathways

- Sectoral Emissions Controls: Cement and Lime: <https://lpdd.org/pathway/sectoral-emissions-controls-cement-and-lime/>

Other Recommendations

- Decarbonize cement through less use of Portland cement, instead replace it with portland limestone cement, supplementary cementitious materials (fly ash, blast furnace slag, ground glass pozzolan), or reduce the amount overall. Make sure cements that are green have Environmental product declarations (EPDs). (Concrete Webinar, 2020)
- Put funding into research for ways to greater the amount of carbon sequestration that can occur through carbon curing, use of carbon-based components and cement plant capture (Concrete Webinar, 2020)
- “Require that carbon emissions from concrete become the determining factor, after cost and structural considerations, when selecting bids for state contracts.” (Prospect, 2020)
- “A program that sets new output-based standards every few years based on the top industry performers could drive a race to the top and encourage continuous improvement in U.S. factories. Standards could be set based on emissions per unit of output where possible or otherwise at the facility level (e.g., CO₂ per ton of cement or BTU per ton of ethylene produced). Refundable tax credits based on performance could be made available to businesses that invest to meet new standards and drive energy efficiency at the same time. To protect and stimulate American industry through this transition, a smart policy would apply the same emissions intensity methodology used in the domestic standard to border adjustments for imported goods.” (Federal Policies for Net Zero, 2020, 9)
- “An effort to reduce cement’s carbon intensity through programs focused on the development and implementation of low-carbon technology through subsidies and commercial incentives will allow for production to meet demand worldwide while still creating incentives for the deployment and development of green cement. Such a program would incentivize the creation and widespread adoption of not-yet mature technology that would make significant emissions reductions in cement possible in the future and set the stage for more aggressive targets at a future date. A particular model for participation would be a Triptych Approach similar to that which was originally used to support the allocation greenhouse gas targets of EU member states under the Kyoto Protocol. 64 This original approach considered the domestic sector, electricity sector, and a sector including carbon-intensive heavy industry such as cement in order to construct national greenhouse gas emission targets.” (Imbabi et al, 2012)
- “A technology sharing agreement that commits to providing common techniques and training already in deployment could easily begin to reduce the greenhouse gas emissions of the highest level polluters, as it would be easy to provide such technical assistance without significant additional cost, though there may be significant ital costs

associated with technical upgrades resulting from replacement of less efficient technology. 82” (Imbabi et al, 2012)

- “Once all the relevant technology is developed and pooled, a sectoral agreement could go on to create incentives for actual deployment through mandates, tax incentives, or specifically intervening in the market to provide purchasers for green cement. 93 Considering that there is not currently a mature market for green cement, one option discussed in Section II of this paper is for governments to create green procurement initiatives specifically requiring the purchase of green cement for construction. This model could create a permanent and sustainable market for green cement to begin commercialization of green cement by providing a guaranteed buyer on the other “side” to a cement producer who invests significant capital into a green plant.” (Imbabi et al, 2012)

Discussion and Analysis

- “There are several ways to make roadways stiffer, the researchers say. One way is to add a very small amount of synthetic fibers or carbon nanotubes to the mix when laying asphalt. Just a tenth of a percent of the inexpensive material could dramatically improve its stiffness, they say. Another way of increasing rigidity is simply to adjust the grading of the different sizes of aggregate used in the mix, to allow for a denser overall mix with more rock and less binder.” (MIT Roadways, 2020)
- “Yet another way is to switch from asphalt pavement surfaces to concrete, which has a higher initial cost but is more durable, leading to equal or lower total lifecycle costs. Many road surfaces in northern U.S. states already use concrete, but asphalt is more prevalent in the south. There, it makes even more of a difference, because asphalt is especially subject to deflection in hot weather, whereas concrete surfaces are relatively unaffected by heat. Just upgrading the road surfaces in Texas alone, the study showed, could make a significant impact because of the state’s large network of asphalt roads and its high temperatures.” (MIT Roadways, 2020)
- “Now, a theoretical study by MIT researchers suggests that small changes in roadway paving practices could reduce that efficiency loss, potentially eliminating a half-percent of the total greenhouse gas emissions from the transportation sector, at little to no cost. They found that one key to improving mileage efficiency is to make pavements that are stiffer, Kirchain explains. That reduces the amount of deflection, which reduces wear on the road but also reduces the slightly uphill motion the vehicle constantly has to make to rise out of its own depression in the road.” (MIT Roadways, 2020)
- Policies to note: Marin County has a low carbon concrete building code, Portland requires EPDs, Honolulu adopted a mineralized concrete resolution (Hastings Resolution Webinar, 2020)
- “Portland cement, the most common binder, accounts for more annual carbon emissions than every country on the planet, except for the U.S. and China.” Proposal “requires that carbon emissions from concrete become the determining factor, after cost and structural considerations, when selecting bids for state contracts. There are many ways to lower concrete emissions, from decades-old low-tech solutions to new technologies that use carbon in the production process itself. The idea is to incentivize suppliers to measure how much CO₂ their concrete mixes emit, which they have no obligation to report

currently. Then, suppliers must use any available fix to reduce emissions without ballooning costs, catalyzing a race to what was once considered far-fetched: affordable, carbon-sinking concrete.” (Prospect, 2020)

- “Governments are the largest purchasers of concrete... Climate Earth, an emissions analytics company, designed an EPD generator that enables concrete plants to create reports for new mixes within seconds after an initial setup period...” Additionally, many companies are deploying “carbon capture and utilization” technologies in the production process.” (Prospect, 2020)
- “The City Council will consider legislation requiring DEP and the Department of Transportation (DOT) to establish an expansive program to test the effectiveness and durability of sustainable pavements throughout the city... several cities, such as Boston and Chicago, have completed pilots and are now implementing targeted permeable pavement programs. As discussed above, annual precipitation has been increasing in New York City since at least 1900, and the severity of downpours is projected to grow in the future. Meanwhile, the NPCC found that an area’s permeability may play an even larger role in localized flooding than climate change.” (Securing Our Future, 2020, 63)
- “Analysis of the cement clinker kiln is based on dry process rotary clinker kiln cases (wet clinker production is less energy efficient compared with the dry process, which uses the residual heat of combustion to preheat the wet reactants¹¹²). Roughly 59 percent of carbon emission of cement clinker production comes from direct combustion to produce heat.¹¹³ The second largest portion of carbon emissions is reaction-associated carbon emission. The balance is indirect carbon emissions, such as electricity and transportation.

Dry clinker production requires 1,450°C minimum temperature, which limits potential low carbon heat options to H₂ and biofuel combustion and electric resistive heating. The original fuel for cement clinker production is assumed to be coal (which is commonly the case).

With these options, only blue hydrogen (natural gas SMR plus CCUS) appears to hold the potential for a lower cost than CCUS on heat production (see figure 8). For the case when power costs are extremely low (e.g., \$0.04/kWh firm), it may be possible to electrify heat, but substantial engineering improvement will be required with uncertain costs. The lower cost bounds for all replacement heat sources are all close to full-facility CCUS costs (with the exception of renewable hydrogen, which is much higher).

All options other than blue hydrogen would result in clinker prices at least 50 percent higher and in most cases likely double the price. The main reason is that clinker is very cheap to produce, as low as about \$40/ton, while the carbon intensity is high. Heat for cement production represents at least half the production cost, making the product costs especially sensitive to fuel cost. This suggests that heat substitution in cement may prove prohibitively expensive with CCUS as the preferred option. In contrast, all pathways could dramatically improve in the future with more advancements in technology, system integration, and process design.” (Low Carbon Heat, 2019, Considerations Of Specific Industrial Applications, pg. 44-45)

- “Some sectors, such as cement and glass, also have significant process emissions, and it may be more challenging to address those process emissions, as they are related to

chemical reactions and processes to meet safety, product-specific, or regulatory standards for the final products.” (CA Scoping Plan, 2017, 92)

- “C\$A’s production process is more efficient than that of traditional Portland cement, producing roughly 20% carbon dioxide per ton produced as compared to traditional cements... In order to push the adoption of Calcium Sulfoaluminate Cement (C\$A) cements governments will need to consider active intervention to encourage production and make it more economical to utilize C\$SA over traditional Portland cement. This may require direct funding of capital expenditures to convert plants and manufacturing equipment to produce C\$A. In addition, while C\$A does result in lower carbon emissions, it still emits a significant amount of carbon dioxide during production due to the underlying chemical processes used to produce it. This note addresses both potential mechanisms to drive the adoption of C\$A and methods for moving beyond C\$A towards carbon neutral cements requiring more radical changes to the cement production process.” (Imbabi et al, 2012)
- “Such cements even have the potential to absorb carbon dioxide during the production process, perhaps even resulting in a carbon negative cement that would mineralize carbon dioxide in the end product itself. 38 This process has the added benefit of using magnesium silicates that are common and widespread in nature, reducing potential material bottlenecks that plague other low cement options such as C\$A. 39 Similar options for cement sequestration and removal in concrete have been pursued by other companies, such as injecting carbon dioxide when rehydrating cement or sequestering it within cement through other means.” (Imbabi et al, 2012)
- “The cement industry, due to the need for significant technical innovation and commercialization of said innovation, would particularly benefit from a sectoral agreement. The unique structure of the cement industry also presents both opportunities and barriers for such an agreement. 48 The cement industry’s large scale of industrial production and emission makes it naturally attractive as a regulatory target. 49 However, outside of China cement production is primarily driven by the private sector, with government environmental regulation focused on pollution control and regulation instead of direct controls of cement production itself. 50 Cement production is also generally local or regional, with large-scale cement manufacturing fractured among many companies instead of a few larger corporations. 51 The large forecasted growth of the sector makes it a prime potential contributor to future emissions as well as a valuable target for preemptive action to reduce cement emissions and introduce low carbon manufacturing processes because such innovations will not only reduce current emissions as they displace Portland Cement production, they can also be deployed in place of traditional cement production before factories can be established. The opportunity to replace Portland Cement before it ever comes online can remove future emissions without having to reconfigure already existing processes or deal with invested actors.” (Imbabi et al, 2012)
- “One factor which suggests a cement sectoral agreement should focus on efficiency over targeting emissions directly is that cement is a critical material in construction for which demand in the developing world will continue to increase in the coming decades. 59 With such a massive increase in cement production anticipated over the next 10 years, it

is unlikely that overall emissions can be significantly reduced while still meeting global construction needs. 60” (Imbabi et al, 2012)

- “With cement demand uncertain but almost certain to grow immensely, countries will be very unlikely to sign onto any hard caps on emissions from the sector for fear of harming their own ability to produce cement needed for construction in a growing economy and because it would be entirely unclear what the actual limits on emissions should be.” (Imbabi et al, 2012)
- “Examples already exist of sectoral agreements which could be drawn on to develop the framework for a staged cement industry sectoral agreement. The most prominent example is The Montreal Protocol, which regulates ozone destroying chemicals, represents a successful sectoral agreement which could serve as a blueprint for the cement sector. 69 The Montreal Protocol provides potential models for the implementation of global sectoral regulation of the cement industry, and has been put forward as a potential model for other climate agreements from sectoral regulations to broader greenhouse gas agreements. 70 Of particular note in the Montreal Protocol is the phase-out plan for targeted chemicals known to negatively impact the ozone layer. 71” (Imbabi et al, 2012)
- “Because green cement production methods are currently in their infancy, a production plan for green cement must also create pathways for new cement technologies to achieve the targets needed for them to be commercialized and deployed on a large scale. 77 Considering these embryonic development levels, governments must take action to create markets in which these products can achieve production at scale. Within the cement sector, such exchanges will be even more crucial because moving to truly carbon neutral cement will require the deployment of technology still only in the prototype stage, and the fractured nature of the industry means that outside support may be needed to drive rapid implementation across the many small and medium-sized cement producers throughout the world.” (Imbabi et al, 2012)
- “It should be noted that for many high-polluting cement factories, high emissions are often the result of cheap electricity and high availability of high-polluting fuels such as coal rather than a lack of technical knowledge.” (Imbabi et al, 2012)
- “A green procurement program for cement will therefore have to absorb higher construction costs as the price of promoting and creating a market for green cement. All this points to the need for a willingness to invest significant funds and accept higher construction costs. In short, in order to kickstart green cement production, lawmakers and procurement managers at the federal level must be willing to absorb higher costs to advance carbon efficiency.” (Imbabi et al, 2012)
- “Examples of preferential procurement for green cement already exist at the local level and in some cities, for example with Dallas announcing a green cement purchasing policy in 2007 focused on shifting to cement mixes with lower levels of NOx. 139 Similar programs were implemented throughout Texas in the 2007-8 period to address air pollution across the state for several dangerous precursor chemicals, with such programs creating preferential terms in public procurement for materials produced with less polluting methods. 140 The most notable among these was implemented by the City of Plano, which allowed for preference to be given to qualifying green bids even when their prices exceeded non-green bids by up to 105%. 141” (Imbabi et al, 2012)

- “Domestically, significant coordination will be required across the cement sector and potentially cement companies in order to encourage a sustainable large-scale transition to green cement. Furthermore, as sectoral agreements often require specific techniques for production that reduce greenhouse gas emissions while simultaneously increasing production costs, potential sectoral agreements may require heavy regulation to ensure that all potential participants follow the agreement’s requirements.” (Imbabi et al, 2012)

Other Resources

Related Topics in this Document: Government Procurement

Portland city contract law: <https://www.portlandoregon.gov/brfs/article/731696>

Primary Metals (Steel and Aluminum)

Related LPDD Database Pathways

- Sectoral Emissions Controls: Primary Metals: <https://lpdd.org/pathway/sectoral-emissions-controls-primary-metals/>

Discussion and Analysis

- “The authors’ analysis focused on blast furnace operations specifically. The authors assumed coke and coal as the primary heat sources. The operational temperature requirement is 1,200°C, again, restricting options to H₂, biomass, and electric resistive heating. Blast furnaces consume up to 75 percent of coal energy content in an integrated facility, which provides primary energy and results in carbon emissions. Energy costs represent a substantial fraction of steel production costs (20 to about 40 percent) depending on fuel type, fuel price, and the full operational technology suite. Although the blast furnace consumes most of the input energy and emits most of the CO₂, fractional costs on blast furnaces’ energy input alone is much smaller than for cement production.” (Low Carbon Heat, 2019, Considerations Of Specific Industrial Applications, pg. 45)
- “The incremental cost increase for heat supply substitution is similar to the cement clinker case, with the two options of blue hydrogen and CCUS on heat production alone appearing to be the most cost competitive (see figure 9). Most other options overlap the range of the full facility CCUS baseline, except for renewable hydrogen, which is most expensive. Applying replacement heat sources would cause the blast furnaces’ energy costs to rise dramatically, from less than 10 percent to roughly 20 percent as a function of the technology option. This would cause the remaining energy costs to grow from 20 to about 40 percent for a total increase of 30 to about 50 percent. The effect on the final product’s price appears more manageable than the cement case. However, since steel costs more than cement, the total cost to consumers would be greater on a unit production basis.” (Low Carbon Heat, 2019, Considerations Of Specific Industrial Applications, pg. 45)

Other Resources

Related Topics in this Document: Industrial Process Incentives

Refrigerants, HFCs

LPDD Recommendations

- *“Utilities should include low-global warming potential refrigerants in their energy-efficiency incentive programs.”*
- *“State governments should restrict use of HFCs in building efficiency programs.”*
- *“State governments should update and amend their green purchasing program requirements to eliminate purchases of HFC-containing equipment where other low-global warming potential and more energy-efficient alternatives are available on the market.”*
- *“State legislatures or governors should adopt legislation or executive orders, respectively, mandating that state and local government agencies identify measures to reduce HFC emissions.”*
- *“States could reduce national HFC emissions from do-it-yourself mobile air conditioning by amending their existing rules to adopt California’s deposit and recycling program.”*

Related LPDD Database Pathways

- Regulatory Approaches to Reducing Fluorinated Gases:
<https://lpdd.org/pathway/regulatory-approaches-to-reducing-fluorinated-gases/>
- Reducing Fluorinated Gases through Purchasing Policies:
<https://lpdd.org/pathway/reducing-fluorinated-gases-through-purchasing-policies/>

Other Recommendations

- *“The purpose of this subarticle is to reduce hydrofluorocarbon (HFC) emissions by adopting specific prohibitions for certain substances in refrigeration, air-conditioning, chillers, ice rinks, cold storage, aerosols-propellants, and foam end-uses to support California’s progress toward the 2030 greenhouse gas emission reduction goals and hydrofluorocarbon emissions reduction targets as well as the Short Lived Climate Pollutant Strategy.” (California Air Resources Board Webinar, 2020)*
- *“Replace fluorinated gases” (U.S. Net Zero Emissions By 2050: Decarbonizing Industry, 2019)*
- *Slash potent “super-pollutants” from dairies, landfills and refrigerants. (CA Scoping Plan, 2017, 8)*

Discussion and Analysis

- Washington State Law, March 2019 on Reducing Hydrofluorocarbon Greenhouse Gas Emissions: “Hydrofluorocarbons came into widespread commercial use as United States environmental protection agency-approved replacements for ozone-depleting substances that were being phased out under an international agreement. However, under a 2017 federal appeals court ruling, while the environmental protection agency had been given the power to originally designate hydrofluorocarbons as suitable replacements for the ozone-depleting substances, the environmental protection agency did not have clear

authority to require the replacement of hydrofluorocarbons once the replacement of the original ozone-depleting substances had already occurred.” This act restricts sale of specific HFCs and creates a mandate to label products that emit HFCs when manufacturing.

(<https://apps.leg.wa.gov/billssummary/?BillNumber=1112&Year=2019&Initiative=false>)

- “Replace fluorinated gases (14%): Fluorinated gases (F-gases) used as refrigerants, propellants, and electrical insulators can be replaced with more climate-friendly alternatives serving the same functions, such as propane, ammonia, isobutane, and various synthetic chemicals. The Montreal Protocol, an international treaty that phased out the use of refrigerants that damage the ozone layer in the 1990s-2000s, has now been extended to similarly phase out F-gases that harm the climate. The U.S. must ratify this extension, which has strong bipartisan and business support, and would create economy-wide benefits including manufacturing jobs and U.S. exports.” (U.S. Net Zero Emissions By 2050: Decarbonizing Industry, 2019)
- “The Short-Lived Climate Pollutant Reduction Strategy also identifies measures that can reduce hydrofluorocarbon (HFC) emissions at national and international levels, in addition to State-level action that includes an incentive program to encourage the use of low-Global Warming Potential (GWP) refrigerants, and limitations on the use of high-GWP refrigerants in new refrigeration and air-conditioning equipment.” (CA Scoping Plan, 2017, 25)

Other Resources

Related Topics in this Document: Industrial Process Incentives

Bitcoin Mining

Other Recommendations

- “As for the New York Climate Leadership and Community Protection Act, banning Bitcoin or regulating it could be a “energy efficiency improvement” referred to in this part of the act: “A statewide goal of reducing energy consumption by 185 trillion British thermal units (BTUs) from the state's 2025 forecast through energy efficiency improvements.” A potential issue with these acts, however, is that they set generic goals rather than specific mandates or steps to move forward. If a Bitcoin ban is to be pursued through future acts, the legislators should write in specific “ban” language similar to California’s Assembly Bill 1826, which implemented organic waste bans and mandatory recycling. Four other states and six municipalities have done the same.” (Truby, 2018)
- “Taxation could be an effective way to counter Bitcoin energy usage. In general, there are three possible ways to use taxation—taxing miners, taxing people that trade money for Bitcoin, and taxing the people that send or receive Bitcoin. The last two are distinct. Bitcoin cannot be traded for money within the Bitcoin network. This transaction has to occur through a separate forum, which spurred the creation of “digital currency exchange” sites such as Coinbase. On Coinbase, people can securely buy and sell Bitcoin for their country’s currency. The “taxing of people that trade money for Bitcoin” means imposing a tax on the trade of Bitcoin for cash. Meanwhile, sending and receiving Bitcoin

occurs on the Bitcoin network and is broadcasted to every miner through the method described previously. “Taxing the people that send or receive Bitcoin” means imposing a tax on each time Bitcoin is sent or received.” (Truby, 2018)

- “One way to impose this tax would be to do so through a Value Added Tax. A Garrick and Rauchs study found that “large miners...are aware of the environmental impact of their activities,” and that these miners are particularly opposed to taxes, such as Value Added Taxes. Other options include a customs duty, an excise tax (similar to Belgium's Ecotax Law), or a tax of profits/exports. Id. In the UK, HMRC (Her Majesty's Revenue and Customs) transactions and miners are currently VAT exempt, but the option for future taxation has been left open. Id. Right now, a miner's main taxation concern is simply the income tax. If Bitcoin is received as payment for goods and services or if it is earned from mining, it will be treated as ordinary income and subject to state and federal income taxes... registering devices and introducing an annual emissions tax that differentiates rates charged “based upon the emissions output of the device.”... This is similar to the annual vehicle fee that exists in the UK. Id. This fee differentiates rates based on the emissions of each vehicle. The Czech Republic also has a similar approach. Id. They charge “different rates on different types of emissions used in industry.” Id. One problem, however, is if you tax the least advanced mining equipment (which is the least energy efficient), you will only capture the smallest mining operations. If you tax the most advanced mining equipment (which is the most energy efficient), miners could be run out of business, but that tax would have to be across all countries. If one country imposes this tax, but others do not then miners will simply migrate to the countries that do not have the tax. Or, if the miners don't migrate, new miners will inevitably pop up in the non-tax countries because they will realize that the competitiveness of the system has decreased. On a global-level, the emissions will remain the same. If you try to tax other non-Bitcoin specific resources that miners use, such as fans, wires, etc, that will impact normal people who purchase these items for normal use.” (Truby, 2018)
- “Other strategies to make Bitcoin more sustainable include creating laws surrounding heat regeneration and then using technology to make use of the heat. In Plattsburgh, the local law says: “No more than 20 percent of the heat dissipated by the mining activity shall be released directly to the outside when the average daily temperature is less than 40 degrees.” 68 A device called BitBox has been invented that can capture the heat of mining devices and exhaust it into buildings that need to be heated. Id. This does not ameliorate the environmental harms drastically, but can make a small difference. Similar heat regeneration laws can be implemented elsewhere as well, which will incentivize miners to use creative products like BitBox. Plattsburg also has a law that says “noise levels for cryptocurrency-mining operations cannot exceed 90 decibels at a distance of 25 feet from the containment structure's exterior.” Id. Creating more restrictive nuisance related laws could be a potential way to prevent Bitcoin operations from expanding as well. But this would be a challenge in foreign jurisdictions that might not follow similar property laws as the United States. Even in the United States, noise complaints have not always yielded effective results despite happening in Colorado Springs, Montana, Virginia, and Washington.⁶⁹ Moreover, most violations of local ordinances would only require miners to pay a small fine of a couple hundred dollars, which would not be an effective deterrent for these highly profitable mining operations.” (Truby, 2018)

- “One way to ban all three at once would be to pass a law that forbids U.S. citizens from mining, buying/selling, or sending/receiving Bitcoin. This would be similar to the Endangered Species Act, which states that no person subject to U.S. jurisdiction may trade in endangered species.⁵¹ Congress could rely on both the Currency Clause, as mentioned earlier, and the Commerce Clause.⁵² The Commerce Clause states that Congress has the power “to regulate commerce with foreign nations, and among the several states....” Id. In *Gonzalez v. Raich*, the commerce clause extended to federal regulation of homegrown marijuana even though it was not being sold within or outside of the state. Id. Although there is no precedent surrounding the Commerce Clause and cryptocurrency, it can be argued that because cryptocurrency is traded for cash, it functions like a good that is part of interstate and even international commerce. As for regulation and enforcement, Congress could give this authority to the SEC or CFTC.” (Truby, 2018)
- “In 2018, Plattsburgh responded and imposed an 18-month moratorium on commercial Bitcoin mines in an attempt to curb the increase in energy costs.⁴⁵ After they imposed this moratorium, other municipalities such as the Village of Rouses Point, Lake Placid and North Elba decided to do the same. In 2019, the New York State Public Service Commission permitted “upstate municipal power authorities to charge higher electric rates ‘to cryptocurrency companies that require huge amounts of electricity to conduct business.’”⁴⁷ Thus, the mining operators became responsible for paying overage costs. This system worked for the municipality because their main issue was financial, but the mining operators still consumed large amounts of energy. But a strategy similar to the moratorium can be used to stop Bitcoin’s impacts on a broader scale if local governments decide to ban Bitcoin generally rather than simply requiring miners pay for overage costs.” (Truby, 2018)
- “Another option is to tax the buying and selling of Bitcoin through sites like Coinbase. Coinbase basically acts as a broker. On Coinbase, you can pay cash for Bitcoin. Changing the tax code surrounding buying and selling Bitcoin could be helpful because, currently, Bitcoin and other crypto assets have relatively preferential tax treatments. The IRS has determined that cryptocurrencies are “property” and are to be taxed like a stock. Therefore, “if you buy Bitcoin and hold it for more than a year, you pay long-term capital gains when you sell. For federal taxes, that means you pay a 15% tax on any gains, unless you make a lot of money (more than \$479,000 (for married couples) or \$425,800 (for individuals)), in which case you pay 20%. That compares favorably with almost every other alternative investment.” (Truby, 2018)
- “Another way would be to add a sales tax to the use of Bitcoin for purchasing. There are numerous uses for Bitcoin, aside from the illegal uses. You can use Bitcoin for cross-border transactions, buying gift cards through Gyft or eGifter, paying for flights through Expedia, shopping at the Microsoft app store, downloading music, furnishing your house with Overstock, ordering a pizza through PizzaforCoins, and even paying for legal service.³⁵ So far, “only a few states offer clarification on the issue of sales tax and Bitcoin purchases. Most US states have absolutely no guidance whatsoever on how a merchant and customers should handle sales tax.” A sales tax that is higher than the normal sales tax for cash transactions could disincentivize people from using Bitcoin.” (Truby, 2018)

- “The last taxation method is to tax people for making Bitcoin transactions, such as sending someone Bitcoin or receiving Bitcoin. The major problem that arises is that it’s nearly impossible for the IRS to enforce this as Bitcoin transactions are all anonymous and Decentralized.” (Truby, 2018)

Discussion and Analysis

- “Mining is like a lottery system. In order to win this lottery as often as possible, you are incentivized to gather and use an immense amount of computing resources. Computing resources includes (1) electricity, (2) the hardware (3) the capacity of your data center to cool the components after the computers have converted electricity into heat, and (4) the amount of space available. These resources, particularly electricity usage and the carbon footprint that leaves, directly translates to environmental harm.” (Truby, 2018)
- “Due to the decentralization and scarcity, miners are highly incentivized to use resources and use them as voraciously as possible. This has led to real world consequences. In 2019, a study done by researchers from Technical University of Munich (TUM) in Germany showed that Bitcoin alone emits “over 22 megatonnes of carbon dioxide annually, comparable to the total emissions of cities such as Las Vegas and Vienna....” When other cryptocurrencies are considered, the emissions figure could roughly double. In 2018 alone, the Bitcoin network used more power than the country of Ireland and Denmark, and even the processes of a single Bitcoin transaction could provide electricity to a British home for a month. Moreover, in 2017, the increased power usage demanded by Bitcoin contributed to blackouts in countries such as Venezuela because people were turning to Bitcoin as an alternative to hyperinflation (Grist 2017). In 2019, King & Spalding released an energy newsletter that evaluated the carbon footprint of Bitcoin. In that newsletter, they found that a single Bitcoin transaction contributes as much carbon as burning two 14-gallon tanks of gasoline in an average American car. 8 They also reported that in a 24-hour period there are over 390,000 transactions. Id. Unfortunately, Bitcoin’s energy consumption is only increasing... And as of 2019, it is estimated that Bitcoin used roughly 64 TWh of energy consumption, which was equal to roughly 0.21% of the world’s supply.” 64TWh “is more than the country of Switzerland uses (58 TWh per year), but less than Colombia (68 TWh per year). In the ranks of nations, it is the ‘41st most energy-demanding country.’” (Truby, 2018)
- “The most promising of the three approaches seems to be the first—taxing miners. There are several ways to do this. This could work because miners depend on this technology and if it becomes too expensive to purchase it, then they may abandon mining. In the past, any person used to be able to mine for Bitcoin on their laptop or desktop computer, but mining became more and more difficult as people found faster ways to solve the problems. Soon, Bitcoin mining was not achievable by just anyone. Miners needed specific, highly efficient technology such as graphic cards to be competitive.²⁷ Now, graphics cards have been surpassed by ASICs (Application Specific Integrated Circuits). Id. ASIC “is a microchip designed and manufactured for the sole purpose of mining Bitcoins at breakneck speed. It offers a 100x increase in hashing power, while reducing electricity consumption compared to all the previous technologies. Some experts consider ASIC to be the ‘end-of-the-line’ technology, as there is nothing to replace it in

the immediate future.... Since Bitcoin mining involves racing other miners, any miner who can't get access to the high-tech equipment will not be able to win often enough to make a profit. Thus, this ASIC equipment is crucial for miners and could be a useful place to start taxation. If miners are taxed heavily for buying the equipment or manufacturers are taxed heavily for making the equipment, these additional costs could potentially determiners." (Truby, 2018)

Other Resources

Related Topics in this Document: Industrial Process Incentives

Natural Gas Production, Processing and Distribution

New York Actions

- Creation of the NYS Methane Reduction Plan, the results of which are listed below in the *Other Recommendations* section

LPDD Recommendations

- *“State legislatures or environmental agencies can consider adopting regulations to cost effectively control venting, flaring, and leaks from well sites.”*
- *“PHMSA or state pipeline safety authorities could update their existing regulations to require the prompt detection and repair of all leaks.”*
- *“State PUCs could change existing cost recovery frameworks where they discourage repair by, for example, impos-ing the risk of increased leakage entirely on customers.”*
- *“States could impose an outright ban on new coal-fired generation and/or a formal limit on new natural gas gen-eration additions.”*

Related LPDD Database Pathways

- Regulation of oil and gas sector methane emissions: <https://lpdd.org/pathway/regulation-of-oil-and-gas-sector-methane-emissions/>
- Pipeline Leaks: <https://lpdd.org/pathway/pipeline-leaks/>

Other Recommendations

- “Reduce methane emissions from production and transmission infrastructure that can be regulated by DEC as air emission sources. [DEC]
 - “Implement new EPA rules: New Source Performance Standards³ for new/modified sources of methane emissions (40 CFR 60 Subpart OOOOa).
 - Develop, propose and adopt regulations, as necessary, to limit emissions from existing transmission facilities (e.g., compressor stations) not regulated by the federal New Source Performance Standards. Regulatory development will include the collection of data on emissions from existing sources, due to EPA’s abandonment of its information-gathering efforts in March 2017. DEC will base potential regulations in part on EPA’s Control Techniques Guidelines for existing sources of volatile organic compounds from natural gas industry emission sources. DEC will also evaluate other natural gas infrastructure for potential air

emissions and the feasibility of reducing identified emissions, and increase monitoring and accounting of emissions from gas component infrastructure.” (Methane Reduction Plan, 2017, pg. 5)

- “Reduce methane emissions from gathering lines.
 - Propose policy or changes to permitting programs to require odorization⁴ of existing gathering lines, for both enhanced safety and methane monitoring.
 - Modify existing requirements to address repairs of leaks on gathering lines and leak monitoring, as necessary.” (Methane Reduction Plan, 2017, pg. 5-6)
- “Reduce methane emissions from oil and gas storage, abandoned wells, and other infrastructure that is not directly regulated as an emission source. 5 [DEC, DPS]
 - Revise or establish policy or guidance to promote best practices that result in the identification and reduction of emissions in operation, monitoring, emergency response, and other plans required for permit/registration approval, evaluations, and renewals.
 - Evaluate and implement changes to regulations, policy, or guidance to address emissions from non-permitted, orphaned or abandoned infrastructure.
 - Continue to properly plug abandoned natural gas and oil wells that otherwise may be a long-term source of methane emissions. One hundred and fifty abandoned oil wells and thirty abandoned natural gas wells are scheduled for proper plugging by 2020.
 - Continue to inspect active natural gas wells for methane leaks and require leaks to be repaired. Investigate and utilize, to the extent feasible, additional technology for detection of leaks.
 - Modify existing requirements to align with Pipeline and Hazardous Materials Safety Administration (PHMSA) rules⁶ to address safety issues and emissions related to underground natural gas storage.” (Methane Reduction Plan, 2017, pg. 6)
- “Reduce methane emissions from oil and gas storage, abandoned wells, and other infrastructure that is not directly regulated as an emission source. 5 [DEC, DPS]
 - Revise or establish policy or guidance to promote best practices that result in the identification and reduction of emissions in operation, monitoring, emergency response, and other plans required for permit/registration approval, evaluations, and renewals.
 - Evaluate and implement changes to regulations, policy, or guidance to address emissions from non-permitted, orphaned or abandoned infrastructure.
 - Continue to properly plug abandoned natural gas and oil wells that otherwise may be a long-term source of methane emissions. One hundred and fifty abandoned oil wells and thirty abandoned natural gas wells are scheduled for proper plugging by 2020.
 - Continue to inspect active natural gas wells for methane leaks and require leaks to be repaired. Investigate and utilize, to the extent feasible, additional technology for detection of leaks.
 - Modify existing requirements to align with Pipeline and Hazardous Materials Safety Administration (PHMSA) rules⁶ to address safety issues and emissions

related to underground natural gas storage.” (Methane Reduction Plan, 2017 pg. 6)

- “Prioritize leak repairs in the distribution system. [DPS]
 - Utilize rate cases to incentivize utilities to maintain a low backlog of leaks and replace leak-prone pipe for State jurisdictional pipeline operators. 7
 - Intervene at the Federal Energy Regulatory Commission to prioritize leak repair when interstate pipelines file rate cases.
 - Refine current methodology and ranking system for repair of non-health and safety-related leaks⁸ and determine if incentives are required in rate cases to ensure higher volume leaks are addressed by utilities, regardless of classification.
 - Identify alternative funding or business models for leak repair, particularly leaks on customer-owned infrastructure, that do not rely on ratepayers and that prioritize the safety of low-income communities such as the Quadrennial Energy Review’s Natural Gas Infrastructure Modernization Initiative. 9
 - Remove barriers to replacement of leak-prone infrastructure through local tax reform. Work with localities to establish tax policies which help to limit rate pressure due to infrastructure replacement for safety and environmental improvement.” (Methane Reduction Plan, 2017 pg. 6-7)
- “Improve Management of Methane Emissions by Requiring Monitoring and Reporting
 - Revise regulations and policy to improve accounting, including inventory, of infrastructure emissions, repairs, operations, equipment, and components. [DEC lead; DPS]
 - Revise regulations to support adoption of new technologies to meet monitoring requirements. [DEC lead; DPS]
 - Develop and implement residential methane detection and educational outreach to enhance safety and GHG emissions control (e.g., ‘soft-offs’, gas leak and odor reporting) including widespread installation of stationary methane detection and advancing large scale deployment and commercialization of a new technology for residential methane detection. [DPS]” (Methane Reduction Plan, 2017 pg. 7)
- “Improve Consistency Across Regulatory Jurisdictions and Programs
 - Establish an interagency Memorandum of Understanding to share knowledge across regulatory boundaries and facilitate effectiveness and consistency across agencies. This will allow utilities and infrastructure owners to comply with requirements utilizing similar actions and equipment. [DEC lead; DPS]
 - Update and improve State Environmental Quality Review Act guidance for assessing greenhouse gas emissions including methane. This guidance will also address projected effects of climate change on infrastructure, including oil and gas infrastructure. [DEC]
 - Formalize and standardize DEC’s review process regarding mitigation of methane emissions from new transmission infrastructure projects, including those subject to primary jurisdiction of the federal government. [DEC]” (Methane Reduction Plan, 2017 pg. 7-8)

Discussion and Analysis

- “Methane capture and destruction (8%): Methane is the main component of natural gas, with a heat-trapping ability 28 times that of CO₂ per molecule over a 100-year timescale. Leaks from natural gas wellheads, pipelines, and equipment were responsible for 31% of U.S. methane emissions in 2015 while coal mining was responsible for another 9%. Better monitoring and prompt repair of natural gas leaks and systems to destroy methane leaking from coal mines (or phasing out coal mining) can help reduce these emissions.” (U.S. Net Zero Emissions By 2050: Decarbonizing Industry, 2019)

Other Resources

Related Topics in this Document: Closure of Existing Natural Gas Plants

Industrial Process Incentives

New York Actions

- “DOE also is helping with smart manufacturing, including through the Clean Energy Smart Manufacturing Innovation Institute.¹⁹ The Smart Manufacturing Leadership Act (S.715/H.R. 1633 in the 116th Congress) would expand federal assistance. DOE’s Industrial Assessment Centers also help bring SEM and smart manufacturing to smaller plants.²⁰ DOE’s Save Energy Now program also provided effective energy audits in large plants (Wright et al. 2010). An expanded version could bring newer technologies to the largest energy users.” (Halfway There, 2019, pg. 15)
- “In April 2018, Governor Cuomo announced the energy efficiency target along with the policy framework and the commitment by the State to lead by example. Next steps to advance and implement the policy include stakeholder engagement; technical conferences; Public Service Commission deliberations and actions; legislative proposals; State agency climate and capital planning; and development of Clean Energy Fund initiatives.” (New Efficiency: New York 2018)

LPDD Recommendations

- “DOE, state and local governments should employ a mix of policies to drive material efficiency across the life cycle.”

Related LPPD Database Pathways

- Subsidy Support for Industrial Process Improvements: <https://lpdd.org/pathway/subsidy-support-for-industrial-process-improvements/>
- Material Efficiency: <https://lpdd.org/pathway/material-efficiency/>

Other Recommendations

- “To achieve these savings, improvements—including those that take advantage of R&D advances—must be made in industrial processes at opportune times, such as when facilities are periodically modernized. We also need to provide risk sharing for industrial firms as they make major new investments in new process technologies and products. Manufacturing firms are by nature capital-intensive and often low-margin businesses, so they have limited ability to take on additional risk without public or private sector

mechanisms managing new investments that replace existing assets.” (Halfway There, 2019, 15)

- “Expand DOE’s Save Energy Now program to include new technology.” (Halfway There, 2019, 15)
- “Further incentive programs through utilities or the federal and state governments would spur faster adoption... Renewed focus on cooperative research with energy-intensive industries will be needed to develop, demonstrate, and commercialize the process changes needed. Assistance is necessary not just to invent new technologies and practices but to test them and promote their early deployment. Policies can also help focus corporate management attention.” (Halfway There, 2019, 15)
- “Voluntary incentive programs would be established to reduce the carbon intensity of industrial operations within the state, while fostering increased industrial activity through programs that result in more efficient, productive and cost effective operations. These programs would be available to both existing facilities and new facilities and processes, particularly those new industrial facilities involved in the clean energy economy. The policy option would establish a voluntary program, similar to existing energy efficiency programs, which provides technical assistance and financial incentives. Similar to Leadership in Energy and Environmental Design (LEED), the voluntary program would also provide recognition to industrial facilities that have met defined targets for reduction of their carbon intensity on a per-facility basis. The programs would include, but are not limited, to: Efficiency measures, including building energy efficiency, process optimization, water usage minimization, minimization of waste generation, e.g., solid wastes and wastewater; Adoption of advanced process technologies, including electro-technologies, which result in an immediate net reduction in carbon intensity; Installation of CHP systems; Waste heat capture and reuse, either onsite, including the production of electricity from waste heat (bottoming cycles), or shared with neighbors through district energy systems; Application of renewable energy systems, including the use of renewable fuels.” (CAC Report 2010, Chapter 6, page 24)

Discussion and Analysis

- “Special policy options may be needed to decarbonize industrial heat. The high cost and low technical maturity of most low-carbon heat options in most applications limit policy approaches substantially. The complexities of trade, labor, and security are acute in heavy industry energy policy and politics, and the risk of backlash to poorly designed policy appears substantial. Many industrial sectors are exempted today from carbon control policies.” (Low Carbon Heat, 2019, Findings and Conclusions, pg. 60)
- “Several policy options appear both effective and actionable. Of the policy options explored, government “buy clean” procurement policies appear to have low political risk and could stimulate private investment in low-carbon heat options by creating a new customer for low-carbon products—substantial volumes of industrial product are purchased directly by governments. An innovation policy also appears to carry low political risk while accelerating creation of new options and deployment of existing options by accelerating cost reduction and discovery” (Low Carbon Heat, 2019, Findings and Conclusions, pg. 60)

- “As discussed above, many relevant industries trade into international commodity markets. Part of the challenge in driving industrial decarbonization lies in the potential trade risks faced by domestic industry, which could lead to carbon leakage, job loss, trade deficits, and other negative consequences. One potential mechanism to guard against these outcomes is the development of a border tax adjustment (BTA), a tariff based on the carbon footprint of key materials (e.g., fuels, steel). Using some formula, a nation’s government would apply a tax on imported goods related to their carbon footprint. This would provide a benefit in protecting domestic industry that pursues decarbonization as well as potentially incentivize trading partners to pursue decarbonization as well. For cases in which low-carbon heat is more economic than alternatives, a BTA could stimulate deployment.

BTAs on carbon have been considered for many years but not implemented. In part, lawmakers carry concerns about the potential negative consequences, equity concerns, and World Trade Organization compliance. In theory, it is possible to structure BTAs with minimal negative consequences, but to date politicians have been reluctant to undertake them. This may be changing both in the United States and overseas.” (Low Carbon Heat, 2019, Implications for Policy, pg. 58)

- “Industry energy efficiency standards (3%): Industrial energy efficiency investments reduce emissions and fuel expenditures, typically with short payback periods. There remains a great deal of untapped potential for efficiency improvements through new technologies and increased adoption of best practice existing technologies (such as variable speed drives and highly efficient boilers with heat recovery). Designing entire systems for efficiency, rather than simply buying efficient individual components (motors, pumps, etc.), is a crucial strategy. Note that potential abatement from efficiency standards appears low (3%) in this policy pathway because industry transitions to 100% clean energy by 2050 in this net zero scenario. Efficiency standards will drive more emissions reductions if industry fails to meet the 100% clean energy target, and even if industry does achieve this target, efficiency standards lower overall costs by reducing the amount of clean energy generation capacity that must be built by 2050.” (U.S. Net Zero Emissions By 2050: Decarbonizing Industry, 2019)

Other Resources

Related Topics in this Document: Low Carbon Thermal Solutions

Low Carbon Thermal Solutions / Industrial Heat Emissions

Other Recommendations

- “New policies specific to heavy industry heat and decarbonization are required to stimulate market adoption. Policies must address concerns about leakage and global commodity trade effects as well as the environmental consequences. These policies could include sets of incentives (e.g., government procurement mandates, tax credits, feed-in tariffs) large enough to overcome the trade and cost concerns. Alternatively, policies like border adjustment tariffs would help protect against leakage or trade impacts. Because

all options suffer from multiple challenges or deficiencies, innovation policy (including programs that both create additional options and improve existing options) is essential to deliver rapid progress in industrial heat decarbonization and requires new programs and funding.” (Low Carbon Heat, 2019, Executive Summary, pg. 9)

Discussion and Analysis

- “In New York, process heating accounts for more than one-fourth of total manufacturing energy use, making it the largest end use in the segment. Process heating is also significant in net electricity consumption in manufacturing. As such, improvements in process heating present opportunities to reduce costs, improve productivity, and lower greenhouse gas emissions. Process heating includes tasks that use energy to raise heat substances or products involved in the manufacturing process. Process heating is central to the manufacture of an array of consumer and industrial products. Electric technologies use electric current or electromagnetic fields to heat or melt materials. Direct heating methods generate heat within a work piece by passing current through the material, inducing an electrical current (eddy current) into the material, or exciting atoms and/or molecules in the material with electromagnetic radiation. Other heating methods use direct heating methods to heat an element or susceptor that transfers the heat to the workpiece by conduction, convection, radiation, or a combination of these.” (Electrification Scenarios, 2020, 53)
- “Infrared curing and drying. Whereas convection ovens first heat the air to transmit heat to a product, infrared (IR) transmits heat through electromagnetic waves. Electric infrared emitters are primarily used to cure and dry paint or powder coatings, but they can also dry textiles and thermoform plastics. Although IR typically offers increased controllability, it requires line-of-sight transmission that can limit applicability for complex geometries.” (Electrification Scenarios, 2020, 53)
- “Induction surface heat treating. Induction heat treating can be used in many industries that manufacture metal parts. The surface heat treating of metals is a common manufacturing process that produces a hard, durable surface on a softer, ductile metal part. Induction heating offers increased controllability compared to conventional methods but may be less applicable for jobs requiring short production runs.” (Electrification Scenarios, 2020, 53)
- “Induction melting. The melting of conductive material with induction is more flexible, safer, faster, and cleaner than competing coke-fired cupola or natural gas reverberatory furnace technologies. Induction melting appears to favor lower production runs and agile manufacturers, but it also has beneficial applications for high-production runs. Capacity limitations, however, may lead to a higher capital cost per casting rate in some cases.” (Electrification Scenarios, 2020, 54)
- “Resistance heating. Electric resistance heating is broadly applicable in a wide range of industrial processes. It produces no on-site emissions, requires lower setup cost, and can be applied to conductive and non-conductive materials. Because of the underlying inefficiencies associated with resistance technologies, it is difficult to make the economic case for resistance heating based purely on energy cost savings.” (Electrification Scenarios, 2020, 54)

- “Resistance melting. Resistance melting is most commonly used in glass manufacturing. Glass manufacturing involves glass production using melting and refining of raw materials, coating to make a reflective glass surface, annealing to relieve internal stress, inspection, and cutting. Most of the energy—nearly 80% of the total—is used in the melting and refining of the raw materials. Although electric is more efficient and offers additional benefits over conventional fossil-fuel-fired furnaces, capital and energy costs can be higher.” (Electrification Scenarios, 2020, 54)
- “Ultraviolet curing. Ultraviolet (UV) light can be used to polymerize and instantly harden specially compounded coatings, inks, and adhesives. Newer UV LED lamps offer significant improvements in efficiency but at higher capital costs. With further development, the capital cost of LED-based systems is expected to drop.” (Electrification Scenarios, 2020, 54)
- “Electric resistance boilers. These use an electrically resistive heating element and thermostat to maintain temperature to produce hot water or steam. Electric resistance boilers are available in capacities up to ~4 MW and have high efficiency (>90%) in converting water to steam as well as low standby losses. However, because of higher capital and annual energy costs compared to gas boilers, adoption is expected to remain low.” (Electrification Scenarios, 2020, 54)
- “Electrode boilers. Electrode boilers use specific electrodes to apply current to the water stream to generate steam for applications that require high heat output and fast recovery. For applications >4 MW, electrode boilers are attractive because they can quickly provide higher heat output. Although electrode boilers are usually less expensive to install than electric resistance boilers, economic comparisons to gas or fuel-oil boilers remain a major hurdle.” (Electrification Scenarios, 2020, 54)
- “Hydrogen combustion provided the readiest source of heat of all the options assessed, was the simplest to apply (including retrofit), and was the most tractable life-cycle basis. Today, hydrogen produced from reforming natural gas and decarbonized with CCUS (blue hydrogen) has the best cost profile for most applications and the most mature supply chain, and it would commonly add 10–50 percent to wholesale production costs. It also could provide a pathway to increase substitution with hydrogen produced by electrolysis of water from carbon-free electricity (green hydrogen), which today would increase costs 200–800 percent but would drop as low-carbon power supplies grow and electrolyzer costs drop. Hydrogen-based industrial heat provides an actionable pathway to start industrial decarbonization at once, particularly in the petrochemical, refining, and glass sectors, while over time reducing cost and contribution of fossil sources. However, substitution of hydrogen will prove more difficult or infeasible for steel and cement, which might require more comprehensive redesign and investment.” (Low Carbon Heat, 2019, Executive Summary, pg. 8)
- “To make progress on industrial heat decarbonization, a wider set of policy options is required, including some unconventional options. These policy design considerations should be observed to maximize value and minimize disruption or distortion of markets.
 - As much as possible, policies should remain technology agnostic.
 - As much as possible, policies should be applied economy wide, recognizing that specific options could be preferred locally because of engineering design or resource availability.

- As much as possible, policies should minimize direct impacts on the consumer.
- Policies should encourage private investment and innovation.
- Policies should focus on the desired outcome (emissions reduction from industrial heat systems) rather than mechanisms or specific pathways.
- All policies should be time limited and eventually phase out.” (Low Carbon Heat, 2019, Implications for Policy, pg. 54)
- “Ultimately, potential policies to deploy low-carbon heat options should respect and recognize the resource limits associated with geography, which include limits to renewable energy resources (e.g., solar radiance or wind strength), availability of CO₂ storage resources (e.g., for blue hydrogen production), and the geographic availability of key feedstocks (e.g., biomass, natural gas). To achieve the outcome desired — decarbonized industrial emissions — policy designs should allow maximal room for competing approaches and novel configurations.” (Low Carbon Heat, 2019, Implications for Policy, pg. 54)
- “Today, most alternatives to generate low-carbon heat cost significantly more than current heating fuels and systems. Compared to fossil fuel costs (mostly coal and gas), all options show a significant price increase of 2–20 times. These costs are sensitive to price of feedstocks (electric power, natural gas, biomass) and almost certainly carry additional hidden costs associated with poor conversion efficiency, poor heat deposition in real facilities, and system related costs (e.g., infrastructure build-out)” (Low Carbon Heat, 2019, Findings And Conclusions, pg. 60-61)
- “Providing low-carbon heat would likely increase the wholesale cost of production substantially. Because high-quality heat is vital to industrial operations, increased cost of low carbon heat would yield higher unit production costs. Increases would range from 10–200 percent, depending on heat supply, industrial sector, and specific application.” (Low Carbon Heat, 2019, Findings And Conclusions, pg. 60-61)
- “More options and better options are needed. Given the urgency for deep decarbonization globally, options for substitution are essential. Given the paucity of good industrial heat-related emissions options, the current set is hard to deploy even with substantial subsidies. Researchers, governments, industrial leaders, and investors must add greatly to existing efforts to develop new and better solutions or to improve existing ones dramatically.” (Low Carbon Heat, 2019, Findings And Conclusions, pg. 60-61)
- “Much more policy support is needed to decarbonize heat, and there are several options that should be considered, including an RNG mandate requiring that a portion of natural gas consumption come from sources outlined in this paper. The mandate would be the same concept as the RPS and RFS, but focused on heat. New research funding is also needed, not only for research and development and new technologies but also to demonstrate synergy between a decarbonized electricity and gas network and the integration of both systems.” (Chahbazpourr, 2019, pg. 70)

Other Resources

Related Topics in this Document:

Miscellaneous

Regulating the Film Industry

- “MAYOR’S OFFICE OF MEDIA AND ENTERTAINMENT - MOME is overseeing NYC Film Green, a first-of-its-kind environmental sustainability program for the film and television industry, which offers productions with at least one shooting day in NYC the opportunity to be recognized for their efforts to reduce their impact on the environment. In exchange for tracking basic resource usage (including utilities, fuel, and housing) and satisfying certain sustainability benchmarks in the areas of waste diversion, energy conservation, and crew education, qualifying productions will receive the NYC Film Green mark of distinction to place in end credits and any marketing and promotional materials.” (NYC 1.5C, 2017, Agency Highlights, pg. 38)

Glass and Ceramics

- “Glass furnaces require very high temperatures for operation: 1,500°C minimum with typical target temperatures around 1,575°C. Glass furnaces consume about 60 to about 80 percent of the energy input for typical flat glass and container glass manufacturing, with somewhat lower fractions for specialty glass and fiberglass. For flat and container glass, heat produces about 70 percent of the total emission. Natural gas is the typical fuel in the United States for glassmaking and is used as the basis for comparison in figure 10.
Applying CCUS on furnace systems only does not dramatically change the unit cost of glass production and is nearly identical to CCUS applied to the total system. The two CCUS options, along with blue hydrogen, yield a roughly 10 percent hike on production costs. Most other options increase costs roughly 30 percent, while renewable hydrogen effectively would double production costs.” (Low Carbon Heat, 2019, Considerations Of Specific Industrial Applications, pg. 47)

Ammonia Production

- “Ammonia is essential for fertilizer production, which affects food production and national security. Ammonia is also a potential substitute liquid transportation fuel and a potential option to ship hydrogen with minimal associated GHG emissions. One of the most energy intensive industries, ammonia production consumes about 1 percent of total energy around the world. The Haber-Bosch process is the main industrial procedure for ammonia production ($N_2 + 3H_2 \rightarrow 2NH_3$), typically coupled with hydrogen production from SMR or coal gasification.” (Low Carbon Heat, 2019, Considerations Of Specific Industrial Applications, pg. 48-49)
- “The ammonia operation requires temperatures of 800°C, chiefly to operate the SMR process to make hydrogen. The Haber-Bosch process operates at about 450°C. These temperature ranges allow heat from advanced nuclear systems to conceivably apply. An additional comparison is added to ammonia production: H₂ without CCUS applied (use hydrogen onsite) as a basis for comparison with current practice.” (Low Carbon Heat, 2019, Considerations Of Specific Industrial Applications, pg. 48-49)
- “Unsurprisingly, ammonia production using on-site H₂ SMR without CCUS (today’s practice) yields the lowest cost addition but almost no decarbonization (see figure 11). The estimated cost increment associated with CCUS applied to heat sources is less than

10 percent, close to that of blue hydrogen. Since H₂ is a critical feedstock to ammonia production, there may be additional synergies that come from additional H₂ generated on site as a heat source.” (Low Carbon Heat, 2019, Considerations Of Specific Industrial Applications, pg. 48-49)

- “Using ammonia as a proxy for relatively high-temperature kinds of petrochemical production reveals an intuitive fact: decarbonization is expensive. In this analysis, the more decarbonized the heat source is, the more expensive it is as well, which affects total product cost. Deep decarbonization options such as green hydrogen and CCUS on the full system are among the most expensive choices. The other options that have relatively low cost either offer limited decarbonization (e.g., on-site H₂ without CCUS) or are too speculative or uncertain to deploy (e.g., advanced nuclear heat).” (Low Carbon Heat, 2019, Considerations Of Specific Industrial Applications, pg. 48-49)

Menthol Production

- “The comparison results reveal that CCUS applied directly to heat or the whole facility appears to be the lowest cost decarbonization pathway (see figure 12). This is also the only case when a clear winner seems apparent for all pathways. The authors believe two factors are most important. First, methanol production is energy intensive, making replacement heat sources expensive to unit costs. Second, carbon is an essential chemical feedstock that remains in the product, greatly reducing the carbon intensity of methanol production. However, it may prove that applying CCUS to the heat sources in these facilities is prohibitively difficult. Many petrochemical plants (including methanol plants) have tens to hundreds of small distributed heat sources (burners and furnaces), which may prove unworkable for CCUS from an operational perspective. Additional analysis is required to test this initial conclusion.” (Low Carbon Heat, 2019, Considerations Of Specific Industrial Applications, pg. 49)

Electricity Generation

Closure of Existing Fossil Fuel Facilities

New York Actions

- NY has emissions limits on power plants that effectively bans coal:
<https://lpdd.org/resources/new-york-co2-limits-on-power-plants/>

LPDD Recommendations

- “States could impose an outright ban on new coal-fired generation and/or a formal limit on new natural gas generation additions.”
- “State legislatures should re-envision the severance taxes that create natural resource trust funds as tools for phasing down extraction of fossil fuels and raising more near-term resources for social policies that support just transitions.”

- “State governments could pay utilities the remaining ‘book value’ for investor utility-owned plants, and negotiate prices with private plant owners to pay them to close GHG-emitting facilities.”
- “States could ban or limit coal mining and oil and gas production.”
- “States could impose an outright ban on new coal-fired generation and/or a formal limit on new natural gas generation additions.”

Related LPDD Database Pathways

- Prohibiting Oil and Gas Extraction: <https://lpdd.org/pathway/prohibiting-oil-and-gas-extraction/>
- Restricting New Fossil Fuel Powered Plants: <https://lpdd.org/pathway/restricting-new-fossil-fuel-powered-plants/>

Recommendations

- “This White Paper proposes that the Commission amend the requirements for repowered facilities to be eligible for Tier 1. The goal of this proposal is to ensure that existing facilities see the correct price signal for repowering, while avoiding any duplicative expenditure of ratepayer funds for facilities that have already received support and have yet to reach the end of their useful lives. For purposes of this proposal, the useful life of wind and solar facilities shall be deemed to be 20 years, and for hydroelectric facilities shall be 50 years.” (CES White Paper, 2020, 61)
- “Establish an economy-wide carbon pricing system to deliver effective price signals to energy consumers throughout the state” (Getting Greener, 2019, pg. 39-40)
- “Retain the use of nuclear energy to continue to obtain the benefits of carbon avoidance” (Getting Greener, 2019, pg. 39-40)
- “Look beyond the borders of New York State for low-cost, low-emissions energy supplies and for opportunities to cut global GHG emissions” (Getting Greener, 2019, pg. 39-40)
- “Avoid self-imposed constraints such as limiting gas pipeline capacity” (Getting Greener, 2019, pg. 39-40)
- “Promote broad transportation solutions that build on existing infrastructure” (Getting Greener, 2019, pg. 39-40)
- “Establish a prioritization system to pursue renewables that provide the greatest GHG reductions at lowest cost.” (Getting Greener, 2019, pg. 39-40)
- “A carbon price can provide the financial incentives needed to keep the best, most efficient, and lowest-carbon fossil units on the system in safe and efficient form, and provide the locational price signal needed for retention of the right fossil resources in the right locations to support reliable operations.” (NYISO, 2019, 39)
- “Intense, continued focus on resolving the 80% in-city generation requirement is needed.” (Kass, 2018, 56)
- “Conduct a study in partnership with local electric and gas utilities on a utility transition plan to achieve 80 x 50, including potential impacts to electricity demand and the natural gas system” (NYC 1.5C, 2017, 2020 Climate Actions, pg. 20)

Discussion and Analysis

- The challenge for New York is to adopt efficient approaches to achieve the worthy long-term GHG reduction goals while limiting harm to the state’s economic competitiveness. With this in mind, New York should prioritize the most cost-effective options in terms of incremental carbon reduction per dollar spent. Doing so will require: Reducing GHG emissions of all sectors in the economy; Maintaining optionality with respect to fuels, sources, and technologies, with a portfolio approach that includes short and long-term contract commitments; and Partnering with other states and Canada to promote market solutions. (Getting Greener, 2019, Recommendations To Achieve GHG Emission Reduction Goals, pg. 39-40)
- “Renewables are and should continue to be part of the state’s energy portfolio; however, policymakers should allow price signals to determine how much wind capacity, distributed solar, utility-scale solar, and hydroelectric power is built rather than mandating specific technologies. All these projects should be put on a common basis of cost to consumer for tons of GHG avoided and those with the lowest net cost should be prioritized for development and contracts. Clear economic signals provide the best opportunity to find the most cost-effective solutions; this should not preclude short-term use of natural gas to meet emission targets. Proponents of renewable power have voiced concern over making commitments to natural gas pipelines that will lock in financial commitments for decades. There should be a similar concern that the rush to build offshore wind commits electric customers to pay for expensive power contracts for the next two decades.” (Getting Greener, 2019, Prioritize Renewable Projects with Lowest Cost of GHG Reductions, pg. 49-50)
- “A balanced portfolio of resources and contract terms will provide New York with the greatest security and stability to reach its long-term GHG reductions goals. Project developers may prefer that all contracts are for twenty-years or greater, but some portion of projects should be for shorter duration. This will allow for competition from new resources five or ten years down the road so that if newer projects can be done at lower cost, New York will reap the benefit. It also allows for the possibility that leaps in technology will be able to fill the mix rather than being locked into old technology for twenty years.” (Getting Greener, 2019, Prioritize Renewable Projects with Lowest Cost of GHG Reductions, pg. 49-50)
- “The Act sends a loud and clear signal to those owners that without some way to address their carbon emissions, their assets’ future years are numbered. It would be economically rational under such circumstances for those owners to consider this fact as they decide whether to make investments (and if so, which ones) to keep their facilities in good working order, or to potentially increase generation efficiency and lower the carbon intensity of operations. In a world in which all new renewables and existing nuclear plants receive contracts that provide revenue streams for the renewable or zero-carbon attributes, and in which compensation in the NYISO markets is greatly affected by the combination of low natural gas prices and by the entry and operation of plants with very low operating costs, the owners of such fossil units may be disinclined to spend more than the minimal amount on operations and maintenance. And yet, for the near term and until there are sufficient storage or other resources at scale on the system to allow for reliable operations around the clock and over long periods without sunshine or robust wind, such fossil units will be needed to integrate renewables and balance the

electric system. A carbon price can provide the financial incentives needed to keep the best, most efficient, and lowest-carbon fossil units on the system in safe and efficient form, and provide the locational price signal needed for retention of the right fossil resources in the right locations to support reliable operations.” (NYISO, 2019, 39)

- “A price on carbon in NYISO markets will also change incentives for certain asset owners to retire and/or repower older, inefficient, higher-emitting generating units. In the latter instance, sites now used for inefficient fossil generating units that hold transmission access may opt for installation of new storage facilities and/or the siting of more-efficient and more-responsive generating resources. This is particularly true in the New York City area, which such options would provide additional emissions reductions and other benefits to the electric power system. Repowering involves replacing older, less-efficient power generation technology (e.g., older steam turbines) at an existing facility with newer, more-efficient technology (e.g., fast-start gas-fired combustion turbine or combined cycle units). Repowering provides a number of benefits, including increased power generation efficiency with lower costs and lower emissions. Generally, a power plant owner will choose to repower a unit if the owner anticipates that market conditions in the future will support making investments that lower a unit’s power production costs (including emission costs such as NYISO’s proposed carbon pricing mechanism), thereby improving its position on the dispatch curve and increasing its potential to be dispatched (and receive revenues) in the energy and/or ancillary services markets.” (NYISO, 2019, 44)
- “Intense, continued focus on resolving the 80% in-city generation requirement is needed. The in-city generation requirement is a challenge. Even if all the old plants are repowered, they will still burn fossil fuel that will be utilized at some significant level. Can the 80% requirement be reduced without compromising reliability? Is more dedicated transmission to the City a feasible solution? Regardless, the City and the NYISO need to perform a deep dive into this issue and identify solutions.” (Kass, 2018, 56)
- “State and federal authorities have taken important steps in recent years toward a renewables-based electricity grid, including through the Clean Energy Standard and the Clean Power Plan, and those efforts need to be protected and accelerated. The impending closure of the Indian Point Energy Center ...amplifies the need to increase large-scale renewable energy generation and distribution.” (NYC 1.5C, 2017, We Can’t Do It On Our Own, pg. 30)
- “Eventually, however, existing sources would have to meet emission standards that would be applicable in 2030 after the above policies have been given a chance to work. These standards could be based on the standards applicable to new sources in PSD-10 (based on the emissions of natural gas-fired plants). Depending on the level of their emissions, existing sources would have a number of options available to meet specified emission standards, including efficiency upgrades, repowering with lower carbon fuels, co-firing of lower-carbon, sustainable biofuels, and the use of CCS (when it becomes commercially available). Flexibility may be provided by allowing the grouping or system-averaging of unit emissions to demonstrate compliance with applicable emission limits.” (CAC Report 2010, Chapter 8, page 24)

- “In developing and implementing the policy, the State should ensure that any incentives are cost-effective and it should avoid providing incentives to plants that are not expected to operate many years into the future. Implementation of this policy is important to environmental justice communities that are burdened inequitably by existing fossil fuel-fired plants.” (CAC Report 2010, Chapter 8, page 24)

Other Resources

Related Topics in this Document: Controls on New Fossil Fuel Facilities, Closure of Existing Natural Gas Facilities

Closure of Existing Natural Gas Plants

LPDD Recommendations

“States could impose an outright ban on new coal-fired generation and/or a formal limit on new natural gas generation additions.”

- *“State legislatures should re-envision the severance taxes that create natural resource trust funds as tools for phasing down extraction of fossil fuels and raising more near-term resources for social policies that support just transitions.”*
- *“State governments could pay utilities the remaining ‘book value’ for investor utility-owned plants, and negotiate prices with private plant owners to pay them to close GHG-emitting facilities.”*
- *“States could ban or limit coal mining and oil and gas production.”*
- *“States could impose an outright ban on new coal-fired generation and/or a formal limit on new natural gas generation additions.”*

Related LPDD Database Pathways

- Prohibiting Oil and Gas Extraction: <https://lpdd.org/pathway/prohibiting-oil-and-gas-extraction/>
- Restricting New Fossil Fuel Powered Plants: <https://lpdd.org/pathway/restricting-new-fossil-fuel-powered-plants/>

Other Recommendations

- “Better matching of electricity supply and demand through demand management and a smart grid is also essential. Investing in these technologies is investing in a healthy economic and planetary future. Natural gas is not, in our view, a constructive solution to achieving a carbon-free future for New York.” (No Room for Natural Gas, 2020)
- This agreement involves a zero-net increase in gas use. Looking toward the medium and long terms, it advances the deployment of such important technologies as heat pumps, district heating, building efficiency upgrades, and possibly geothermal district energy and renewable natural gas. It would terminate all GSA expansion pilot programs and end the promotion of natural gas. All of this is in explicit recognition of the goals of the CLCPA and the social cost of carbon and methane. If these pledges are vigorously implemented and adequately funded, it is the sort of program that should be undertaken statewide. (Techniques to phase out natural gas, 2020, Appendix M)

- There should be no extension or future funding to the Lansing or DeRuyter pipeline. Closure of NG dependent pilot programs, including oil-to-gas programs. (Techniques to phase out natural gas, 2020, Appendix M, pg. 4)
- “The Companies agree that the social cost of carbon, the global warming potential of methane over 20 years, and methane life cycle emission from extraction to consumption should be part of whatever NPA BCA methodology is developed. NPA projects shall be amortized over the anticipated "used and useful" life of installed decades for a ground loop.) NPA projects without a clearly measurable period for amortization shall use a 20-year default amortization period.” (Techniques to phase out natural gas, 2020, Appendix M, pg. 5)
- End of rebates for natural gas from NYSEG. Leftover funds will be applied to an enhanced heat pump rebate system. “The enhanced heat pump rebate program will be available for households with income of 120% of state median income or less, low income housing providers, and nonprofits. Eligibility criteria, incentive levels and application processes will be developed in partnership with NYSERDA Clean Heating and Cooling Community programs that are operating in the NYSEG service territory. With respect to RG&E customers, RG&E commits up to \$750,000 in previously unspent economic development funds for a comparable enhanced heat pump rebate program to be deployed in RG&E’s territory.” (Techniques to phase out natural gas, 2020, Appendix M, pg. 4)
- “Avoid self-imposed constraints such as limiting gas pipeline capacity... Regulatory and legal actions should not hamper use of resources that can continue to reduce GHG emission and provide reliable energy solutions. New York should create a competitive market of options to reduce greenhouse gases.” (Getting Greener, 2019, Executive Summary, pg. 4)

Discussion and Analysis

- “Any new gas infrastructure will either make it more difficult to meet the CLCPA goals, or will become stranded assets, a waste of capital that should instead be invested in wind and solar power, in storage technology, in an improved electric grid and in electrifying transportation and building heating systems with 21st century technologies. Donohue wrote of perhaps using “renewable natural gas” to fuel the huge new electric plants in the future. We do not believe that there will be enough economically competitive biomass feedstock in New York to produce the volume of renewable methane that would be needed by these plants.” (No Room for Natural Gas, 2020)
- “Several Parties to this Rate Case have expressed that with the passage of the Climate Leadership and Community Protection Act (CLCPA) it is important to proactively evaluate issues and potential strategies for reducing natural gas usage and increasing electricity usage as an alternative. In response, the Companies agree that within eighteen months of a Commission Order approving the Joint Proposal in these rate cases, the Companies will prepare a report that evaluates how the Companies’ businesses may evolve in the decades ahead and which identifies the potential issues and strategies related to reducing natural gas usage and increasing electricity usage as an alternative and the modernization and expansion of the electric grid needed to support the widespread deployment of renewables and beneficial electrification. The report shall be

developed in light of the renewable energy and greenhouse gas reductions goals set forth by the CLCPA. The report shall provide a meaningful analysis of the scale, timing, and costs of achieving significant, quantifiable reductions in gas use, grid improvements necessary to achieve various levels of renewables deployment and beneficial electrification, and potential financing mechanisms. Interested parties to the rate case proceeding shall be invited to provide input to the scope of the study.” (Techniques to phase out natural gas, 2020, Appendix M, pg. 2)

- “The Parties recognize that duplication of efforts in this area is not in anyone’s interest. If the Commission requires the Companies to participate in a similar statewide study or initiative within eighteen months from the date of the Order, the Companies will not prepare or provide a separate report. The Companies will continue to produce their own report for any items not included in the statewide study or initiative, with funding reduced proportionally. The Companies anticipate that the studies identified in paragraphs 3 and 11 will utilize the majority (\$400k-\$500k) of the total of funds to be used for Studies (\$750k) as identified elsewhere in the Joint Proposal.” (Techniques to phase out natural gas, 2020, Appendix M, pg. 2)
- “The Companies will structure their gas planning with the objective of achieving a zero-net increase in billed gas use, normalized for temperature, in their service territories over the three-year term of these rate proceedings. For the purpose of this Joint Proposal, achieving a zero-net increase in billed gas use shall mean that the weather-normalized levels of billed gas use for NYSEG and RG&E each in RY2 and in RY3 do not exceed the forecasted levels of gas use in RY1.” (Techniques to phase out natural gas, 2020, Appendix M, pg. 1)
- “In addition, NYSEG will structure its gas planning with the objective of achieving a zero-net increase in gas use, normalized for temperature, for customers served by the DeRuyter pipeline over the three-year term of this rate case. NYSEG will identify areas served by the DeRuyter pipeline and its distribution network that are most likely to request load growth or expansion and will also identify areas of the DeRuyter pipeline and its distribution network that may be considered for replacement. The Companies will seek out and pursue opportunities for reducing gas demand in the identified areas through projects that may include targeted heat pump programs, district heating projects, building efficiency upgrades, non-gas NPA projects , and other initiatives. For the purpose of this Joint Proposal, achieving a zero-net increase in gas use for the DeRuyter pipeline shall mean that the weather-normalized volume of gas flow to the DeRuyter pipeline from Dominion Transmission, Inc. (“Dominion”) for each May through April twelve-month period during the term of the rate plan does not exceed the weather-normalized volume of gas flow to the DeRuyter pipeline from Dominion for the twelve-month period of May 2018 through April 2019 (2,187,969 Dths).” (Techniques to phase out natural gas, 2020, Appendix M, pg. 1)
- “The Companies agree to provide quarterly reports (on a calendar quarter basis) starting with the first full calendar quarter following approval of the Joint Proposal to measure progress on the objectives set forth above. These reports will be provided within thirty (30) days after the end of each calendar quarter and will include volumes of actual billed gas use, and volumes of billed gas use normalized for temperature. The reports will identify monthly billed use by sector (residential, commercial and industrial) for each

Company, and will track natural gas customer counts and include net change in natural gas customers by month and will also report billed gas use and customer counts associated with the DeRuyter pipeline. To the extent the information is available, on a monthly basis, the reports will also track customer use of heat pump and building efficiency incentives by replaced fuel type as applicable (new construction or oil, natural gas, propane, etc), as well as BTU's of energy saved with heat pump and building efficiency incentives by replaced fuel type as applicable.... Finally, NYSEG and RG&E will be tracking and reporting heat pump information in the Statewide Heat Pump Program Annual Report filed each April 1st, as required by Case 18-M-0084 - In the Matter of a Comprehensive Energy Efficiency Initiative.” (Techniques to phase out natural gas, 2020, Appendix M, pg. 1-2)

- “Our model suggests that natural-gas plants will be an important source of grid flexibility and stability. But investing and regulating to keep them operational could be controversial because of their GHG emissions. One possibility to address the need for natural gas but to deliver it at a net-zero carbon level and provide the final stretch of full decarbonization is power-to-gas technology (or “zero-emissions gas”).” (McKinsey, 2019, pg. 5)
- “Attempts to expand natural gas pipelines have been blocked, which resulted in moratoria on new gas installations downstate. Natural gas provides an economical alternative to dirtier fossil fuels and is a dependable source when renewable sources like solar and wind are not available.” (Getting Greener, 2019, Executive Summary, pg. 2:)
- “Avoid self-imposed constraints such as limiting gas pipeline capacity. A strong preference for renewable energy has resulted in constraints on expansion of natural gas. Denying permits to several natural gas pipelines is constraining energy markets to the point that New York will not be able to reap the GHG reduction benefits of converting home heating from oil to natural gas. Likewise, a lack of stable natural gas supply for new businesses may harm the state’s economic competitiveness. Regulatory and legal actions should not hamper use of resources that can continue to reduce GHG emission and provide reliable energy solutions. New York should create a competitive market of options to reduce greenhouse gases.” (Getting Greener, 2019, Executive Summary, pg. 4)
- “If these plants are shut down, the energy needed from them will, at least initially, be supplied by natural gas burning plants that will produce approximately 20 MMTCO_{2e} per year. The increased demand for natural gas could also put a strain on the existing gas transmission system, a system whose expansion has been limited in recent years (see Section 3.3.2 of this paper). Every large power plant in New York that uses natural gas as a fuel also has a backup supply of another fossil fuel (kerosene, butane, fuel oil #2) and will switch to the backup when the gas transmission system is in high demand to provide gas for heating. The existing natural gas transmission system has been capable of supplying fuel for these plants on this “interruptible” basis but it is unclear whether the system in New York has the capacity to supply the energy needs to replace all the nuclear plants when they shut down.” (Getting Greener, 2019, 3.3.1 Shutting Down Nuclear Plants Will Likely Reverse Past Gains, pg. 30)

Other Resources

Related Topics in this Document: Power-to-Gas, Demand Management, Closure of Existing Fossil Fuel Facilities

Controls on New Fossil Fuel Facilities

LPDD Recommendations

- “States could put a limit on GHG emissions related to power generation.”

Related LPDD Database Pathways

- Restricting New Fossil Fuel Powered Plants: <https://lpdd.org/pathway/restricting-new-fossil-fuel-powered-plants/>
- Impacting Power Plant economics through Cooling Water Restrictions: <https://lpdd.org/pathway/impacting-power-plant-economics-through-cooling-water-restrictions/>

Other Recommendations

- “New York should integrate new baseload fossil fuel-fired generation into the generation mix in a manner that is consistent with maintaining reliability and reducing system-wide GHG emissions. To reach the goal, this policy option supports the development of a low-carbon emission standard aimed at ensuring that the development of new power generating units contributes to the reduction of the State’s GHG emissions. This standard would require that new or reconstructed fossil fuel-fired electric generating units that produce power for sale in New York and new power purchase agreements for delivery of electricity into the New York Independent System Operator (NYISO, 2019) control area would achieve CO₂ emission rates (pounds of CO₂/MWh gross) that are based on the best available operating technology.” (CAC Report 2010, Chapter 8, page 22)

Discussion and Analysis

- “A strong opposition to any fuel source that produces GHGs has resulted in constraints on expansion of natural gas through refusal to grant water permits to several natural gas pipelines. For example, on May 15, 2019 the DEC denied water permits necessary for the construction of the Northeast Supply Enhancement Project (also known as the Williams Pipeline Project). Other projects rejected over the past few years include the Constitution Pipeline project (2016), and the National Fuels Corp project (2017). This action appears motivated by a general opposition to the use of fossil fuels, specifically the hydraulic fracturing methods used outside New York to extract new supplies of natural gas, and could limit economic growth if new gas customers are turned away.” (Getting Greener, 2019, 3.3.2 Blocking Natural Gas Pipelines Inhibits a Dependable and Economic Resource, pg. 32)
- “The opposition to new natural gas pipeline capacity is already having an impact on the retail market for natural gas serving homes and buildings. Consolidated Edison and National Grid have been sufficiently concerned about the adequacy of natural gas supplies that each has instituted a moratorium on new natural gas customers in portions

of its service area. Consolidated Edison has proposed several non-pipeline alternatives to meet future demand for natural gas, including efficiency programs to reduce natural gas consumption and thereby free up capacity for new customers; and delivering compressed natural gas (CNG) or liquefied natural gas (LNG) by truck. There are likely to be public safety concerns with truckloads of CNG or LNG entering New York City. The number of truck-loads will depend on the total demand for natural gas. The PSC has approved a series of energy efficiency programs proposed by Consolidated Edison but has deferred making a decision on supply-side issues. It has instead directed the company to resubmit those plans as part of a standard gas rate case filing. National Grid has recently lifted its moratorium on new natural gas interconnections and will be submitting its own set of non-pipeline alternatives, which are likely to be similar to those of Consolidated Edison, including CNG and LNG deliveries.” (Getting Greener, 2019, 3.3.2 Blocking Natural Gas Pipelines Inhibits a Dependable and Economic Resource, pg. 32)

- “Opposition to imported fossil fuels has resulted in constraints on expansion of natural gas. By refusing to grant water permits to several natural gas pipelines, the NYS DEC is constraining the energy markets severely. As discussed, the opposition to natural gas pipelines has led to a moratorium on new gas connections in the service territories of Consolidated Edison and National Grid’s downstate affiliates in Brooklyn and Long Island. There is the potential for further moratoria across the state and then New York will not be able to reap the GHG reduction benefits of converting home heating from oil to natural gas. There is also the risk of constraining the operation of gas- fired power plants necessary to provide a stable and reliable electric supply. Likewise, a lack of stable natural gas supply for new businesses may harm the state’s economic competitiveness.” (Getting Greener, 2019, 4.4 Avoid Self-Imposed Constraints such as Limiting Gas Pipeline Capacity, pg. 47)
- “For baseload units, the standard would be set at a level that can be achieved by combined cycle natural gas- fired technology. Gas turbines that are used for peaking purposes would be subject to a higher rate. In either case, the rates would allow for use of oil as a back-up fuel, consistent with reliability guidelines. In accordance with this proposed standard, new coal-fired power plants should not be built until CCS is available. For future decades, the emission standards could be revised based on the best available operating technology that arises in those periods.” (CAC Report 2010, Chapter 8, page 22)
- “The goal of promoting the development and operation of power generation facilities that will have zero- or very-low-carbon emissions is also promoted by the policy of developing an LCPS for power plant emissions (PSD-6). In addition to promoting statewide emission reductions, the instant policy—along with the siting policy (PSD-1)—will reduce the adverse environmental impact of new facilities on particular communities.” (CAC Report 2010, Chapter 8, page 23)

Other Resources

Related Topics in this Document: Natural Gas Production, Processing, and Distribution

Onshore Wind

New York Actions

- “Governor also announced the issuance by NYSERDA and NYPA of the nation's largest coordinated solicitations for land based large-scale renewable energy projects by a U.S. state, under the State's ambitious Clean Energy Standard. Together, the combined solicitations from NYSERDA and NYPA seek to procure over 1,500 megawatts of clean, renewable energy, enough to power nearly 500,000 homes. Applicable land-based projects selected will be fast-tracked to construction under groundbreaking legislation passed in the budget to vastly accelerate renewable energy siting to ensure the projects are developed responsibly and quickly so the state meets its CLCPA mandate.” (Cuomo Solicitations, 2020)
- “Real Property Law Section 487 states that real property containing a solar, wind, or farm waste energy system approved by the State Energy Research and Development Authority is exempt from taxation for a period of 15 years to the extent of any increase in assessed value due to the system. Such property is liable for special ad valorem levies and special assessments. The exemption as reenacted in 1990 is subject to local option. Thus municipalities that opt out of this law can still tax the increase in assessed value of property with a wind system on it.” (Model Wind Ordinance, 2012, 26)
- “New York until 2011 provided substantial leeway to local governments for regulation of wind facility siting, but it limited some of the siting restrictions that local governments might impose. State law expressly preserved the authority of local governments to apply zoning ordinances, building codes, and certain state environmental laws over these facilities, but it precluded local governments from imposing any conditions or requirements not provided by these laws and ordinances (N.Y. Energy Law § 21-106(2)). In 2011, recognizing that this approach had produced varying results for large wind facility siting, the state legislature adopted a one-stop state siting board process for energy facility siting over 25 MW, retaining primacy of local regulation only for smaller facilities. The seven-member New York State Board on Electric Generation Siting and the Environment will consist of five permanent members plus two members appointed for each proceeding from the community where the proposed facility would be located. The law provides that the board will take into account local requirements and consider evidence from local governments supporting such requirements but will preempt requirements it deems “unreasonably burdensome” (Power NY Act of 2011, § 12, codified at N.Y. Pub. Serv. L. § 160 et seq.)” (Planning For Wind Energy, 2011, 62)

LPDD Recommendations

- *“States other than California could adopt laws similar to California’s law encouraging renewables development on disturbed agricultural land.”*
- *“States could adopt liability exemptions for renewable energy facilities under their own laws on contaminated land liability.”*
- *“States should conduct surveys to determine what disturbed lands (and other privately owned lands) would be suitable for renewable energy facilities.”*

Related LPDD Database Pathways

- Utilizing Disturbed Lands for Renewables Development:
<https://lpdd.org/pathway/utilizing-disturbed-lands-for-renewables-development/>

Other Recommendations

- When siting a wind turbine, require reports on: visual impact, noise, electromagnetic interference, avian impact, geotechnical impact, engineer’s report (including ice throw, blade throw, catastrophic tower failure, and certification). Optionally, require reports on shadow flicker, fiscal/economic impact, and land use/water impacts. (Model Wind Ordinance, 2012, 10-11)
- Municipalities should require an Environmental Impact Statement for any onshore wind projects (Model Wind Ordinance, 2012, 14)
- “Transmission and interconnection are vital to the development of new wind projects. New transmission will be needed in many cases for the successful development of new wind energy capacity.” (Planning for Wind, 2011, 67)

Discussion and Analysis

- “State policies help direct the location and amount of wind power development, but wind power growth is outpacing state targets. As of May 2019, renewables portfolio standards (RPS) existed in 29 states and Washington, D.C. Of all wind capacity built in the United States from 2000 through 2018, roughly 47% is serving RPS obligations. Among wind projects built in 2018, however, this proportion fell to 19%. Existing RPS programs are projected to require average annual renewable capacity additions of roughly 5 GW/year through 2030.” (Wind Tech, 2018, 12)
- “System operators are implementing methods to accommodate increased penetrations of wind energy, but transmission and other barriers remain. Studies show that the cost of integrating wind energy into the grid is often below \$5/MWh for wind power capacity penetrations of up to or even exceeding 40% of the peak load of the system in which the wind power is delivered. Grid system operators and others continue to implement a range of methods to accommodate increased wind energy penetrations. Transmission additions were limited in 2018, with approximately 1,300 miles of transmission lines coming online. The wind industry has identified 27 near-term transmission projects that, if completed, could support considerable amounts of wind capacity.” (Wind Tech, 2018, 12)
- “Utility resource planning requirements—principally in Western and Midwestern states—have motivated wind power additions in recent years.⁷⁷ So has voluntary customer demand for “green” power (O’Shaughnessy et al. 2018). State renewable energy funds provide support (both financial and technical) for wind power projects in some jurisdictions, as do a variety of state tax incentives.⁷⁸” (Wind Tech, 2018, 73)
- “Energy analysts project that annual wind power capacity additions will continue at a rapid clip for the next couple years, before declining, driven by the five-year extension of the PTC and the progressive reduction in the value of the credit over time. Additionally, near-term additions are impacted by improvements in the cost and performance of wind power technologies, which contribute to low power sales prices. Factors impacting wind energy demand also include corporate wind energy purchases and state-level renewable energy policies.” (Wind Tech, 2018, 77)

- “Though greater loads and customer counts are seen in urban areas, siting restrictions that are due to building densities within cities restrict urban opportunities. Instead, the greatest opportunity is seen for low-density urban centers (e.g., industrial areas) and suburban and rural areas. In particular, agricultural, commercial, and industrial end-use customers may offer the greatest near-term possibility for market expansion because of their high electricity requirements and larger sites, which both favor larger and lower cost (per kW) turbines.” (NREL, 2018, vi)
- “New York was observed to have the second-highest economic potential, owing to the generally strong wind resource (Figure ES-3b), large amount of electricity consumption, high retail rates, and favorable incentives. High levels of potential are specifically observed for areas near Suffolk, Westchester, Saint Lawrence, Monroe, and Erie counties (Figure ES-3a). These counties respectively house population centers corresponding to Long Island, White Plains, Canton, Rochester, and Buffalo, again adhering to the trend found in Colorado and Minnesota that economic potential correlates well with areas of high electricity consumption (Figure ES-3c). Though New York had the highest level of end-user load of the three states studied, lower siting availability (Figure ES-3d), which corresponds to high population density, limits the overall potential.” (NREL, 2018, viii)
- “Detailed spatial analysis was conducted for Colorado, Minnesota, and New York, three states understood to have promising, if yet unrealized, potential for distributed wind market growth. Counties observed to have high economic potential within each state were generally observed to have modest to good wind resource quality, significant load, favorable rate structures, and sufficient spatial patterns to enable siting of distributed wind turbines. Areas where these characteristics converge favorably to elucidate areas of high potential include counties in... Long Island, White Plains, and Buffalo in New York. These findings demonstrate that while distributed wind is not economic everywhere, certain market segments show clear growth potential, particularly for agricultural, commercial, and industrial end users.” (NREL, 2018, x)
- “First, by systematically updating retail rate tariffs, we can identify sub-state variation in the economic attractiveness of distributed wind. That is, the rates offered by different utilities might provide different value to distributed wind customers based on the rate structure—even if those customers had similar retail costs on an averaged basis. This insight allows us to demonstrate with greater confidence the most-fruitful areas for deployment in each state. Second, our analysis adds important insight to the difference in rates as a function of utility ownership (e.g., investor-owned utilities, municipal utilities, and co-operative utilities). Rural regions are disproportionately served by municipal and co-operative utilities and previous techno-economic analysis has focused on urban areas with higher population density. Therefore, this analysis contributes to the base of energy research pertinent to rural and semi-rural communities.” (NREL, 2018, 5)
- “The states—Colorado, Minnesota, and New York—were identified by subject experts as having promising potential for growth due to their favorable policies and strong wind resource... In this scenario, Colorado could have approximately 360 MW of economically viable capacity in 2018, Minnesota over 1,950 MW in the same year, and New York about 920 MW. With the exception of New York, these estimates remain at similar magnitudes in the long term, with Colorado modeled to have 480 MW of economic potential in 2050, Minnesota 2,140 MW, and New York 210 MW.” (NREL, 2018, 27)

- “We consider the spatial distribution of several input factors, including wind resource, siting availability, and end-use load. Counties observed to have high economic potential within each state were generally observed to have modest to good wind resource quality, significant load, favorable rate structures, and sufficient spatial patterns to enable siting of distributed wind turbines. For example,... Long Island, White Plains, and Buffalo in New York all represent areas where these characteristics converge favorably to elucidate areas of high potential. These spatial trends could aid policymakers and stakeholders of the distributed wind industry in identifying the areas of greatest potential within the three states.” (NREL, 2018, 27)
- “In New York State, local municipalities have substantial control over wind siting policy. In order to effectively develop New York’s prodigious wind energy capacity it is necessary for New York municipalities to put into place comprehensive wind siting ordinances. Some municipalities lack a wind siting policy or have a policy that inhibits development of wind energy facilities.” (Model Wind Ordinance, 2012, 1)
- “On-site turbine substations must be located close to a power source. As such, there may be miles in between the actual wind turbines and the substation. This distance may span wetlands or uneven terrain making it necessary for power lines between turbines and the on-site substation to run above ground rather than below ground.” (Model Wind Ordinance, 2012, 18)
- “Although distributed wind has grown substantially over the five years (Table 2.1), this market segment faces a number of challenges. Along with cost, other concerns also impacting the market include:
 - Zoning restrictions (especially for structure heights)
 - Aesthetic concerns from neighbors
 - Noise concerns
 - Proper assessment of wind resources to allow turbines to achieve power production potential
 - Warranties (small companies may not provide warranties, and lenders may require them)
 - Availability of technicians
 - Availability of spare parts

In addition, the broader economic slowdown coupled with fragile state and local policy incentives for small wind has reduced demand and introduced uncertainty into the distributed wind market.” (Planning For Wind Energy, 2011, 15)

- “Small wind energy conversion systems (WECS) can fit in a wide variety of settings, including urbanized communities. San Francisco, Denver, and Chicago are large cities that permit a variety of small WECS. As discussed in Chapter 6, reasonable standards may readily be drafted to address safety concerns and other potential impacts of small WECS that make it possible to site them close to other uses. A significant challenge for small WECS in urban areas is access to good quality wind. The presence of numerous structures and obstructions in urban areas cause very turbulent wind at many urban sites, limiting the potential of small WECS in these areas. The turbulence and obstructions result in large differences in wind quality over short distances, making site specific testing very important to cost-effectiveness analysis. WECS technologies are being developed to take advantage of urban locations and conditions. (See Figure 2.3,

page 24.) Some roof-mounted models are designed to be placed in a row along the windward edge of flat commercial and industrial rooftops, where they take advantage of the updraft from the building face. Micromodels may be mounted atop light poles in parking lots. However, wind access and quality remain challenges in such locations. Studies that measure the performance of urban and rooftop wind turbines indicate substantial concerns for many urban sites due to turbulence. Therefore, it is not advisable at this time for local governments to limit allowable small WECS to building-mounted models, even in urban settings.” (Planning For Wind Energy, 2011, 22)

- “Large wind energy projects can provide economic value to communities in a variety of ways. Due to the current nature of electricity and the grid, the energy produced by a utility turbine does not always stay just in that community, but property taxes and lease payments to owners of land where turbines have been sited do. Construction and maintenance of wind farms also creates both short- and long-term jobs, and wind farms can also generate tourism dollars, as in the case of Fenner, New York. And through alternative ownership structures such as limited liability companies (LLCs), local residents can partner to develop and manage utility wind projects, as has been the case with Minnesota’s nine farmer-owned Minwind projects.” (Planning For Wind Energy, 2011, 113)
- “Set up a straightforward, standardized application process. If a permit is required for small-scale projects, the permitting process does not need to be complicated, as long as small-scale wind systems comply with basic standards for safety. For small wind projects, complicated and time-consuming permitting processes can add up to 10 or 20 percent to total project costs. In Kittitas County, for example, planners set up a user-friendly, over-the-counter permitting process, making it easy for residents to obtain permits through submitting the required information.” (Planning For Wind Energy, 2011, 114)

Other Resources

Related Topics in this Document: Offshore Wind

[Case Study of Residential, Distributed Wind in New York, pg. 20](#)
[Developing Municipal Wind Energy Ordinances in New York State](#)

Offshore Wind

New York Actions

- “Governor Andrew M. Cuomo today announced the largest combined clean energy solicitations ever issued in the U.S., seeking up to 4,000 megawatts of renewable capacity to combat climate change. New York’s second offshore wind solicitation seeks up to 2,500 megawatts of projects, the largest in the nation’s history, in addition to last year’s solicitation which resulted in nearly 1,700 megawatts awarded. The solicitation includes a multi-port strategy and requirement for offshore wind generators to partner with any of the 11 prequalified New York ports to stage, construct, manufacture key components, or coordinate operations and maintenance activities.” (Cuomo Solicitations, 2020)

- “Further, beginning in its 2020 Tier 1 and offshore wind solicitations, NYSERDA will explicitly incorporate community engagement and prioritization of benefits to disadvantaged communities into its selection process. Bidders will be required to describe impacts to disadvantaged communities associated with their proposals and NYSERDA will reward those proposals that will confer benefits to disadvantaged communities, including economic benefits and job creation.” (CES White Paper, 2020, 18)
- “Accordingly, this White Paper recommends that the Commission formally adopt the CLCPA’s minimum statewide goal of 9 GW of offshore by 2035 and grant NYSERDA authority to procure the remaining amount of ORECs necessary to achieve that goal... This White Paper proposes that NYSERDA conduct offshore wind procurements in a manner that ensures, at a minimum, cumulative contracted capacity equivalent to between roughly 750 MW and 1,000 MW per year through 2027.” (CES White Paper, 2020, 38)
- “This White Paper proposes that NYSERDA have no minimum or maximum procurement requirements for any one solicitation. NYSERDA should be free take a long-term view and evaluate each contract award decision with focus on both ensuring CLCPA compliance and obtaining the best overall value.” (CES White Paper, 2020, 39)
- “This White Paper recommends that the Commission make clear that LSEs are free to procure ORECs directly for compliance and need not obtain them from NYSERDA. This White Paper also recommends that the Commission grant NYSERDA authority to resell ORECs to nonLSE buyers, provided that it do so at a cost no less than it sells to LSEs.” (CES White Paper, 2020, 41)
- “This White Paper therefore proposes the development of a feasibility study for Great Lakes wind.” (CES White Paper, 2020, 41)
- “NYSERDA is moving forward with 1,700 Mw of new offshore wind projects, from two development teams: the Empire Wind project being developed by Equinor US Holdings; and Sunrise Wind, a joint venture of Ørsted’s A/S and Eversource Energy.” (Getting Greener, 2019, The Cost of New Offshore Wind Generation, pg. 28)

LPDD Recommendations

- “States with offshore wind capacity should develop and implement processes to promptly review and act upon applications for offshore wind projects.”

Related LPDD Database Pathways

- Offshore Wind Development: <https://lpdd.org/pathway/offshore-wind-development/>

Other Recommendations

- “Continue issuing solicitations for offshore wind that spur competition and cost reductions, including second solicitation for at least 1,000 MW in 2020, and build the supply chain in New York State.” (Clean Energy, 2020, Renewable Energy, pg. 14)
- “Identify a Policy Need for Offshore Wind in PPTPP. Given the importance of offshore wind in attaining New York’s 70% renewables requirement, the Commission should act quickly to identify a Public Policy Transmission Need related to offshore wind in Case 18- E-0623 and simultaneously convene a Task Force with NYSERDA, NYPA, LIPA, the

NYISO, relevant investor-owned utilities, offshore wind developers, qualified transmission developers and other stakeholders to explore innovative funding mechanisms to support coordinated offshore wind transmission investment. Failure to act will impede the state's ability to meet its renewable goals, and will result in piecemeal, ineffective or lacking and lagging transmission expansion.” (Transmission Investments, 2019, Transmission Solutions, pg. 12)

- “A NYGLOW PEIS or GEIS could therefore provide guidance for a site-specific assessment of such issues as avian and visual impacts, water based recreational uses, and environmental justice issues. It could also identify regional research requirements, such as avian migration routes or locations of critical habitat for threatened or endangered species, which may apply to any proposed project in a region or be used to identify sites that are inappropriate for development. As projects are implemented and gains are made in regulatory experience, the NYGLOW PEIS could be updated to include an assessment of cumulative impacts and guidance on such issues as turbine spacing, further limiting the scope of the site-specific environmental review.³²” (Great Lakes Offshore Wind, 2009, pg. 4-5)

Discussion and Analysis

- “The focus on building renewable resources, particularly offshore wind, and entering into long term power contracts limits flexibility and diminishes consideration of other cost-effective approaches. Efforts to scale up renewables are necessary, but projects planned require the State to offer supplemental payments to make them work. Furthermore, the massive infrastructure investment required to procure offshore wind capacity will require long-term contracts that will lock in increased costs for electric customers for years to come. Based on analysis of a recent offshore wind project contract, meeting the renewable target entirely with offshore wind will increase electricity costs by \$2.3 billion annually, an increase of between 8 and 12 percent to New Yorkers’ electric bills, which could be a significant increase in monthly living expenses for some low-income and working class New Yorkers. Other options may be more cost-effective, particularly as technology evolves in the long term.” (Getting Greener, 2019, Executive Summary, pg. 2)
- “By specifying a preferred resource as the path to meet GHG reductions, the state is limiting flexibility and undermining the opportunity for competition to offer innovative solutions to meet the broader goals of GHG reductions. As a result, the massive infrastructure investment required under the state’s plan to procure offshore wind capacity would lock in increased costs for electric customers” (Getting Greener, 2019, 3.2 Concerns with State's Ability to Achieve CLCPA Targets, pg. 23)
- “Building out this new infrastructure will be costly. NYSERDA is moving forward with 1,700 Mw of new offshore wind projects, from two development teams: the Empire Wind project being developed by Equinor US Holdings; and Sunrise Wind, a joint venture of Ørsted’s A/S and Eversource Energy. In announcing the results of the competitive solicitation, NYSERDA states that the contract prices “are approximately 40 percent less than projected by NYSERDA’s 2018 analysis.” Nevertheless, both projects require additional public subsidies to be viable: they are designed for the developers to sell the energy output into the competitive NYISO market and to then receive a supplemental

payment for Offshore Wind Renewable Energy Certificates (ORECs). This supplemental payment is an above-market subsidy to ensure that the projects are economically viable.” (Getting Greener, 2019, The Cost of New Offshore Wind Generation, pg. 28)

- “Complementarity between wind and solar profiles means both get built wherever possible, but regional specialization will occur depending on resource quality. Offshore wind should be emphasized in places, like the Northeast, where this resource holds promise as a vital part of the electricity system long-term. Transmission that connects renewable resources to loads takes time to permit and build and thus planning must start early for this critical infrastructure.” (350 PPM Pathways, 2019, 65)
- “Both state and federal government jurisdictions are triggered when siting offshore wind facilities. States have jurisdiction over the territorial waters in their respective coastal zones, which extend from their shorelines out three nautical miles. The federal government has jurisdiction from the state coastal zones out 200 miles, an area known as the Outer Continental Shelf (OCS). It appears that new offshore wind turbines will, for the most part, be located in the OCS;20 therefore, the federal government will have jurisdiction over the siting of these components. State jurisdiction applies once a facility’s transmission lines hit the state coastal zone.” (Laniado & Wolcott, 2017, 122)
- “The PSC is statutorily required to make several findings to grant an Article VII certificate of environmental compatibility and public need (CECPN) to a transmission facility: the basis of the need for the facility; its probable environmental impact; that the facility represents the minimum adverse environmental impact, considering the state of available technology and the nature and economics of the various alternatives, and other pertinent considerations; that the facility represents a minimum adverse impact on active farming operations that produce crops, livestock, and livestock products; that the facility conforms to a long-range plan for expansion of the electric power grid of the electric systems serving New York and interconnected utility systems, which will serve the interests of electric system economy and reliability; that the location of the facility as proposed conforms to applicable State and local laws, except that the PSC may refuse to apply local ordinances that it finds unreasonably restrictive; and that the facility will serve the public interest, convenience, and necessity.” (Laniado & Wolcott, 2017, 123)
- “The PSC has found several bases of need⁵² for submarine transmission lines that could be applicable to a line from an offshore wind facility. The PSC has cited the need to develop additional capacity and supply for Long Island, and the need to replace output from facilities planning to retire. Additionally, the PSC has relied in part on the increases in competition and supply diversity that result from new resources. The PSC has also found need related to air emissions reductions.” (Laniado & Wolcott, 2017, 125)
- “The PSC has recognized that many of the environmental impacts of submarine transmission lines can be minimized by installing the line with jet plowing. Jet plowing is a unique construction method that plows a trough in the waterbed using water jets to “fluidize” sediment while simultaneously laying the line. Sediment then resettles quickly, minimizing effects on the benthic community.⁶⁵ Where the line cannot be buried with a jet plow, developers often cover it with concrete mats. The PSC has agreed with developer arguments that the benthic communities affected by these mats quickly recover, similar to jet plowing. Environmental impacts also can be minimized by limiting

construction to seasons when aquatic organisms are less likely to be negatively affected.” (Laniado & Wolcott, 2017, 126)

- “As explained in more detail below, an Article VII application must also demonstrate compliance with the substantive provisions of municipal codes and other local requirements. In Article VII cases, the PSC has taken the position that it does not have the authority to grant, at least in the first instance, rights to cross municipal real property such as roads. A private applicant must secure those rights from the pertinent municipality if a transmission line will cross or occupy municipal property.” (Laniado & Wolcott, 2017, 127)
- “Title to lands under water in New York’s territory is held by the State in trust on behalf of its citizens.” (Laniado & Wolcott, 2017, 127)
- “The PSC has established sufficient Article VII precedent in other transmission line certifications that can be adapted to the expected set of facts an offshore wind project may raise.” (Laniado & Wolcott, 2017, 127)
- “The offshore wind turbine boom in Europe illustrates the potential of this technology... Key impediments to offshore wind in the United States are the relatively high cost of offshore wind compared to land-based wind projects, the complexity and prolonged duration of the environmental approval process for offshore wind farms.” (Karmel et al, 2016, 144)
- “There are high wind velocities offshore of Long Island. Another advantage of the Atlantic coast off of Long Island (and elsewhere on the East Coast south of Maine) is the relatively shallow offshore water depth, which facilitates the installation of the turbine support structures on the sea bed.” (Karmel et al, 2016, 145)
- “The PSC recognized that offshore wind will be a “vital component” in achieving the 50 by 30 goal, and requested NYSEDA to identify mechanisms that would help maximize this potential source of renewable energy in New York State.” (Karmel et al, 2016, 145)
- “To obtain approval of the SAP, the lessee must demonstrate that the plan conforms to all applicable laws, regulations, and lease provisions; is safe; does not unreasonably interfere with other uses of the leasehold area, including national defense; does not cause undue harm or damage to natural resources, wildlife, the marine environment, or archeological or historical resources; employs best available and safest technology, best management practices, and properly trained personnel; and will collect the information and data required to construct and operate the facility.” (Karmel et al, 2016, 145)
- “The EA describes in considerable detail the site characterization and site assessment activities that would be conducted by the prospective lessee pursuant to the SAP. These activities will include construction of a meteorological tower and buoys, high-resolution geophysical surveys, geotechnical sampling, and biological surveys for benthic habitat, birds, bats, marine mammals, fish, sea turtles, and other marine fauna. The SAP activities also will include surveying of potential routes for a transmission cable that would connect the wind turbines to an onshore power substation.” (Karmel et al, 2016, 146)
- Prevalent issues regarding animal life - especially endangered species. (Karmel et al, 2016, 146)
- “Another issue likely to require careful attention in the EIS is the potential presence of historic resources in the WEA. Humans migrated to North America more than 10,000

years ago during the last Ice Age when sea levels were far lower than today. The EA concludes that the WEA has a “high potential for the presence of submerged archeological sites.” (Karmel et al, 2016, 146)

- “The wind turbine project will also require a determination that the project is consistent with the federally approved coastal policies established by New York (and potentially, New Jersey) under the Coastal Zone Management Act. This statute requires that “[e]ach Federal agency activity within or outside the coastal zone that affects any land or water use or natural resource of the coastal zone shall be carried out in a manner which is consistent to the maximum extent practicable with the enforceable policies of approved State management programs.” (Karmel et al, 2016, 146)
- “As mentioned above, these activities, like construction of the wind turbine generators, would trigger permitting under Section 10 of the Rivers and Harbors Act because they would involve the placement of a “structure” or “excavating from or depositing of material” in or over the navigable water of the United States. Because some of these activities would involve the “discharge of dredged or fill material” into the territorial seas, they also would require a permit from the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act.” (Karmel et al, 2016, 147)
- “The sponsor of the project would be required to secure the property right under State law for the occupation of the area of the transmission cable route under State waters. Similarly, franchises and property interests needed for occupation of the upland area portion of the transmission cable would need to be acquired... Further, the construction of a “major utility transmission facility” in New York State requires a Certificate of Environmental Compatibility and Public Need (Certificate) issued by the PSC under Article VII of the Public Service Law. A “major utility transmission facility” is defined to include “an electric transmission line of a design capacity of ... [125 kV] or more extending a distance of one mile or more, or of ... [120 kV] extending a distance of ten miles or more, and associated equipment.” Assuming that the transmission cable for the wind farm would exceed one of these jurisdictional thresholds, a Certificate would be required for its installation within the underwater lands and upland areas of the State.” (Karmel et al, 2016, 147)
- “In order to issue a Certificate, the PSC must find that there is a need for the facility; that it would cause the minimum adverse environmental impact, considering the state of available technology and various alternatives; and that the facility as proposed conforms to applicable State law and regulations, and to local laws and regulations, “all of which shall be binding” upon the PSC except those it finds to be “unreasonably restrictive.” (Karmel et al, 2016, 148)
- “The New York State Department of Environmental Conservation (DEC) remains responsible for the exercise of its federally delegated authority to issue State Pollutant Discharge Elimination System (SPDES) permits and Section 401 certifications under the Clean Water Act. Likewise, the Department of State would remain responsible for considering the consistency of the project, including the transmission cable, with the State’s coastal policies, because that responsibility springs from both federal and State law.” (Karmel et al, 2016, 149)
- “New York regulates activities and development in coastal erosion hazard areas,¹⁰⁰ which include the Atlantic shoreline of Long Island. A “regulated activity” for purposes

of the coastal erosion program includes “the placement of a structure,” a term which is defined as “any object constructed, installed or placed on land or in water.” Since a transmission cable would appear to come within this definition, its placement would not be permitted if it would likely cause a measurable increase in erosion or would fail to prevent or minimize effects on natural protective features, significant fish and wildlife habitats, and shellfish beds. The State’s endangered species law also requires the issuance of a permit authorizing the broadly defined “taking” of protected species. It is likely that this requirement, if determined to be applicable, also would be addressed by the PSC in the Article VII proceeding.” (Karmel et al, 2016, 150)

- “In addition, a water quality certification from DEC would likely be required under Section 401 of the Clean Water Act confirming that any discharges associated with the construction of the transmission cable would comply with applicable effluent limitations and water quality standards. A general SPDES permit authorizing storm water discharges from construction activities likely would be needed as well.” (Karmel et al, 2016, 151)
- “Lakes Erie and Ontario have the potential to provide a significant source of clean renewable energy for New York. A study completed for the Ontario Power Authority (OPA) estimated that the developable potential offshore wind generating capacity of the Canadian side is 2,599 megawatts (MW) for Lake Ontario and 21,054 MW⁴ for Lake Erie--a combined capacity equivalent to about nine power plants the size of the Robert Moses Niagara Hydroelectric Plant.... The Province of Quebec has effectively utilized a similar strategy by combining access to a significant (4,000 MW) land-based wind energy market with local economic development and local content requirements in a way that has spurred investment in converting some of Quebec's existing manufacturing infrastructure to wind energy component manufacturing.⁶ Quebec's current wind energy offerings are expected to result in over \$4 billion of investment, 60% of which will be expended in Quebec, and result in 1,500 full time jobs. Significant additional offerings are planned for the future.⁷” (Great Lakes Offshore Wind, 2009, pg. 2-3)
- “Given the broad review requirements, potential areas of impact, and considerable potential benefits of NYGLOW, an efficient strategy for the environmental review and approval process must be developed. NEPA regulations encourage the use of programmatic environmental impact statements (PEISs) that address the potential environmental impacts of activities that have a broad scope (in this case, the NYGLOW program as a whole) before the environmental impacts of activities having a narrower scope (e.g. a particular NYGLOW project) to eliminate the repetitive discussion of issues.²⁸ Assessments used in PEIS documents would then be referenced for issues common to project levels of review.²⁹ The scope of issues for the project level environmental review could therefore be limited, thus ensuring consistent application of mitigation measures and reducing the costs and time required for project level review, as well as limiting additional mitigation measures to site-specific issues... New York's Generic EIS (GEIS) process within SEQRA uses a similar approach and, with the cooperation of the appropriate federal agencies, should be sufficient to meet NEPA requirements.³¹” (Great Lakes Offshore Wind, 2009, pg. 4-5)
- “New Jersey's approach began in 2004 with a Blue Ribbon Panel commissioned by the Governor that recommended a two-pronged strategy for assessing the development of wind turbine facilities off the New Jersey coast.³⁴ First, the panel recommended that a

State-funded environmental and economic baseline survey be conducted to examine the potential environmental, aesthetic, and economic impact of offshore wind in coastal regions of New Jersey.³⁵ Portions of this survey have been completed and the survey findings are available to all developers. It identifies areas that are to be developed as well as areas that are to be excluded in advance, thereby reducing financial risks to developers from siting approval delays.³⁶ Second, the panel recommended the development of a commercial scale (up to 350 MW) pilot facility through the use of State grants of up to \$19 million to understand the power generation costs, transmission impacts, and financial viability of such facilities.³⁷ A subsequent solicitation for such projects elicited five bids and result in an award of a \$4 million in State money to a \$1.07 billion, 345.6 MW privately-funded project 16 miles off the coast that is projected to become operational in 2012.³⁸ The winning bidder is planning to build a port to support wind farm construction, which could support the construction and maintenance of other offshore wind farms along the northeast coast and create hundreds of skilled trade jobs for New Jersey Residents.³⁹” (Great Lakes Offshore Wind, 2009, pg. 7)

Other Resources

Related Topics in this Document: Land-Based Facilities for Offshore Wind, Onshore Wind, Research and Development: Topics

Land-Based Facilities for Offshore Wind

New York Actions

- “The solicitation includes a multi-port strategy and requirement for offshore wind generators to partner with any of the 11 prequalified New York ports to stage, construct, manufacture key components, or coordinate operations and maintenance activities.” (Cuomo Solicitations, 2020)
- “New York’s nation-leading 9,000 MW offshore wind goal is now a mandate in law. This ambitious level represents a significant portion of the renewable energy necessary to meet the State’s 70% renewable electricity mandate.” (Transmission Investments, 2019, Transmission Solutions, pg. 9)

Discussion and Analysis

- “Given its close proximity to load centers in the Downstate metropolitan region, offshore wind development will help address some of the transmission congestion issues that impede the flow of Upstate renewable generation to Downstate load centers. However, offshore wind has its own transmission challenges and it is clear from comments submitted as part of the Commission proceeding on offshore wind (Case 18-E-0071), that there are differing visions of optimal transmission for offshore development.” (Transmission Investments, 2019, Transmission Solutions, pg. 9-10)
- “To maintain momentum towards the 9,000 MW goal, it is imperative that New York issue a second offshore wind RFP in 2020 and publish a schedule of future annual solicitations to ensure that the 2035 statutory target is met. Decision-making regarding

coordinated development of transmission for offshore wind should occur simultaneously to meet this timeline but should not delay the solicitation process. First, the Commission should declare a Public Policy Transmission Need for offshore wind in the PPTPP proceeding (Case 18-E-0623). Second, the Commission should convene a Task Force with NYSERDA, New York Power Authority (NYPA), Long Island Power Authority (LIPA), the NYISO, relevant investor-owned utilities, offshore wind developers, qualified transmission developers and other stakeholders to explore innovative potential funding mechanisms to support offshore wind transmission investment. One option is to continue to have each developer integrate the cost of transmission into the individual bids they submit to NYSERDA as part of the procurement process.” (Transmission Investments, 2019, Transmission Solutions, pg. 9-10)

- “Another approach is to consider a “backbone” or shared transmission approach. To be clear, planning for a backbone transmission will take significant time and resources, and although this planning is critical to efficient, long-term development and interconnection of regional offshore wind projects, backbone transmission planning should not delay federal permitting or leasing, or New York State solicitation of offshore wind development with project-led interconnection. Each potential funding mechanism should address the questions of procurement approach, cost allocation, cost recovery, and ownership of the transmission assets. This deliberation should proceed on a parallel track with the FERC Order 1000 planning process, as the questions of funding, cost allocation, and ownership need to be addressed regardless of what specific transmission projects are ultimately selected to move forward.” (Transmission Investments, 2019, Transmission Solutions, pg. 9-10)

Other Resources

Related Topics in this Document: Transmission, Offshore Wind, Onshore Wind

Utility-Scale Solar

New York Actions

- “New York’s budget, which passed in early April, includes ambitious reform of state siting and permitting laws, a key SEIA objective, and one which should significantly streamline utility-scale development there as the state seeks to meet its 70% RPS goals.” (New York Solar, 2020)
- “Long Island Solar Farm was completed in 2011 by developer BP Solar. This photovoltaic project has the capacity to generate 32 MW of electricity - enough to power over 5,264 New York homes.⁵ Several large retailers in New York have gone solar including Anheuser-Busch, Bed Bath and Beyond and Dr. Frank’s Vinifera Wine Cellars. Owens Corning has installed one of the largest such installations with 2 MW of solar capacity at their location in Feura Bush.⁶ At 2 MW, Argos Solar LLC in Seneca is among the largest solar installations in New York. Completed in 2015, this photovoltaic project has enough electric capacity to power more than 329 homes.⁷” (New York Solar, 2020) (List of major projects: <https://www.seia.org/major-solar-projects-list>)

- “New York’s Megawatt Block Incentive is a direct, generous incentive for solar energy available under New York's ambitious NY-Sun Initiative. The program provides an up front dollars-per-watt (\$/W) rebate for both commercial and residential solar panel systems. The size of your subsidy depends on how much solar energy is already being produced in your area and could be as high as \$1/W.” (New York solar incentives, 2019)
- “New York net metering.... Any credits for excess solar power that you accrue are stored in a “credit bank” and can be used in future months (usually winter) if your solar energy system produces less electricity.” (New York solar incentives, 2019)
- “The New York solar tax credit can reduce your state tax payments by up to \$5,000 or 25% off your total solar energy expenses (whichever is lower). The great advantages of the Solar Equipment Tax Credit are twofold: first, you don't have to purchase your system to claim the credit (i.e. it applies to you even if you went solar with a lease or PPA), and second, if your tax liability isn't large enough to claim the entire credit in the first year, you can roll it over into the next year.” (New York solar incentives, 2019)
- “NY-Sun is an umbrella program for a number of solar industry support mechanisms in New York State, including (but not limited to) the Megawatt Block Incentive Structure. NY-Sun, in conjunction with NYPA, also provides the backbone for the state's Community Solar and K-Solar programs.” (New York solar incentives, 2019)

LPDD Recommendations

- “States other than California could adopt laws similar to California’s law encouraging renewables development on disturbed agricultural land.”
- “States could adopt liability exemptions for renewable energy facilities under their own laws on contaminated land liability.”
- “States other than California could adopt laws similar to California’s law encouraging renewables development on disturbed agricultural land.”
- “States should conduct surveys to determine what disturbed lands (and other privately owned lands) would be suitable for renewable energy facilities.”

Related LPDD Database Pathways

- Pollinator-Friendly Solar Practices: <https://lpdd.org/pathway/pollinator-friendly-solar-practices/>
- Utilizing Disturbed Lands for Renewables Development: <https://lpdd.org/pathway/utilizing-disturbed-lands-for-renewables-development/>

Recommendations

- “Preserve net metering - in some form - for residential/small commercial customers” (New York Solar, 2020)
- “Finalize fixes to New York's VDER tariff for larger-scale solar projects” (New York Solar, 2020)
- “Revising the NY Sun declining block program in accordance with Governor Cuomo's recent expansion” (New York Solar, 2020)

Discussion and Analysis

- “New York has a considerable amount of solar potential and has consistently been in the top 10 US solar markets. The state has other policies in place to promote solar investment, including a feed-in tariff through Long Island Power Authority (LIPA) and net metering. Through its Reforming the Energy Vision docket, the Energy Commission is reviewing the regulatory and market environment needed to encourage a more efficient electricity system, including increased amounts of distributed generation.” (New York Solar, 2020)
- “Renewable energy adoption in California has been promoted through the RPS and several funding mechanisms, such as the California Solar Initiative (CSI) programs, Self-Generation Incentive Program (SGIP), Net-Energy Metering (NEM), and federal tax credits. These mandates and incentives have spurred both utility-scale and small-scale customer-developed renewable energy projects. SB 350 increased the RPS requirement from 33 percent by 2020 to 50 percent by 2030.” (CA Scoping Plan, 2017, 87)

Other Resources

Related Topics in this Document: Storage, Low Carbon Thermal Solutions / Industrial Heat Emissions, Solar Thermal, Distributed Solar, Community Solar, Transmission, Grid Planning, Rates

Distributed Solar

New York Actions

- “New York City offers property tax abatements to property owners that install solar electric-generating systems (photovoltaic solar panels) on their buildings. In order to pursue the property tax abatement, projects must be filed along with a PTA4 Application at The HUB.” (<https://www1.nyc.gov/site/buildings/business/solar-panel.page>)
- “NEW YORK HOMEOWNERS: Government incentives allow homeowners to go solar for \$0 upfront & receive thousands back in tax credits. Sell excess electricity back to the grid at wholesale rates. See if your home qualifies in 30 seconds!” Created a tool to quickly quantify how much distributed solar would cost a homeowner. (Home Solar Incentives, 2020)
- “Adoption of solar PV is beginning to ramp up quickly in New York City. New York State has done its part to evolve the regulations and provide incentives to consumers. The City government is pushing hard as well. According to the DCAS website, the City has completed 53 solar PV projects at public facilities totaling almost 9 MW with plans to increase to 25 MW by 2019.²¹ In addition, installations of solar PV across all of New York City’s homes and commercial buildings have more than quadrupled over the last few years. In April 2017, the City announced that it had reached 100 MW of solar installed in the city and that it expected to attain 140 MW by the end of 2017.²²” (Kass, 2018, 50)
- “The NYC Solar Partnership was formed over a decade ago with CUNY, MOS, and NYCEDC to remove barriers to solar in NYC and has successfully reduced permitting time and grown the market to over 100MW of distributed solar across NYC. CUNY’s Smart DG (distributed generation) Hub is a collaborative effort with New York State and

City agencies, utilities, and industry to integrate solar and storage into the New York infrastructure.” (NYC 1.5C, 2017, Agency Highlights, pg. 39)

Distributed Solar in RPS’s

LPDD Recommendations

- *“An RPS should include mandates for solar energy, possibly specifically for DG sources, as well as mandates for energy storage and microgrid capacity.”*

Related LPDD Database Pathways

- Incorporating DERs, Microgrids, and Thermal Energy into Renewable Portfolio Standards: <https://lpdd.org/pathway/incorporating-ders-microgrids-and-thermal-energy-into-renewable-portfolio-standards/>

Distributed Solar Value and Incentives

LPDD Recommendations

- *“Federal, state, and local governments should provide financial incentives for various renewable resources.”*
- *“In addition to statewide mandates for DG renewable resources, state legislatures should mandate energy storage or provide incentives for utilities and consumers to provide energy storage for grid-connected solar PV.”*
- *“The Public Service Commission should continue developing the value of distributed energy resources through the eponymous proceeding until it fully captures the true, long-term value of distributed energy resources to utilities, ratepayers, individual communities, the environment, and society.”*

Related LPDD Database Pathways

- Providing Financial Incentives to Distributed Renewables: <https://lpdd.org/pathway/providing-financial-incentives-to-distributed-renewables/>
- Net Metering and Value of Solar: <https://lpdd.org/pathway/net-metering-and-value-of-solar/>

Distributed Solar Permitting and Homeowners’ Covenants

LPDD Recommendations

- *“States should create technology-driven uniform standards to address electrical, building, and fire requirements for all DG PV installations.”*
- *“States or the federal government should bar homeowners associations from imposing covenants, conditions or restrictions against solar technologies.”*

Related LPDD Database Pathways

- DER Permitting and Zoning: <https://lpdd.org/pathway/standardized-permitting-laws-and-standards/>
- Barring Homeowners Associations from Restricting Solar Energy: <https://lpdd.org/pathway/barring-homeowners-associations-from-restricting-solar-energy/>

Distributed Solar and Utility Interconnection

LPDD Recommendations

- *“The Public Service Commission should continue to advance policies to encourage utilities to speed up the interconnection approval process through streamlined automated procedures. The Commission should direct utilities to continue refining hosting capacity and locational value maps to encourage the deployment of high-value DER and better direct DER providers to target the highest-need areas of the grid.”*

Related LPDD Database Pathways

- Reducing Interconnection Costs and Burdens: <https://lpdd.org/pathway/reducing-interconnection-costs-and-burdens/>

Distributed Solar Access Rights

LPDD Recommendations

- *“Congress or States should enact solar access protection statutes.”*
- *“Local governments should enact zoning codes that prospectively protect some degree of solar access rights for lots and that provide alternatives for high-density dwellers to have access to solar power.”*

Related LPDD Database Pathways

- Protecting Solar Access Rights: <https://lpdd.org/pathway/protecting-solar-access-rights/>

Community Solar (See to: the Community Solar section)

LPDD Recommendations

- *“States legislatures or state agencies should facilitate the deployment of solar installations through third-party ownership models, through maintaining net metering rate structures, and excluding third-party owners from the definition of regulated utilities.”*
- *“The state should protect the community solar project market by further developing the value of distributed energy resources to account for their full, long-term value to the grid, ratepayers, individual communities, the environment, and society at large. The state should recognize the additionality principle in community distributed energy projects by allowing participating customers to retire the RECs produced by these projects, instead of automatically granting them to load-serving entities for compliance purposes.”*

Related LPDD Database Pathways

- Community Renewables: <https://lpdd.org/pathway/ownership-structures/>

Other Recommendations

- *“Develop strategies and mechanisms to achieve the 6,000 MW distributed solar goal by 2025, including strategies to serve low-income communities and consumers.” (Clean Energy, 2020, Renewable Energy, pg. 14)*

- “Municipalities need to fast track solar permit applications: The City of Long Beach is a leader. They process solar permits in 6.3 days. Oyster Bay is right behind with an average of a 7.8 day review. However, other municipalities are not as diligent in their review processes.” (LI Solar, 2019, pg. 6)
- “Municipalities need to keep the application at a reasonable cost to homeowners: Long Beach, North Hempstead, Town of Southampton, and Town of East Hampton lead the way with a FREE application. Other towns base permit fees on the total cost of the solar installation or number of panels installed. These models are not solar friendly. It does not require more work for the municipality whether the homeowner is installing a \$20,000 project or a \$30,000 project.” (LI Solar, 2019, pg. 6)
- “Municipalities need to keep the application at a reasonable cost to homeowners: Long Beach, North Hempstead, Town of Southampton, and Town of East Hampton lead the way with a FREE application. Other towns base permit fees on the total cost of the solar installation or number of panels installed. These models are not solar friendly. It does not require more work for the municipality whether the homeowner is installing a \$20,000 project or a \$30,000 project.” (LI Solar, 2019, pg. 6)

Discussion and Analysis

- “The complete lack of action from the City and State to displace peaker plants has led NYC-EJA and our members to co-launch the PEAK Coalition. Our partnership consists of NYC-EJA, THE POINT CDC, UPROSE, New York Lawyers for the Public Interest, and Clean Energy Group. Our campaign will use community organizing, policy and legal advocacy, research, analysis, and planning to move New York City and New York State to replace dirty peaker plants in frontline communities with large-scale energy storage systems (ESSs), customer-sited solar and battery storage systems, and virtual power plants. A virtual power plant is a cloud-based data control center that aggregates a number of distributed energy resources (DERs) like solar photovoltaic arrays, ESSs, and wind farms. NYC-EJA urges the City to unify its OneNYC 2050 goal to have 500 MW of storage available by 2025 with the development of large-scale distributed generation to reduce usage of peaker plants sited in low-income communities of color” (NYC EJA, 2020, pg. 17)
- “California has previously experimented with more redistributive policy measures designed to enhance DAC participation in energy transitions (Lukanov and Krieger, 2019). Unfortunately, the scope of the impacts from these programs have thus far been small due to their limited budgets and restrictive eligibility requirements. For example, the California solar initiatives single family affordable solar home (SASH) program, established in 2006 by state assembly bill 2723, has provided qualified low-income homeowners fixed, up-front, capacity-based incentives to help offset the upfront cost of a solar electric system – currently, \$3 per watt (California State Assembly, 2006). In order to be eligible for this incentive however, applicants must (1) own and live in their home, (2) have a household income that is 80% or below the area median income, and (3) live in a home defined as “affordable housing” by California Public Utilities Code 2852. Due to these restrictions on eligibility, over its entire lifetime the program has spent \$124 million on the construction of 8,228 PV systems representing a total combined capacity of just 26 MW statewide.” (Growing Inequities in the Residential Energy Sector, 2020)

- “In addition to SASH there was also a Multi-Family Solar Housing (MASH) program. First initiated in 2008, MASH provides fixed, up front, capacity-based incentives for qualifying solar energy systems (California State Assembly, 2013). The amount of the incentive depends on the chosen application tract. Different tracts reflect different characteristics of the loads intended to be offset by the system. Under the program participating tenant units receive benefits through a virtual net metering scheme which offset a portion of their energy consumption with a portion of the output from the installed system. Despite the potentially transformative power of this virtual net metering concept for renters, the program’s reach has been limited. Since its inception just 480 projects have been completed statewide, representing 41.9 MW of installed capacity. Furthermore, at present, the MASH program is closed and is no longer accepting new applications.” (Growing Inequities in the Residential Energy Sector, 2020)
- “Much of the energy sector “buzz” in New York centers around distributed generation. While REV represents structural changes to regulation at all levels of the grid, much of the market focus is on two areas, and both are about the distribution system:
 1. The transformation that the investor-owned utilities such as Con Edison are undertaking to become a platform for distributed generation, energy efficiency, and other forms of demand management.
 2. Defining the value of distributed energy resources and stimulating entrepreneurs and their customers to participate and engage in a more dynamic marketplace... As is always the case, construction is more difficult, and physical space comes at a premium in New York City. Given the city’s density, shadows and the limitations on roof space make siting solar photovoltaics (PV) and other technologies more difficult.” (Kass, 2018, 50)
- “The impact of voluntary participation efforts, however, is ultimately limited. Eventually—and probably sooner than later—some combination of mandates, codes, and tax mechanisms will need to be introduced to achieve the levels of clean distributed generation needed to reach 80x50. The impact of voluntary participation efforts, however, is ultimately limited. Eventually—and probably sooner than later—some combination of mandates, codes, and tax mechanisms will need to be introduced to achieve the levels of clean distributed generation needed to reach 80x50.” (Kass, 2018, 50)

Other Resources

Related Topics in this Document: Utility-Scale Solar, Community Solar

Community Solar

New York Actions

- “Community-shared solar programs. For building owners and renters without adequate roof space for solar PV, these programs offer subscriptions to portions of a large solar array located on- or off-site at another building. The Shared Solar NYC program offers this for building owners and multifamily renters.” (Retrofit Accelerator, 2020)

- “Community Solar makes solar affordable and accessible for all New Yorkers.” (Clean Energy, 2020, Renewables: Highlighted Programs and Initiatives, pg. 15)
- “Solar for All makes subscriptions to community solar projects available at no cost for low income consumers.” (Clean Energy, 2020, Renewables: Highlighted Programs and Initiatives, pg. 15)
- “Solar PV + Storage funds deployment of solar with onsite storage capacity.” (Clean Energy, 2020, Renewables: Highlighted Programs and Initiatives, pg. 15)
- “NYC-EJA member UPROSE has launched New York State’s first community-owned solar cooperative, Sunset Park Solar, which will be owned and operated by a cooperative (co-op) for the benefit of local residents and businesses.¹¹ One of the ways a community solar system can be part of the city’s environmental justice solutions is through a co-op ownership structure. Not only will Sunset Park Solar increase Sunset Park’s resiliency, but by increasing solar electricity generation, the adverse health and environmental impacts resulting from the GHG and other pollutants emitted from fossil fuel electricity generation can be reduced. Community solar systems provide a viable solution for in-city, regenerative energy solutions that address the high demand for energy. However, due to regulatory and utility interconnection regulations, community solar projects are often costly and time-consuming.” (NYC EJA, 2020, pg. 15)
- “The building’s energy consumption is balanced out by a 650-kW PV system made up of more than 2,000 solar panels on the roof and south facade.” Systems like the one set up at the Kathleen Grimm School could model for community solar. (NY to Zero, 2019, Case Study: Kathleen Grimm School, pg. 24)
- “NY SUN, New York State is making solar energy more accessible to homes, businesses, and communities through NY-Sun, which provides multiple resources: Incentives and financing for home and business to make going solar more affordable; Education for homeowners and renters to make informed decisions about solar; Local Government Resources including training, tools, and assistance to help local identify opportunities, mitigate barriers, and create solar programs; Community Solar programs to expand access to solar projects for all New Yorkers” (NY to Zero, 2019, NYSERDA Programs, pg. 36)
- “Int. 1630-2017 (Local Law 230) will require the City to create implementation plans for “Solarize” programs, which would create easy pathways for adopting solar energy through cost-effective bulk procurement of renewable energy or of the systems that produce solar energy. Int. 1630 targets homeowners within the vast City government workforce of more than 300,000 employees, of which even a small subset of participants could lead to implementation of tens of thousands of systems.” (Kass, 2018, 50-1)
- “The Solarize programs described above constitute a simple, straightforward form of “community energy”—a way for a group of energy consumers to come together, aggregate, and access clean energy in an affordable way. Each one of these initiatives is a key building block to greening the grid. There are other vehicles for community energy—which can be enabled by public-private partnerships—to reimagine the grid and engage and incentivize customers to act. The potential of community energy needs to be unlocked, replicated, and scaled—and it can be. Each such project, however, has its own combination of technology solutions, field conditions, and stakeholders, so the barriers to implementation can be daunting.” (Kass, 2018, 50-1)

- “Since 1997, a policy called net energy metering (NEM) for reimbursing generators of renewable energy on the grid had been in place in New York, with incremental expansions and amendments to the policy over the past two decades.⁹ Under NEM, the monetary value a utility customer pays for a unit of energy from the grid on their utility bill, for example \$.14 per kilowatt hour, would be the same price a utility would pay the customer for every unit of energy generated through a solar panel and fed back onto the grid.¹⁰... New York’s Public Service Commission (the Commission) issued an order directing Department of Public Service (DPS) staff to consider the development of a “community net metering” program.” (Prakash, 2018, 202)

LPDD Recommendations

- *“States legislatures or state agencies should facilitate the deployment of solar installations through third-party ownership models, through maintaining net metering rate structures, and excluding third-party owners from the definition of regulated utilities.”*
- *“New York should protect the community solar project market by further developing the value of distributed energy resources to account for their full, long-term value to the grid, ratepayers, individual communities, the environment, and society at large. The state should recognize the additionality principle in community distributed energy projects by allowing participating customers to retire the RECs produced by these projects, instead of automatically granting them to load-serving entities for compliance purposes.”*
- *“More states could adopt virtual net metering to allow customers to receive utility bill credits from an off-site generating system.”*
- *“More states could allow community solar systems so that electricity service providers may sell electricity from a centralized system to multiple power purchase agreement customers.”*

Related LPDD Database Pathways

- Community Renewables and Other DER Ownership Structures: <https://lpdd.org/pathway/ownership-structures/>
- Community Ownership Structures: <https://lpdd.org/pathway/community-ownership-structures/>

Other Recommendations

- “One of the ways NYC can create economic opportunities while making communities more resilient is by investing in the physical energy infrastructure. Community solar is becoming an increasingly popular opportunity. A community solar program allows residents who might not own their home or apartment, possess strong credit scores, or have adequate roof space to invest in a solar array and receive credits on their electricity bill for solar power.” (NYC EJA, 2020, pg. 14)
- “More often, it leads to customers assuming that they are getting renewable electricity when they are not. This leads to double-counting and undermines the state’s renewable energy goals. Some customers who want to do their part by buying renewable electricity believe they are getting it when they sign up for community solar or hydropower, even

when they are not... Allow customers to keep the RECS instead of allowing the utility to use them for clean energy standard credits.” (Konrad, 2019)

- “First, the VDER Value Stack mechanism should incorporate the full scope of environmental, economic, and social externalities. Second, the State should support the development of financing tools, either through a State-sponsored entity such as the New York Green Bank or in partnership with other third-party financing institutions, to overcome the barriers facing projects that serve a lower-income subscriber base to animate a self-sustaining community solar market that is accessible to all New Yorkers in the long term. Third, the State should expand support for the necessary capacity building and staff development at lean and often under resourced CBOs that are uniquely positioned to sponsor projects.” (Prakash, 2018, 205-6)

Discussion and Analysis

- “The problem comes from double-counting. If community solar members sign up just for the financial benefits (which can be substantial; typical savings are a 10 percent discount on the utility bill), it does not matter if they think they are getting solar electricity. If, on the other hand, the members signed up in part because they want to advance solar energy in New York by making sure that all the electricity they personally use is renewable, they will be disappointed if they learn that “their” solar electricity is being used by their utility to meet its Clean Energy Standard mandate. When utilities can count community solar toward their state-mandated renewable energy goals, every kilowatt-hour a utility gets from community solar allows it to buy less renewable electricity from some other source. In any case where a utility is purchasing clean energy solely to comply with the state Clean Energy Standard, community solar customers of that utility will not add to the total amount of renewable energy used by the utility. Instead, their community solar will displace renewable energy from some other source. Without the REC tracking mechanism, there is a risk that people will claim to be using more renewable electricity than is actually generated. For every megawatt-hour of renewable electricity generated, only one person can claim to have used it, and that person is the one who bought and retired the REC (or had the REC purchased and retired on their behalf.)” (Konrad, 2019)
- “Conversations about the energy system of tomorrow often start with renewable energy production, and renewable resources will indeed play a critical role in shaping New York’s energy future, providing resilient power, reducing fuel cost volatility, and lowering GHG emissions. Shared Renewables, or community net metering, opens a pathway for customers and entire communities to take advantage of solar and other renewable energy sources for the first time. Interested New Yorkers will be able to participate in local renewable energy projects and receive credit on their utility bills for their portion of the carbon-free power produced.” (NY to Zero, 2019, NY As a Climate Policy Leader, pg. 26)
- “Across the U.S., solar photovoltaic (PV) installations have seen the most growth in the residential rooftop segment concentrated in middle- and upper-income households, which now contributes to a multi-gigawatt market.⁶ One of the biggest barriers low-income communities face is lack of access to affordable financing, a critical factor in the disproportionate rise of rooftop solar PV and energy efficiency investments in higher

income communities. Low-income communities are also increasingly vulnerable to the impacts of climate change that may disrupt access to power, such as heat waves, flooding, and storm surge, and stand to benefit most from renewable and resilient energy systems.” (Bautista et al, 2019, 2)

- “NYC-EJA and THE POINT CDC, as stakeholders in the Hunts Point Resiliency process, have long advocated for Hunts Point Food Distribution Center rooftops to be utilized for community co-owned solar-plus-storage, addressing local climate resiliency needs and optimizing economic co-benefits without adding to existing environmental burdens. NYC-EJA recommends the City and State identify larger solar ready public properties such as bus depots, parking lots, and wastewater treatment plants suitable for community shared solar, complementing the City’s public solar program, which is limited to consumption behind the meter. Many of the City’s environmental justice communities, such as areas in and around designated Significant Maritime and Industrial Areas, are designated for large-scale manufacturing, industrial uses, and polluting infrastructure. Assessing the solar-readiness of these sites would support existing community efforts, such as those led by our members UPROSE, PUSH Buffalo and THE POINT CDC, as well as the broader REVitalize partnership, to accelerate installations of community co-owned renewable and resilient energy systems in vulnerable areas. This can also provide local economic opportunities for residents often facing displacement pressures from gentrification... Some sites should host community solar projects that mandate at least 70% of LMI subscribers with the aim of lowering utility bills. Other sites should offer no cost leases for community-based organizations to explore new business models for clean energy projects that maximize low-income community ownership and participation. All sites should have local hiring requirements for solicitations, with strong preference given to proposals that commit to utilizing union labor and local hiring.” (Bautista et al, 2019, 5)
- “New York’s Public Service Commission (the Commission) issued an order directing Department of Public Service (DPS) staff to consider the development of a “community net metering” program. Up to this point, the installation of photovoltaic (PV) systems for solar energy generation largely occurred on the property of the offtaker of the solar energy. A common example is a homeowner deciding to “go solar” and financing and building a PV system on the roof of his or her own home. In return, that same homeowner receives a monetary credit on a volumetric basis on his or her utility bill for the energy generated by the PV system. In contrast, a community net metering program allows renters or homeowners without roofs that can support PV systems to subscribe to an offsite solar project on a remotely located building or lot and receive credits on their bills from the energy generated as if the systems were located on roofs they owned. Community solar therefore at its core is grounded in a utility billing mechanism—community net metering.” (Prakash, 2018, 202)
- “In contrast to NEM’s locked-in value, VDER creates a “Value Stack” with many layers, each of which quantifies different values based on the benefits and costs of distributed energy that is fed onto the grid. From an environmental justice standpoint, VDER is an important piece of the regulatory landscape for community solar. As it currently stands, the Value Stack does not fully value and incorporate the potential of distributed renewable energy resources to rectify disparate health and environmental burdens from

the energy sector in environmental justice communities and to close a historical gap in access to clean energy for lower-income households. If community solar projects are not properly compensated at their full and appropriate value, the deployment of such projects and their ability to provide extensive benefits in the environmental, climate, and economic arenas are severely limited. The manner in which the Value Stack is refined during Phase Two of VDER implementation will dramatically impact the feasibility of community solar projects, particularly those that seek to tap into social and economic co-benefits.” (Prakash, 2018, 203)

- “CBOs saw the development of CDG projects as a forward-thinking solution for building clean energy and economic opportunity in environmental justice communities that could be pursued in concert with longstanding campaigns to halt noxious and polluting energy generation. Environmental justice advocacy groups, social and economic justice organizations, and community economic development entities began both to develop campaigns around community solar to educate community members and also to affirmatively reshape the landscape of solar development, an area of expertise traditionally solely in the wheelhouse of solar development companies. CBOs began exploring what it would take to sponsor and steward clean energy development in their communities on their own terms, emphasizing principles of community ownership and governance and targeted benefits for those typically left behind in economic transitions.” (Prakash, 2018, 204)
- “CBOs entering the community solar development space are typically seeking a spectrum of outcomes, ranging from immediate benefits for individual households to deeper systemic change for entire communities. The outcomes sought include opportunities for local residents to be involved in the visioning, planning, and governance of renewable energy projects in their own neighborhoods; reduction and stabilization of utility bills for low-income families; transitioning a community away from reliance on fossil fuel infrastructure that pollutes the local environment and exacerbates climate change impacts; and longer-term community economic development through asset ownership and workforce development opportunities.” (Prakash, 2018, 204)
- “Community solar development tends to be a more complex process than traditional rooftop solar development from a legal and financing standpoint given the project scale, the number of parties involved, and the range of types of transactions and contractual relationships necessary for implementation. Community solar projects that seek to operationalize community ownership and governance and to direct benefits to low-income, energy-burdened²⁵ members of the community are made particularly complicated by three factors: nontraditional ownership models, innovative financing mechanisms, and targeted eligibility for the subscriber base. A CBO’s role in a community solar project will affect, and be affected by, the choices made regarding these three factors.” (Prakash, 2018, 204)
- “While many of the goals of a CBO seeking to develop community solar projects in underserved communities may be similar across the board, the specific role of a CBO in any given project can vary significantly. A CBO can operate as a sole owner, part owner, partner, subscription manager, or community outreach coordinator. Defining the desired role, from a legal standpoint in particular, is critical to narrowing the suite of options of ownership entities and financing strategies at the outset of project concept development.

It also serves to clarify how the community's perspectives and interests will be represented in the project's ownership entity and throughout the development process as decisions are made about siting, financing, defining a subscriber base, and the use of profits." (Prakash, 2018, 204-5)

- "A compromise solution that balances the desires for community control and the limitations on financing is the partnership flip model.²⁷ This approach allows for joint ownership of the project. between the community entity that is sponsoring the project and the tax credit investor only for the applicable period of time for the use of the tax credit by the equity investor, typically six to seven years, after which time full ownership of the project reverts to the community sponsor." (Prakash, 2018, 204-5)
- "One alternative to utilizing solar tax credits through a partnership flip model is for a CBO to receive another form of capital for project development, through either a grant or other fundraising efforts, to offset the 30% of costs no longer being funded by the tax credit. While raising capital is more time-consuming and places greater demands on an organization's capacity and resources, it offers the opportunity to organize community members around the vision for the project and to utilize innovative fundraising platforms that emphasize community engagement and collective involvement."(Prakash, 2018, 204-5)
- "Microgrids are emerging as a key form of community energy in New York City. A microgrid is a discrete subset of the electric grid that can balance, command, and control supply and demand points. Military bases, college campuses, and correctional facilities have operated microgrids for decades, for various reasons, including resiliency, public safety and security, energy efficiency, demand management, and cost savings. Solar PV, storage, building energy management systems, and use of equipment can all be harmonized on a microgrid. They can be financed in a variety of ways, and REV regulations will bring utilities to the table to "pay a microgrid operator" to balance flow of electricity on "macro" distribution grids, including supporting Con Edison Non-Wires Alternatives projects." (Kass, 2018, 51)
- "Community solar opens up renewable power consumption to renters as well as owners, including those in multi-tenant buildings. If a multi-unit building has separate meters for each unit, a renter may participate directly in CDG. If the building has one main meter, the landlord may represent tenants that wish to participate indirectly in a CDG arrangement... Community solar also allows for a degree of flexibility and mobility. If members move within the same utility service territory, they may retain their interest in the CDG project. This certainly is not the case with individual panels installed on a home's rooftop. In addition to allowing for greater access to solar energy, community solar may be able to finally bring utilities on board as advocates for the continued growth of renewable energy production and distributed energy generation. Utilities have always had concerns that renewable energy projects do not take into account the utility's need to maintain the grid, and that certain costs then are passed on to non-renewable customers." (Nason, 2016, 127)
- "Credits from power produced by a facility are applied against a bill from the utility, and any difference is owed to the utility. However, the utilities are still not completely satisfied, and are working to implement developer fees and changes to the crediting methods currently used for community solar... While the CDG Order garnered significant

attention and created interest in the development of community solar projects, no CDG projects have been completed and put on line yet in New York (as of 2016).” (Nason, 2016, 127)

- “Industry groups seek a guarantee that “projects that invest in substantial development activities under the current program rules will continue to be eligible for the current bill crediting methodology for the full lifetime of the project... The CDG, REV, and DER proceedings are all tightly interwoven and, to some degree, interdependent.” (Nason, 2016, 127)

Other Resources

Related Topics in this Document:

[Brooklyn Army Terminal Community Solar](#)

Hydropower – In-state

New York Actions

- “Appendix A limited the hydroelectric resources eligible under Tier 1 of the RES to (i) the incremental production associated with upgrades to existing facilities without new storage impoundments, and (ii) low-impact run-of river projects. The CLCPA, by contrast, includes all hydroelectric resources as “renewable energy systems.” (CES White Paper, 2020, 13)
- “For future Tier 1 procurements, which are targeted to new projects, this White Paper proposes that NYSERDA continue to impose the same eligibility restrictions on hydropower that appear in Appendix A of the 2016 CES Order. However, as explained in Section II.c.3 below, this White Paper also proposes that the Commission authorize NYSERDA to procure RECs from certain types of hydropower under a new Tier 4, so long as the associated energy does not involve new impoundments and is shown to be additional to the supplier’s baseline production of renewable energy.” (CES White Paper, 2020, 13)
- “This White Paper recommends that hydropower’s eligibility under Tier 4 should be limited in two ways. First, as the Commission has explained previously, new hydropower impoundments can cause negative environmental impacts, including methane emissions that may undermine their efficacy as a mitigation tool.⁶⁷ Therefore, this White Paper recommends that Tier 4 be closed to any hydropower impoundment not already in existence or under construction as of the date of issuance of this White Paper.” (CES White Paper, 2020, 48)

Pumped Storage Hydropower

LPDD Recommendations

- “State PUCs should direct their regulated electric utilities to evaluate the need for and benefits of grid-scale storage such as pumped storage hydro.”
- “States should consider including pumped storage hydro as transmission assets entitled to cost-of-service rate recovery in their transmission planning as an alternative to construction of new transmission lines.”

Related LPDD Database Pathways

- Promoting Pumped Storage Hydro Facilities: <https://lpdd.org/pathway/promoting-pumped-storage-hydro-facilities/>

Hydropower Licensing

Related LPDD Database Pathways

- Promoting Efficiency in the Hydropower Licensing Process: <https://lpdd.org/pathway/promoting-efficiency-in-the-hydropower-licensing-process/>

Grid Services Revenues for Hydropower

LPDD Recommendations

- “States should consider including pumped storage hydro as transmission assets entitled to cost-of-service rate recovery in their transmission planning as an alternative to construction of new transmission lines.”
- “RTOs and ISOs should enact market rules to accommodate the participation of energy storage (including hydro pumped storage) in energy markets, consistent with FERC’s final rule.”
- “RTOs and ISOs should establish new products and reform existing products that would adequately compensate ancillary services such as those provided by hydropower.”

Related LPDD Database Pathways

- Promoting Pumped Storage Hydro Facilities: <https://lpdd.org/pathway/promoting-pumped-storage-hydro-facilities/>
- Opening New Revenues to Hydro: <https://lpdd.org/pathway/opening-new-revenues-to-hydro/>

Hydro in the CES

LPDD Recommendation

- “States should change their restrictive RPS requirements by allowing all duly licensed and exempted nonfederal hydropower to qualify.”

Related LPDD Database Pathway

- Hydro in State RPS’s: <https://lpdd.org/pathway/hydro-in-state-rpss/>

Other Recommendations

- “The NYISO and PSC should modify transmission planning processes to incorporate consideration of energy storage in addressing transmission needs and public policy objectives. New York’s transmission planning process and the manner of cost recovery and compensation limits the consideration of energy storage as a solution to transmission needs.” (NY Energy Storage Roadmap 2018)

Discussion and Analysis

- “Expect a shift in the use of hydropower. New York State’s pumped and reservoir hydro assets are dispatched to balance hour-to-hour imbalances between energy supply and demand. According to our model, pumped hydro will go from five to ten days of substantial usage a year to more than 250 days. The way in which these assets are operated and maintained will need to change accordingly, allowing for faster ramp-up times and accounting for increased wear on mechanical components.” (McKinsey, 2019, pg. 5-6)
- “Energy Storage as a Bulk Transmission Resource in NYISO Planning: The NYISO and PSC should modify transmission planning processes to incorporate consideration of energy storage in addressing transmission needs and public policy objectives. New York’s transmission planning process and the manner of cost recovery and compensation limits the consideration of energy storage as a solution to transmission needs.⁷⁵ The NYISO generally looks at energy storage as a type of generator with the grid as if it is fuel. If storage were proposed as a solution to a transmission need, the current NYISO tariff likely classifies energy storage as non-wires alternatives, which fall outside of the ISO, and FERC jurisdiction does not allow for cost recovery of non-transmission assets. However, FERC has clearly stated that energy storage qualifies as transmission and should be compensated as such when it fulfills a transmission need. Energy storage could provide especially valuable flexibility as New York transitions to higher penetrations of renewables, serving as an alternative transmission solution that may defer large transmission investments until more renewable generation resources are located and developed. This could also provide optionality in transmission planning given the uncertainty of changes to load including energy efficiency, EV penetration, and other forms of beneficial electrification. The Commission could also consider ensuring that energy storage is included in the Public Policy Transmission Needs Assessment process and make storage projects eligible for cost allocation and recovery” (NY Energy Storage Roadmap 2018)

Other Resources

Related Topics in this Document: Hydropower - Out of state; Canada

Hydropower – Out-of-state; Canada

New York Actions

- “Recently Mayor Bill DeBlasio announced that New York City will pursue a deal to purchase Canadian hydropower and have it delivered to the city through a new transmission line-this would be a positive addition to New York’s resource mix.” (Getting Greener, 2019, 4.2 Look Beyond the Borders of New York, pg. 46)
- “Recently, a privately developed transmission project, the Champlain Hudson Power Express (CHPE) obtained all necessary permits to construct a 330-mile transmission line from the U.S.–Canada border to New York City. The project has a designed capacity of 1,000 Mw and is expected to be able to deliver approximately 8,000 Gwh per year to New York. The project developers are seeking a long-term delivery contract of

hydropower, but have not yet concluded a deal. The absence of Tier 1 RECs has an impact on the price negotiations and ultimately whether the energy will be counted as renewable power.” (Getting Greener, 2019, 3.3.3 Short-sighted Constraints on Importing Clean Hydroelectric Power, pg. 34)

Other Recommendations

- “On Tier 4, the advocates support extra weighting for in-state renewables being delivered into the city over Canadian hydropower. They also call for a specific prohibition on new or expanded water impoundments qualifying for Tier 4 and capping the price of Tier 4 RECs at the price of Tier 1 RECs.” (French, 2020)
- “Look beyond New York’s borders for low-cost, low-emission energy supplies and to cut GHG emissions. New York should explore the possibility of a multi-state buyers’ consortium to purchase large-scale low- and zero-GHG energy resources.” (Getting Greener, 2019, Executive Summary, pg. 4)

Discussion and Analysis

- “Although we commend the de Blasio administration’s commitment to climate justice and to achieve 100% clean electricity in OneNYC 2050, we are concerned that this goal relies largely on importing hydropower from Quebec.⁹ This requires the construction of a 330-mile underground high-voltage transmission cable, called the Champlain-Hudson Power Express (CHPE), to bring power from Canada down to NYC. The nearly \$20 billion project would lock NYC into long-term dependence on Canadian hydropower while inhibiting local offshore wind, solar and other renewable industries from developing, providing that energy, and catalyzing good green jobs in the process.” (NYC EJA, 2020, pg. 14)
- “We have concerns about the ecological and social impacts of hydropower, including the potential exposure of Indigenous communities in Canada to poisonous methyl-mercury from dam construction, and the potential exposure to PCBs that may result from constructing the CHPE under the Hudson River, the nation’s largest Superfund site. A recent study also shows that the City’s sourcing of hydropower may actually increase overall State carbon emissions by drawing hydropower away from other parts of the state that currently source from HydroQuebec, and would consequently have to switch to fossil fuel power.¹” (NYC EJA, 2020, pg. 14)
- “Meeting climate policy targets in the U.S. Northeast will likely require the nearly complete decarbonization of electricity generation. To that end, consideration is being given to expanding imports of hydropower from neighboring Quebec, Canada. We use a capacity expansion and dispatch optimization model to analyze the role Canadian hydro might play, and the economic trade-offs involved. We find that, in a low-carbon future, it is optimal to shift the utilization of the existing hydro and transmission assets away from facilitating one-way export of electricity from Canada to the U.S. and toward a two-way trading of electricity to balance intermittent U.S. wind and solar generation. Doing so reduces power system cost by 5-6% depending on the level of decarbonization. Expanding transmission capacity enables greater utilization of existing hydro reservoirs as a balancing resource.” (MIT Hydropower, 2020, pg. 1)

- “Second, expanding transmission enables Quebec hydro to play a greater balancing role in future low carbon power systems in the Northeast. We find that new transmission between Northeastern states and Quebec increases both imports from and exports to Quebec (shown by the purple line in the figure below for transmission expansion of 4 GW), allowing trading to further complement intermittent renewables. If we employ the analogy of Quebec’s reservoirs as a battery for Northeastern power systems, more transmission to Quebec effectively increases the rate at which this battery can be charged and discharged. The additional balancing provided by new transmission would allow New England to reduce its reliance on gas-powered plants, reducing CO₂ emissions. The role of Quebec hydro as a storage resource suggests that building additional transmission is a complement to deploying clean energy in the Northeast, rather than a substitute. This is in contrast to current plans by Massachusetts to use new transmission to import energy that substitutes for output from retiring nuclear plants. In the near term, new transmission will likely result in more imports. However, we show that, in the longer term, cost effective decarbonization entails that states build wind and solar PV plants and utilize transmission with Quebec to manage their intermittency.” (MIT Hydropower, 2020, pg. 2)
- “While hydro is a key renewable resource, state policies have not supported use of hydro when construction of a new dam is involved, limiting the ability to access additional affordable and clean power from Canada.” (Getting Greener, 2019, Executive Summary, pg. 2)
- “New York, New Jersey, Connecticut, Rhode Island, and Massachusetts are all in the process of developing offshore wind energy projects. The states are seeking low-cost electricity, but also vying for jobs from the burgeoning offshore wind industry. Rather than compete, these states should work together to bring the most cost-effective resources to the market. Another opportunity is to import Canadian hydropower, which is competitively priced and clean.” (Getting Greener, 2019, Executive Summary, pg. 4)
- “The RPS established criteria for resources eligible to count towards the renewable energy goals and these resources were initially referred to as “Main Tier” resources and are now identified as “Tier 1 RECs.” When the RPS was issued, the PSC limited hydro projects to the incremental output from upgrades provided there was no new impoundment (dam) constructed. This policy was reaffirmed with the issuance of the Clean Energy Standard, which imposed an obligation on load serving entities (companies selling electric energy through the transmission and distribution system) to purchase Tier 1 RECs.

The administrative history in the original RPS order provides little background for the rationale against new impoundments. This policy may have stemmed from local opposition in Canada to additional hydro exports and also been driven by concern for potential GHG emissions from new hydro facilities. Although it is correct that there are methane emissions from the surface of hydro impoundments, lifecycle GHG emissions from hydro facilities are on a par with wind and solar (see Background: Greenhouse Gas, and Figure 2).” (Getting Greener, 2019, 3.3.3 Shortsighted Constraints on Importing Clean Hydroelectric Power, pg. 34)

- “Another area of focus should be to encourage additional imports of hydroelectric energy from Canada. New York State currently imports about 7,500 Gwh per year of

hydropower from Canada. Hydro Quebec, a Canadian electric utility, has proposed building new transmission lines to New York to supplement the resources that New York already imports from Canada. Champlain Hudson Power Express, a private transmission development company, has completed all permitting requirements to bring 1,000 MW of power from the Canadian border to New York City. Depending on demand and operational considerations this would amount to approximately 8,000 Gwh per year. Previous contracts for Canadian hydropower have shown that the Canadian utilities are capable of providing power that is priced competitively for the New York and New England markets while allowing the seller to earn a favorable return. The PSC should review its finding and reconsider the advisability of additional hydro imports as a way for New York to meet the renewable energy goals.” (Getting Greener, 2019, 4.2 Look Beyond the Borders of New York, pg. 46)

Other Resources

Related Topics in this Document: Transmission

Geothermal

New York Actions

- NYC Local Law No. 6 (2016, <https://perma.cc/BK4X-QL8D>) that established this planning tool for the cost efficiency of geothermal heating systems, NYC Geothermal Heat Pumps tool: <https://www1.nyc.gov/assets/ddc/geothermal/geothermalTool.html>

LPDD Recommendations

- “State governments should add specific provisions to address geothermal and district heating technologies in their plumbing and electric codes.”
- “State agencies should develop modeling rules that capture the energy efficiency of geothermal heating systems and help agencies determine whether a geothermal heating mandate makes sense in comparison to other building alternatives such as a Passive House construction mandate.”
- “State legislatures should consider vesting developers of geothermal or district heating with some measure of eminent domain authority comparable to that provided to other utilities such as natural gas line construction.”
- “State PUCs should consider adopting special electricity rates customized to homes with geothermal systems.”

Related LPDD Database Pathways

- Creating Technical Standards for Geothermal and District Heating: <https://lpdd.org/pathway/creating-technical-standards-for-geothermal-and-district-heating/>
- District Heating Systems: <https://lpdd.org/pathway/district-heating-systems/>
- Oregon’s [Model Ordinance for Energy Projects](#) provides a guide for Oregon cities and counties on siting wind, solar, biomass, **geothermal**, and cogeneration projects, electric power transmission and distribution lines, and other large power production facilities.

Other Recommendations

- Use of Geothermal heat pumps expanded to the rest of the state outside of NYC, expansion of the Geothermal Pre-feasibility Tool (linked above) to outside of NYC with a law similar to Local Law No. 6 (2016) that established this planning tool for the cost efficiency of geothermal heating systems. Note: This law actually establishes municipal social costs of carbon through 2021, at a range of \$128-142 per metric ton of carbon dioxide equivalent.
- Research geothermal ‘networking’ as a way to address stranded assets for natural gas (Gellerman, 2020)

Discussion and Analysis

- “Although GSHP systems show significant promise, due to their higher upfront and total costs coupled with their more limited applications resulting from space constraints and geology, they were not considered among the primary heating technology options for consumer adoption in this study. Further work is needed to assess the benefits, costs, and feasibility of various cold-climate heat pump technologies as well as building shell efficiency measures.” (Electrification Scenarios, 2020, 24)
- Geothermal ‘Networking’: “The idea is that a gas utility takes out its leaky gas pipe and, instead of putting in new gas pipe, we put in a hot water loop... Eversource conducted its own study of networked geothermal heat pump systems, leading it to propose three different pilot projects to Massachusetts regulators in order to prove that the networked systems are feasible... “Under a networked system, homes and businesses would own the geothermal heat pumps, while Eversource would own and manage the system of pipes, sensors and pressure regulators, Conner said. That would convert the gas utility into a networked, thermal management company.” (Gellerman, 2020)
- Eversource is conducting three research projects: Geothermal in a densely-packed residential area, like a low income multi-family building (pg. 47), in a urban environment with both residential and C&I customers (pg. 47), and in a residential or suburban neighborhood (pg. 48). They plan to conduct these projects for three years to analyze the benefits relative to Natural gas.

“Geothermal networks and ground source heat pumps (“GSHP”) would provide customers with an additional choice for heating besides natural gas or delivered fuels. The Company is seeking to test if geothermal heating could be an alternative for customers that are either too far away from a gas pipeline or simply do not want to use natural gas. From a customer perspective, geothermal networks and GSHPs could provide the following benefits: Less costly ongoing heating/cooling system; A reliable system that does not have components such as a condensing unit outside of the house; Cleaner, safer, quieter system (no on-site combustion within the house means no carbon dioxide); Provides both heating and cooling; GSHP equipment is located inside the building so there is an ease of repair/maintenance and no aesthetic impacts; and Conventional heating and cooling equipment typically has a life expectancy of 5 to 10 years, whereas GSHPs are estimated at 25 years for the inside heat pumps and 50+ years for the ground loop.

The Company has reviewed estimates that geothermal networks and GSHPs can reduce carbon emissions by up to 60 percent for an average residential customer. Utilizing geothermal networks would provide the Commonwealth with an additional avenue to help meet its aggressive carbon reduction goals.” ([https://lpdd.org/wp-content/uploads/2020/04/Initial Filing Volume 2 11-8-19.pdf](https://lpdd.org/wp-content/uploads/2020/04/Initial_Filing_Volume_2_11-8-19.pdf))

Other Resources

Related Topics in this Document: Close of Existing Natural Gas Facilities

Nuclear

New York Actions

- Indian Point Unit 2 closed in April 2020. Indian Point Unit 3 is scheduled to close in April 2021.
- “The PSC has recognized the contribution that nuclear power plants make to avoiding GHG emissions with the establishment of Zero Emissions Credits (ZECs) in its Clean Energy Standard (CES) Order issued August 1, 2016. The CES incorporates two mandatory payment schemes: one supports the development of renewable energy resources via renewable energy credits (RECs) and the other supports the continued operation of four upstate nuclear power plants via ZECs. The cost of the ZECs is added to the bills of all electric customers in New York.” (Getting Greener, 2019, 3.3.1 Shutting Down Nuclear Plants Will Likely Reverse Past Gains, pg. 30)

LPDD Recommendations

- *“State governments should also consider subsidies for nuclear generation comparable to direct subsidies for renew-ables that improve, if not reverse, the cost comparison relative to renewables.”*
- *“In cost-of-service rate-regulated environments, state legislatures and state utility commissions can ease financing burdens by allowing some form of early cost recovery through rates for new nuclear plant development costs.”*
- *“State legislatures or state utility commissions could adopt approaches such as public financing and infrastructure support to assist private entities investing in new nuclear projects.”*
- *“Where cost-of-service rate recovery is not available, state legislatures, utility commissions, utilities, nuclear devel-opers, and nuclear investors could consider tax/equity models used for financing of renewable projects; sale-leaseback models; or other innovative approaches to enhance the ability of developers to obtain financing for new nuclear power plants.”*

Related LPPD Database Pathways

- Setting the Value for Nuclear Power: <https://lpdd.org/pathway/setting-the-value-of-nuclear-power/>
- State Nuclear Portfolio Standards: <https://lpdd.org/pathway/state-nuclear-portfolio-standards/>

- Financing and Ownership Models: <https://lpdd.org/pathway/financing-and-ownership-models/>
- Investments to Extend Nuclear Plant Life: <https://lpdd.org/pathway/investments-to-extend-nuclear-plant-life/>

Other Recommendations

- “Retain nuclear energy to retain the benefits of carbon avoidance. The state’s nuclear facilities operate with the help of subsidies, known as Zero Emissions Credits, that expire in 2029. If these subsidies are not extended, the nuclear plants may shut down while still holding valid operating licenses. The state should explore further extensions of these operating licenses with the U.S. Nuclear Regulatory Commission. The implementation of a properly priced carbon fee would be a benefit to the nuclear plants, which generate no greenhouse gases.” (Getting Greener, 2019, Executive Summary, pg. 4)
- “Nuclear power should be retained so that the state does not lose ground in its emissions reductions. While the Indian Point facilities are scheduled to shut down in 2020 and 2021, the operation of the remaining nuclear plants seems assured only as long as the ZECs are in place and they are now scheduled to expire in 2029. The implementation of a properly priced carbon fee would be a benefit to the nuclear plants and might reduce or eliminate the need for a continuation of the ZEC program. In addition, in order to continue to reap the benefits of this zero GHG emission resource, the State should explore with the U.S. Nuclear Regulatory Commission whether further extensions of operating licenses are feasible.” (Getting Greener, 2019, 4.3 Retain the Use of Nuclear Energy to Continue to Obtain the Benefits of Carbon Avoidance, pg. 46)

Discussion and Analysis

- “Nuclear is an important source of low-cost carbon free electricity and when possible to do safely, the lowest cost path to decarbonization involves maintaining these resources. Retiring nuclear to ‘make room’ for renewable resources is ultimately self-defeating. Reducing climate change should be the priority when weighed against nuclear accidents given relative risk and consequence except where specific circumstances dictate otherwise (E.x. reactors in active seismic zones). This is not an assertion of the safety of generation III nuclear but rather a recognition of the urgency of the latest climate science.” (350 PPM Pathways, 2019, 67)
- “As generation three nuclear retires, it should be replaced with fourth generation nuclear technologies if possible. By the 2040s renewables make up most of all electricity generation. Because of high marginal balancing costs when installing further wind and solar, dispatchable zero-carbon technologies such a nuclear are highly competitive.” (350 PPM Pathways, 2019, 68)
- “Between now and 2040, when all of the state’s power must come from zero-carbon supplies, all but one of New York’s existing, zero-emitting nuclear units are set to end operations. In 2019, nuclear plants provided approximately a quarter of New York consumers’ needs. If the plants operate until the end of their agreed upon lives (in the case of Indian Point 2 and 3) or the end of the current operating licenses (in the case of Ginna, FitzPatrick, and Nine Mile Point 1 and 2), the percentage of nuclear generation is estimated to drop to 11 percent by 2030 and to 6 percent by 2040 (or even lower, in a

high-electrification case). Looking just at 2030, it will take essentially all of the specifically named resources committed in the Act—i.e., 6,000 MW of solar, 3,000 MW of storage, and half of the 9,000 MW of offshore wind due by 2035—simply to replace the carbon-free generation that has been provided by the four units that will retire by then. Doing so will help meet the 70 percent renewable target by 2030 but it would not advance the state’s ultimate target of 100 percent zero-carbon generation by 2040.” (NYISO, 2019, 28)

- “Because the current contracts for up to 27,618,000 ZECs per year from the four upstate units (i.e., FitzPatrick, Ginna, and Nine Mile Point 1 and 2)93 end on March 31, 2029, there is no visibility beyond then with respect to whether those units would be compensated for their zero-carbon attribute. Ginna and Nine Mile Point 1 have operating licenses that end in 2029, while FitzPatrick’s goes to 2034 and Nine Mile Point 2’s extends beyond 2030. An energy price environment that reflects the social cost of carbon during the 2020s and beyond can provide that forward-looking visibility in the years leading up to 2029, and can create efficient and transparent market incentives for the owner to continue to invest in those projects, including potentially deciding whether to seek the ability to extend the lives of the units beyond 2029.” (NYISO, 2019, 38: carbon tax & nuclear plant closings)
- “Retain nuclear energy to retain the benefits of carbon avoidance. The state’s nuclear facilities operate with the help of subsidies, known as Zero Emissions Credits, that expire in 2029. If these subsidies are not extended, the nuclear plants may shut down while still holding valid operating licenses. The state should explore further extensions of these operating licenses with the U.S. Nuclear Regulatory Commission. The implementation of a properly priced carbon fee would be a benefit to the nuclear plants, which generate no greenhouse gases.” (Getting Greener, 2019, Executive Summary, pg. 4)
- “Indian Point Energy Center Units 2 and 3 are not included in the ZEC payment plan. The ZECs expire in 2029 and it is conceivable that the entire fleet of nuclear plants may shut down at that point unless the ZEC program is extended. If these plants are shut down, the energy needed from them will, at least initially, be supplied by natural gas burning plants that will produce approximately 20 MMTCO_{2e} per year... it is unclear whether the system in New York has the capacity to supply the energy needs to replace all the nuclear plants when they shut down.” (Getting Greener, 2019, 3.3.1 Shutting Down Nuclear Plants Will Likely Reverse Past Gains, pg. 30)
- “Advanced nuclear power could provide temperatures high enough for ammonia and petrochemical production, but no reactor designs appear sufficient to even hypothetically provide enough heat for glass, steel, and cement. Nuclear power continues to suffer poor public support (in part because of concerns about safety and nuclear waste) and is in decline in many countries, including the United States and EU. Nuclear heat applications provide new risks associated with novel operation (e.g., corrosion, maintenance). That said, the potential for advanced nuclear to produce low-carbon H₂ could prove important and another alternative for low-carbon hydrogen.” (Low Carbon Heat, 2019, Preliminary Technology Rankings, pg. 53)
- “Nuclear power plants currently play an important role of providing necessary baseload power in New York’s electricity system. New York could strive to maintain the net installed capacity of power from nuclear plants that can continue to operate in an

appropriate location and safe manner consistent with all environmental requirements and eventually replace the capacity of the units that are not relicensed with new nuclear or other low-carbon baseload plants. In all cases, the relicensing, replacement with new units at the same facilities, or the development of new nuclear energy (or other zero GHG emitting base-load generation) facilities needs to be done in a safe and environmentally sound manner. In addition to the traditional large-scale reactors, opportunities may arise to site newer smaller scale units.” (CAC Report, 2010, Chapter 8, page 22)

Other Resources

Related Topics in this Document: Low Carbon Heat Emissions, Clean Energy Standard

Emergency Generators

New York Actions

- The Department of Environmental Conservation (Department or DEC) adopted 6 NYCRR Part 222, "Distributed Generation Sources," on November 1, 2016. On March 1, 2017, an Article 78 Petition was filed challenging various aspects of Part 222. On July 26, 2017, a Stipulation and Order was issued whereby the Department agreed to propose a new rule pursuant to the State Administrative Procedure Act to replace the adopted rule. The purpose of this rule making is to promulgate a new Part 222 along with the attendant changes to Part 200, "General Provisions." The proposed rule will apply to economic dispatch sources with output ratings of 200 horsepower (hp) or greater in the New York City metropolitan area (NYMA). Economic dispatch sources will be required to meet control requirements beginning May 1, 2021. The proposed rule also sets forth certain monitoring requirements, maintenance and record keeping requirements for economic dispatch sources. Creates limitations on NOx emissions and creates a tax for price-responsive generation at 2.56 tons/hour beginning May 1, 2025. (DEC Rules 220 and 222, 2017)

Discussion and Analysis

- “The 100-year floodplain may underestimate the energy system’s vulnerability, as in some areas of New York City where Superstorm Sandy caused flooding that exceeded the floodplain estimates.¹⁶ Additionally, 88% of the city’s steam-generating capacity, 53% of in-city electric generation capacity, 37% of transmission substation capacity, and 12% of large distribution substation capacity lie within the 100-year floodplain. As climate change progresses, sea level rise projections show that these numbers could grow to 97% of in-city electric generation capacity, 63% of transmission substation capacity, and 18% of large distribution substation capacity.” (Bautista et al, 2019, 4)
- “Since 2001, the New York Independent System Operator (NYISO, 2019) and distribution utilities in New York have called upon owners of uncontrolled, primarily diesel-fired, engines to generate electricity for the host facility on high demand days in order to reduce demand on the electric grid. Sources enrolled in these programs, referred to as 'demand response programs,' are generally called upon to operate on hot summer days when ozone levels may exceed the ozone National Ambient Air Quality Standards

(NAAQS). The use of uncontrolled DG sources in demand response programs (referred to herein as 'demand response' or 'DR' sources) has correspondingly led to increased emissions from uncontrolled sources previously used exclusively in emergency situations. As further detailed in this document, the emissions associated with the use of DR sources, especially during periods when ground-level ozone concentrations are high, negatively impact the state's ability to attain the 2008 and 2015 ozone NAAQS as required by the Clean Air Act (CAA). As noted, most DR sources are not currently regulated and produce air pollution, including nitrogen oxides (NO_x), a precursor to ground-level ozone and particulate matter (PM) - both of which have been linked to adverse public health impacts. The use of DR sources in the New York City metropolitan area (NYMA), if left unchecked, will exacerbate public health impacts and make it very difficult for New York to meet its obligations under the CAA including attainment of the 2008 and 2015 ozone NAAQS. (DEC Rules 220 and 222, 2017)

- “The Public Service Commission's Reforming the Energy Vision (REV) initiative is expected to result in an increased reliance on distributed resources over central station power.” (DEC Rules 220 and 222, 2017)
- “Emergency generators or "emergency power generating stationary reciprocating internal combustion engines" as termed in regulation, are operated when the usual source of electricity is unavailable or for facility-related emergencies. Pursuant to Section 200.1(cq), emergency generators may operate for up to 500 hours per year, including emergency situations, routine maintenance, and routine exercising.² Emergency generators are exempt from permitting requirements pursuant to 6 NYCRR Section 201-3.2(c)(6). The New York City building code requires buildings greater than 75 feet high be equipped with emergency generators.³ There are approximately 10,960 buildings in New York City greater than 75 feet in height.⁴ Assuming a typical emergency generator is 1000 kW,⁵ the capacity of emergency generation sources in New York City is estimated at 10,960 MW.” (DEC Rules 220 and 222, 2017)

Other Resources

Related Topics in this Document: Closure of Existing Natural Gas Plants

Transmission

New York Actions

- Accelerated Renewable Energy Growth and Community Benefit Act (AREGCBA) includes appurtenant transmission in the definition of major renewable energy facilities, and also tasks the PSC with developing new transmission siting regulations; however, stops short of establishing new regulations around eminent domain and development districts. (AREGCBA)
- “NYPA and Department of Public Service staff filed criteria for the Public Service Commission to designate priority projects under the budget passed earlier this year. That designation allows NYPA to play an outsize role in their development. Other transmission needs identified as part of an in-the-works transmission planning study would be referred to the New York Independent System Operator for their competitive

process. The filing also seeks to have NYPA upgrades to transmission lines in northern New York, including the already proposed second phase of its SMART Path project, designated as a project that is “needed expeditiously.” The projects, mainly upgrades of existing transmission lines to a higher voltage, would unbottle thousands of megawatts of renewable energy, according to NYPA and DPS.” (NYPA Transmission, 2020)

- “Organizational investment in new direction. Con Edison has established and staffed a new Distributed Resource Integration business unit. Also, the utility’s Energy Efficiency and Demand Management Department team has expanded considerably and has been placed in the company’s ratemaking division, which indicates its business function with less emphasis on a regulatory compliance function.¹⁴ Proactive pursuit of Non-Wires Alternatives projects. In 2014, Con Edison obtained regulatory approval for the Brooklyn Queens Neighborhood Program, which proposed to offset 52 MW in anticipated new demand in 2017 through 2019 in a discrete set of distribution networks that were soon to be at risk of being overloaded during peak demand periods. A new substation and other conventional capital upgrades, estimated at \$1.2 billion at the time, were deferred, and \$200 million was committed to energy efficiency, distributed energy resources such as combined heat and power, renewables, storage, and other “non-traditional” upgrades to the grid infrastructure. This project set a precedent for a statewide pipeline of similar efforts. The Con Edison website lists RFPs and/or plans to procure eight new such projects in the near future.¹⁵” (Kass, 2018, 48)

Transmission - Easing the Transmission Siting Process

LPDD Recommendations

- *“As an alternative to use of eminent domain procedures for land assembly for transmission projects, states should consider authorizing the use of special purpose development districts or land assembly districts to increase land-owner participation in land assembly decisions.”*
- *“States could create transmission corridor districts to increase landowner buy-in for transmission projects.”*

Related LPDD Database Pathways

- Increasing Landowner Buy-In for Transmission Siting:
<https://lpdd.org/pathway/increasing-landowner-buy-in-for-transmission-siting/>

Transmission - Storage

LPDD Recommendations

- *“States should consider including pumped storage hydro as transmission assets entitled to cost-of-service rate recovery in their transmission planning as an alternative to construction of new transmission lines.”*
- *“States should adopt new laws or regulatory policies to create additional flexibility for how to classify energy storage projects for purposes of ratepayer recovery, or other means of rewarding energy storage initiatives, to facilitate greater integration of renewable energy into the grid.”*
- *“RTOs can help facilitate both demand response and energy storage through creating rules, incentives, and frame-works to encourage investment in these technologies.”*

Related LPDD Database Pathways

- Energy Storage: <https://lpdd.org/pathway/energy-storage/>

Transmission - Building Transmission

LPDD Recommendations

- *“States could eliminate laws that give utilities the “right of first refusal” to build transmission lines in the state.”*
- *“To the extent state law sets out what is a “public use” for purposes of eminent domain authority, state legislatures could amend the law to make clear that public use includes benefits to a multi-state region as well as to the individual state. If state legislation is unclear regarding how to define “need” and “public use,” state PUCs can interpret those terms expansively to encompass regional need and regional public use as well as clean energy goals within the state or the region.”*
- *“State legislatures or PUCs could make clear that merchant transmission line companies can seek siting permits and exercise eminent domain authority under the same conditions as electric utilities.”*

Related LPDD Database Pathways

- Overcoming Obstacles to State Authorization of Transmission: <https://lpdd.org/pathway/overcoming-obstacles-to-state-authorization-of-transmission/>

Other Recommendations

- *“New York therefore would benefit from some combination of investment in zero-carbon supply in downstate areas and/or further additions to the state’s transmission grid serving north-to-south power flows. Locational pricing, including a price on carbon, can provide efficient economic incentives to spur such development.” (NYISO, 2019, 17)*
- *“Transmission and distribution networks will need to adapt. Getting there will require major investments and operational improvements in transmission grids. Distribution grids will also need to be expanded and modernized to absorb the increased demand from electric vehicles and building heat, and to deal with new ways of actively managing that demand.” (McKinsey, 2019, pg. 5-6)*
- *“The CLCPA cannot succeed cost-effectively without New York State taking concrete steps to facilitate and support the development of transmission projects, with both public and private sector sponsors, to deliver energy that is already being curtailed and new generation that will be needed to satisfy the CLCPA mandates. The consequences of inaction or undue delay will be that New York will fail to meet its ambitious clean energy goals on time or at least cost. ACE NY respectfully submits the following recommendations to the Public Service Commission:*
 - *Identify several specific no-regrets upgrades in the current PPTPP.*
 - *Identify a generic Public Policy Transmission Need related to renewables to proceed on a simultaneous and parallel track within the current PPTPP.*
 - *Involve utilities in transmission improvements by requiring utilities to identify cost effective upgrades to their system that will unbundle renewables.*

- Streamline the PPTPP to achieve selection of a transmission project within one year from the initial NYISO submission to the Commission of proposed transmission needs.
- Act timely on Article 7 to allow for a decision within one year after a completed Article 7 application is filed by the transmission developer.
- Identify a policy need for offshore wind in PPTPP and simultaneously convene a task force to explore innovative funding mechanisms to support coordinated offshore wind transmission investment.
- Require the NYISO to create efficient policies for renewables + storage.
- Support and advocate for improvements to the NYISO interconnection process.” (Transmission Investments, 2019, Executive Summary, pg. 3)
- “Adding transmission is of the utmost importance to promote renewable electricity. It will help meet the State’s clean energy goals; meet these goals most cost-effectively; reduce consumer costs; and ensure reliable supply in the face of impending retirement of nuclear and fossil fuel generation. 4 Upgrades to both bulk transmission (“highways”) as well as local transmission owned by utilities (“byways”) are needed. Some of the specific transmission needs on “highways” are well known. For example, in its January 2018 filing to the Commission, NextEra Energy recommended the following upgrades based on its studies.
 - Northern New York transmission corridor: increase the transfer capability by 900 MW above the original limits of the Moses South Interface.
 - Central East transmission corridor: increase the transfer capability by 3,000 MW above the original limits of the Central East Interface.
 - Southern New York transmission corridor: increase the transfer capability by 1,000 MW above the original limits of the UPNY-CONED, UPNY-SENY, and Dunwoodie South Interfaces.
 - Dysinger East transmission corridor: increase the transfer capability by 900 MW above the original limits of the Dysinger East interface.
 - West Central New York transmission corridor: restore the transfer capability of the West Central interface to its original limits.

While this may be an ambitious list of projects, the Commission should rapidly identify a list of “no regrets” transmission upgrades that address current and future curtailment and negative pricing based on current generators, generators in the interconnection queue, generators holding NYSERDA REC contracts, and the generation that will be developed to meet CLCPA’s goals. Transmission projects that will facilitate the delivery of Upstate renewable generation to downstate loads must be a part of the “no regrets” transmission upgrades.” (Transmission Investments, 2019, The Impacts of Inadequate Transmission, pg. 7-8)

- “A primary recommendation of this Brief is that the Commission should soon declare a Public Policy Transmission Need to facilitate renewables, under the 2018 PPTPP which commenced in August 2018. We strongly recommend that the Commission should pursue two paths simultaneously: (1) immediately identify several specific transmission needs based on current curtailment and negative pricing combined with pending interconnection requests in the same area, and (2) identify a generic transmission need related to the ambitious clean energy mandates included in the CLCPA. This approach

will allow New York to act quickly on some well-known, no-regrets transmission investments now while also inviting innovative solutions to the broader need. Transmission planning in New York must shift quickly from its historically reactive ‘wait-and-see’ stance to active planning of the grid that must be in place to support the clean electricity goals.” (Transmission Investments, 2019, Transmission Solutions, pg. 11)

- “Identify Several Specific No-Regrets Upgrades in the Current PPTPP. The Commission should rapidly identify a list of “no regrets” transmission upgrades that address current and future generation curtailment and negative energy pricing. This list should be based on existing generators, generators in the interconnection queue, and generators holding NYSERDA REC contracts. Transmission projects that will facilitate the physical delivery of Upstate renewable generation to Downstate loads must be a part of the “no regrets” transmission upgrades. Studies exist that can support these decisions being made now in Case 18-E-0623.” (Transmission Investments, 2019, Transmission Solutions, pg. 12)
- “Identify a Generic Public Policy Transmission Need Related to Renewables. On a separate track, the Commission should identify a generic Public Policy Transmission Need in Case 18-E-0623 based on the renewable energy mandates in the CLCPA. The NYISO could then solicit solutions/projects for this generic need based on the amount of generation that will need to be developed to meet the CLCPA goals. This could be on a simultaneous and parallel track (to the specific “no regrets” projects recommended above) in the current PPTPP. This would allow the private sector to propose a variety of transmission solutions for further exploration and evaluation and would recognize that New York’s ambitious renewable energy goals warrant new, creative approaches.” (Transmission Investments, 2019, Transmission Solutions, pg. 12)
- “Involve Utilities in Transmission Improvements. The Commission should initiate a process to require utilities to identify potential cost-effective transmission and distribution upgrades on their systems that would also help unbottle renewable resources, especially on the byways. Failing to socialize the cost of upgrades to the byways will discourage competitive development of smaller (<100 MW) projects and will drive development toward very large (>250 MW) projects that can connect to the 345kV backbone” (Transmission Investments, 2019, Transmission Solutions, pg. 12)
- “Streamline the PPTPP. The Commission and the NYISO should collaborate to rapidly identify opportunities to streamline and improve the Public Policy Transmission Planning Process to shorten its timeframes. The goal should be that the NYISO is able to select a transmission project within 12-months of their initial submission of proposed transmission needs to the Commission.” (Transmission Investments, 2019, Transmission Solutions, pg. 12)
- “Act Timely on Article 7. The Commission should act on transmission Article 7 applications to allow for a decision within a 12-month period after a completed Article 7 application is filed by the transmission developer. These goals could cut the total delay time significantly.” (Transmission Investments, 2019, Transmission Solutions, pg. 12)
- “Require the NYISO to Create Efficient Policies for Renewables + Storage. The Commission should recognize that grid-scale solar or wind partnered with grid-scale storage is becoming the norm in other parts of the country. However, the NYISO interconnection process is not clear when it comes to connecting two dissimilar

resources together so that they may operate in concert. Efficient use of available energy (as well as state incentives for energy storage) depends on resolving the current confusion surrounding the NYISO interconnection process and rules about market participation. The Commission should ensure that the NYISO accelerates the clarification of rules and the accommodation of energy storage in the most flexible and efficient way possible for the benefit of New York consumers.” (Transmission Investments, 2019, Transmission Solutions, pg. 12)

- “Support and Advocate for Improvements to the NYISO Interconnection Process. Finally, the Commission should recognize that the current NYISO interconnection process presents long delays that put certain projects at risk of losing eligibility for time-sensitive incentives, or of not meeting NYSERDA contract requirements. The Commission should signal to the utilities and to the NYISO the strong need to redouble efforts in this area and insist on high quality and timely interconnection results. The Commission should also require utilities to act to improve the interconnection timeframe and establish metrics for the utilities regarding interconnection of grid-scale projects. Each utility should be required to appoint an ombudsman to deal with interconnection issues for grid-scale renewable projects. Finally, the Commission should advocate for a reexamination and updating of the Minimum Interconnection Standard methodology and process in light of the CLCPA goals.” (Transmission Investments, 2019, Transmission Solutions, pg. 12)
- “Advocate for increased generation and transmission of renewable energy into NYC” (NYC 1.5C, 2017, 2020 Climate Actions, pg. 22)
- “Advocate for investments that improve the flexibility of in-city transmission and distribution systems to reduce GHG emissions from in-city power plants” (NYC 1.5C, 2017, 2020 Climate Actions, pg. 22)
- “The State and utilities must also transition to a more reliable, flexible, and “smarter” grid, capable of adding new, intermittent, renewable power sources and build new transmission to bring upstate renewable power into the city.” (NYC 1.5C, 2017, We Can’t Do It On Our Own, pg. 30)
- “It recommended that renewable energy and GHG emissions policy goals be incorporated into existing and ongoing centralized system planning studies. Through this, system planners may identify cost-effective upgrades to existing infrastructure (including opportunities to incorporate smart grid technology) that reduce system losses and new transmission that interconnects remotely-located clean energy resources to the power grid.” (CAC Report 2010, Chapter 8, page 27)
- “The NYISO and PSC will need to develop regulatory mechanisms, market signals, and/or incentives to encourage upgrades and interconnections that facilitate the State’s climate and energy goals. This includes regulatory mechanisms that expedite decisions on cost recovery and cost allocation for New York Transmission Owners (NYTO) that invest in loss-reducing equipment and upgrades. In the Article VII process, PSC could give greater weight to a proposed project’s contribution to state climate and energy policy goals in the determination of project need.” (CAC Report 2010, Chapter 8, page 27)
- “The Technical Work Group focused on ways to encourage cost-effective transmission system upgrades, expand transmission capacity, and reduce sulfur hexafluoride (SF6)

emissions from transmission-related equipment... Utilizing existing rights-of-way should be encouraged to the extent practicable. The policy also recommends that system planning studies identify areas or zones within the New York Control Area that have high potential to provide clean energy, and then target these zones for transmission expansion to accommodate clean resources.” (CAC Report 2010, Chapter 8, page 27)

- “To reduce the emissions of SF6 from transmission operations, the policy calls for all NYTOs to sign on to the U.S. Environmental Protection Agency’s SF6 Emission Reduction Partnership for Electric Power Systems and set goals for reducing SF6 emissions, and to establish a New York State working group including the NYTO and other stakeholders, to share best practices and develop strategies to meet the Partnership’s goals. The State could also support the development of environmental regulations, manufacturer incentives, and federal SF6 emissions performance standards to encourage the use of environmentally-friendly equipment that limits emissions of SF6, and encourage research and development programs to find ways to limit and/or replace SF6 technologies.” (CAC Report 2010, Chapter 8, page 27-28)

Discussion and Analysis

- “But, without new transmission capacity, the addition of new upstate renewables will not on its own increase the penetration of renewable energy consumed in New York City to a level that enables statewide compliance with the 70 by 30 Target.” (CES White Paper, 2020, 46)
- “First, the optimal use of U.S.-Canadian transmission lines will change drastically as Northeastern states decarbonize their power systems. Today transmission capacity is used to deliver energy south, from Quebec to the Northeast (see the blue line in the figure below based on 2018 data). The role of Quebec hydro in Northeastern power systems is therefore as a generation resource. However, our results suggest that, in a future low-carbon grid, it is economically optimal to use the transmission to send energy in both directions (illustrated by the brown line in the figure below). In periods of renewable scarcity in the Northeast, Quebec exports energy (drawing down reservoir levels). In periods of relatively high renewable output in the Northeast, Quebec imports energy (leaving its reservoirs to recharge). This allows power system costs across New England and Quebec to be 5-6% lower than if we limited transmission flows to be north-to-south only. Two-way trading helps balance renewable intermittency at multiple time scales ranging from daily to seasonal. These results suggest that the optimal utilization of Quebec’s hydro capacity in a low-carbon future is as a virtual energy storage resource for the Northeast, rather than as a generation resource.” (MIT Hydropower, 2020, pg. 2)
- “Third, state goals for zero-emission electricity will be achieved at a lower cost if transmission with Quebec is expanded according to our results. We find that new transmission delivers net electricity cost savings (after accounting for the cost of new power lines) for decarbonization levels beyond 90%. For New England, we estimate that 4 GW of additional transmission reduces power system costs across New England and Quebec by \$3/MWh (13%) in a 99% decarbonized power system and by \$7/MWh (24%) in a 100% decarbonized power system in our central Base Case. For New York, we estimated savings across New York and Quebec of \$3/MWh (12%) and \$8/MWh (23%) respectively. The magnitude of cost savings depend on additional assumptions such as

whether states pursue a renewable-only approach to decarbonization, or whether states electrify other energy sectors such as transportation and heating. The full range of estimated cost savings from building 4 GW of additional New England-Quebec transmission is 11-26% for 99% decarbonization and 17-28% for 100% decarbonization.” (MIT Hydropower, 2020, pg. 3)

- The central focus is dramatic transformation and expansion of the grid. For buildout of transmission capacity, focus on improvement, use data analysis, and think about the “tale of two grids” where $\frac{3}{4}$ of power in zone J is fossil fuels and there is a lot of opportunity for upstate renewables to be accessed downstate. Think about the importance of integration of storage, demand side agility, demand response, net metering rules, investment in cutting down energy waste, and electrification of more appliances. (ACE NY Virtual Town Hall, 2020)
- “Transmission flows will reverse direction. Today, most hydro and four out of five nuclear plants are upstate,³ and there is a steady flow south of about five GW. In the future, downstate will likely account for relatively more offshore-wind and distributed-solar generation. By 2030, those north-to-south flows could sometimes be nearer to zero, and eventually, the flow could reverse to reflect the different configuration of the supply (Exhibit 5). If that happens, there will need to be upgrades to the grid, and changes to how the network is operated. This effect will likely be more pronounced in winter, when offshore-wind assets located downstate produce more power and utility-scale-solar assets located upstate produces less.” (McKinsey, 2019, pg. 5)
- “By 2040, our model suggests 17 GW of offshore-wind assets, 11 GW of onshore-wind assets, and 23 GW of utility-scale-solar assets will need to be connected to the grid, sometimes over long distances, to meet the state’s goals. Those estimates are well above the state’s targets. Getting there will require major investments and operational improvements in transmission grids.” (McKinsey, 2019, pg. 5-6)
- “This conversion from direct fossil fuel consumption to electric power [in transportation] will necessitate a dramatic further increase in renewable energy supply and energy efficiency: New York State will need to add an additional 94,000 Gigawatt hours of renewables, more than double existing renewable resources. It will also require an expansion of the state’s transmission capacity, which is already constrained from upstate to the downstate area, where most energy is used. The construction of offshore wind facilities will bring more renewable energy directly to the downstate market, but a larger mix of resources, some operating intermittently, will require an expanded transmission grid to deliver power throughout the state.” (Getting Greener, 2019, Executive Summary, pg. 3)
- “New York has an integrated system of power suppliers and transmission facilities, coordinated and operated reliably and economically by NYISO. For over two decades, this system has operated efficiently based on a competitive market design. NYISO administers a market that is regulated by the Federal Energy Regulatory Commission (FERC), comprising a diverse set of more than 425 market participants—transmission owners with over 11,000 miles of transmission circuits, companies owning over 700 power plants, privately owned and publicly owned distribution utilities, end-use suppliers, consumer groups, environmental organizations, and others—and reliant on

market rules designed to provide reliable and economical power to New Yorkers.” (NYISO, 2019, 4)

- “The “upstate system” (i.e., the western, middle, and northern parts of the state, shown in light blue in Figure 1) has significant amounts of zero-emitting, non-fossil generating resources with low operating costs, low wholesale energy prices, and low CO₂ emissions. The “downstate system” (shown in the darker blue areas of New York in Figure 1) depends much more on fossil generation, and has operating costs and air emissions tied more directly to the combustion of natural gas and oil in power plants. The two sub-regions of the NYISO system are connected by a series of transmission lines that are not sufficiently large, in terms of the amount of power that can flow across them, to allow for the full and unimpeded transfer of low-cost, low-carbon resources from the upstate system to the downstate system.” (NYISO, 2019, 16)
- “This situation—a bifurcated system within a single NYISO market, with upstate and downstate systems affected by the transmission constraint between them—has persisted for years, if not decades. In recent years, however, several new transmission lines have been identified and approved through the coordinated NYISO/PSC process to designate transmission facilities needed to support “public policy requirements.” In April 2019, NYISO’s board approved facilities that will enhance transfer capacity across the Central East and other interfaces. Those facilities are anticipated to go online at the end of 2023 and begin to provide downstate New York with greater access to lower-cost resources... Without further transmission additions, those new zero-carbon resources will compete with other upstate clean energy resources to meet a relatively small share of the state’s customers; likely depress prices in upstate New York and reduce revenues to these and other upstate generators; lead to potential curtailments of clean energy resources that exceed local demand, further reducing revenues to renewable generators; and be prevented from helping to reduce fossil generation in downstate New York where most electricity sales and air pollution occurs.” (NYISO, 2019, 17)
- “For example, when the July 2018 NYISO Study identified areas of potential bottling with curtailment of existing and new renewable resources in the State, the area covered almost the whole of Upstate New York... According to the study, transmission upgrades in the West and in the Southern tier could unbottle over 1,000 MW of renewable resources. Upgrades in the Northern tier could unbottle another 1,000 MW. The potential for so much generation unbottling demonstrates the need for additional transmission investments.” (Transmission Investments, 2019, The Impacts of Inadequate Transmission, pg. 3-4)
- “An older but more detailed study, the 2010 NYISO Wind Generation Study, examined the need for transmission expansion in specific locations that would be required to accommodate many thousands of MW of renewables, specifically land-based wind projects. Conceptual transmission solutions were identified, and cost estimates were provided. This study accurately predicted some of the local problems that are now being encountered in 2019. This bottling will potentially get more acute as actions are taken to comply with the CLCPA. In addition, the CLCPA mandates that 9,000 MW of offshore wind resources be built by 2035. Moving this power to shore will require transmission investments as well. Failing to comprehensively plan for such capacity additions will result in a piecemeal, insufficient and overly costly expansion of the New York grid. In

contrast, planning and executing strategic investments now will allow clean energy goals to be achieved most cost-effectively.” (Transmission Investments, 2019, The Impacts of Inadequate Transmission, pg. 5)

- “Most studies examine only high-voltage transmission corridors and neglect the portion of the grid that operates at 115kV and below. However, the 2010 NYISO Wind Generation Study did go into detail about lower-voltage local networks. It showed the need for substantial transmission expansion projects in certain pockets where competing renewable projects are currently being proposed in clusters. Two examples of the pockets identified then are in evidence now: the 115kV grid in Steuben County (Zone C) and the 115kV grid in Jefferson County (Zone E). In both of these pockets, well over 1,000 MW of renewable projects (including decades-old hydro-electric plants) have connected or have proposed interconnection. Absent local transmission expansion, many of these projects risk curtailment and negative prices as described above. Unfortunately, due to the locations involved, effective transmission expansion will cost more than individual generation project owners can bear. To maximize renewables investment and production in these locations, multiple transmission lines need upgrading or construction.” (Transmission Investments, 2019, The Impacts of Inadequate Transmission, pg. 8)
- “Many utilities can identify opportunities for upgrades on their local systems that would help unbundle output from current and proposed renewable projects. Some of the upgrades could be made by the incumbent utilities in the context of simply doing their routine local transmission upgrades that would have multi-value proposition including unbottling of renewable resources. Other upgrades would have to be done solely to accommodate more renewables. In either case, transmission projects could be developed that benefit both utility customers and renewables development. Creative cost sharing solutions between the utilities and renewable project developers could be found that would provide a win-win for utility customers and renewable developers. This would most likely require collaboration between utilities, renewable developers, and the Commission to move forward.” (Transmission Investments, 2019, The Impacts of Inadequate Transmission, pg. 8)
- “Many transmission needs can be addressed by upgrades in existing corridors. Environmental impacts can be further limited by following “Smart from the Start” policies and criteria, which address a range of important concerns.⁵ In particular, any transmission development in new areas that conflicts with wildlife conservation areas should be avoided whenever possible and long-term conservation improvements should be implemented to mitigate impacts. Environmental mitigation costs should be incorporated into cost analyses when assessing the cost effectiveness of potential projects, which is a best practice followed in several state planning processes and by the Western Electricity Coordinating Council.” (Transmission Investments, 2019, The Impacts of Inadequate Transmission, pg. 9)
- “The most problematic part of the process is the NYISO's Class Year Study, which has regularly taken two years or more to complete. To address this problem, the 2019 NYISO Grid in Transition Draft Report states that reforms to the Class Year Study process have been proposed and the NYISO is currently planning to send a package of modifications to FERC by the end of 2019. These proposed modifications show some promise of reducing the length of the study. New York's utilities also play a large role in conducting

interconnection studies, including the Class Year Study, and their performance must also be improved. Utilities currently do not have a strong incentive to make the interconnection process smooth or timely. An increase in staffing at the utilities, and the hiring and retaining of engineers with deeper experience is needed, even in light of the strong industry demand for such personnel. While this may raise the personnel costs at the utilities, a strong drive forward in this area is essential if New York is to have any chance of achieving its aggressive clean energy goals cost-effectively. New York could also explore allowing industry to provide funding for utility personnel that would be dedicated to improving the interconnection process, and precedent for this exists within federal agencies.” (Transmission Investments, 2019, Transmission Solutions, pg. 10)

- “Another issue is the NYISO Minimum Interconnection Standard (MIS) which provides an inexpensive solution to interconnection by assuming that existing generation will be displaced (i.e., will produce less electricity). The intent of this protocol is to prevent new projects from having to pay for the cost of transmission upgrades that would be required if the system had to simultaneously deliver power from both the new project and from existing nearby resources. However, that assumption of displaced generation worked in the past, now in Upstate NY the existing resources that would be displaced by the incoming new renewable resource are likely to be existing renewable resources. This ‘cannibalization’ of renewables will result in much slower progress made toward the renewable energy goals. On the other hand, obliging a new resource to absorb the cost of transmission upgrades will likely result in that project not being built. Either way, individual renewable projects – whether proposed or ten years old – are jeopardized if the cost of transmission upgrades for interconnection is not fairly allocated in some way. The Commission should encourage the NYISO to revisit and update the MIS process in light of the CLCPA goals and current circumstances.” (Transmission Investments, 2019, Transmission Solutions, pg. 10)
- “New York City’s electric distribution grid serves nearly three million residential, commercial, and industrial customers. The city’s main distribution system, operated by Con Edison,¹¹ reached its all-time highest peak demand of more than 13,300 MW in 2013. In 2015, the 20,200,000 MWh sold to customers by Con Edison represented nearly 1% of the total MWh delivered to customers in the United States.¹² Maintaining Con Edison’s vast, complex, and aging grid, and maintaining safe and reliable service is a demanding ongoing exercise. The system is also expensive for ratepayers, which is one of the main reasons New Yorkers consistently pay the highest electric rates in the continental United States. Looking forward, operation and development of Con Edison’s grid will become ever more complicated, but the opportunities for customers and the utility’s business will also evolve in exciting ways.” (Kass, 2018, 46)
- “The first complementary policy is increasing transmission infrastructure to move electricity from where it’s generated to where it’s ultimately used. Adding more wind and solar benefits significantly from adding more transmission lines to bring electricity from the areas of highest wind and sun potential to the areas with electricity demand. Siting and permitting challenges can make building new transmission difficult, and the net zero pathway assumes U.S. transmission capacity doubles by 2050, so policies that lower the barriers to new transmission line construction are critical to a high-renewables future.” (U.S. Net Zero Emissions By 2050: Decarbonizing Electricity, 2019)

- “However, the age and condition of the transmission infrastructure that has been serving the city limit the extent to which the infrastructure can adapt to become a truly “smart” grid. Even today, the transmission system does not provide adequate bandwidth. Congestion is a longstanding problem. Currently, when demand is at its greatest in the city, lower-cost or cleaner power that is available cannot reach the city because of the transmission bottlenecks.” (Kass, 2018, 52)
- “Siting of transmission projects can be complex and contentious due to regulatory issues at the State and federal level, differing perspectives on the benefits and cost burdens, opposition at the local level, and potential environmental and visual impacts.” (CAC Report 2010, Chapter 8, page 28)

Other Resources

Related Topics in this Document: NYISO pricing, Grid Planning, Rates, Storage

Grid Planning

New York Actions

- “Public utility officials in New York released a grid proposal this week in support of 100% clean electricity by 2040, warning that a crop of massive wind farms could otherwise be left stranded in the state. The transmission plan from the New York Power Authority (NYPA), known as the Northern New York project, would upgrade and expand bulk power lines in the state's upstate areas, near where dozens of large-scale renewable projects are slated for construction in the coming years.” (Iaconangelo, 2020)
- “Future Grid Challenge helps solve technical challenges utilities face with energy transmission and distribution when integrating renewable energy resources.” (Clean Energy, 2020, Resilient and Distributed Energy System, pg. 26)
- “Energy Storage engages those involved in building, installing, integrating, or researching energy storage technology.” (Clean Energy, 2020, Resilient and Distributed Energy System, pg. 26)
- “Fuel NY makes fueling stations resilient to power system outages.” (Clean Energy, 2020, Resilient and Distributed Energy System, pg. 26)
- “The collaborative GridOptimal Buildings Initiative, led by NBI and the U.S. Green Building Council, seeks to provide standards, tools, and guidance to improve building-grid interactions by empowering owners, architects, and engineers with dedicated, standardized grid citizenship metrics. The GridOptimal Buildings Initiative will play a major role in bridging the gap in knowledge, understanding, and priorities across the meter, including both grid operators and electricity consumers.” (NY to Zero, 2019, Beyond the Meter, pg. 33)
- “Initiatives such as the PSC’s Reforming the Energy Vision (REV) and NYISO’s Distributed Energy Resource (DER) Roadmap are addressing these challenges and opportunities by forging a path for the transformation of the electric grid to a more decentralized model.” (Kanyuck, 2018, 223)
- The Distributed System Implementation Plans (DSIPs), established in the REV proceeding, which is “an intelligent network platform that will provide safe, reliable, and

efficient electric services by integrating diverse resources to meet customers' and society's evolving needs. The DSP fosters broad market activity that monetizes system and social values, by enabling active customer and third-party engagement that is aligned with the wholesale market and bulk power system." (Stein, 2014)

LPDD Recommendation

- *"States should evaluate new power projects based on their system-wide project costs and benefits, and should favor integrated planning approaches that compare the social costs and benefits of various power projects."*

Related LPDD Database Pathways

- Integrated Resource Planning: <https://lpdd.org/pathway/integrated-resource-planning/>

Other Recommendations

- "Support integrated grid planning to enable connected buildings, electric vehicles, and other grid edge, including developing the technology and equipment that can enable grid interactivity, as well innovative utility rate structures and tariffs that will drive end users to buy and implement the technology." (Clean Energy, 2020, Clean Energy Economy, pg. 22)
- "Incorporate resilience considerations into NYSERDA programs, to ensure that investments are protected against future climate impacts." (Clean Energy, 2020, STRATEGIES FOR 2020–2023, pg. 26)
- "Maximize renewable energy content in resiliency solutions, including pairing renewables, storage and Distributed Energy Resources (DER) for on-site resiliency." (Clean Energy, 2020, STRATEGIES FOR 2020–2023, pg. 26)
- "Explore cost reductions through smart grid technologies" (Clean Energy, 2020, STRATEGIES FOR 2020–2023, pg. 26)
- "Continue to support research and development activities for the State that strengthen our analytical understanding of the energy system in transition and the environmental benefits and impacts that such changes will bring to ensure promotion of robust, well-informed policy measures." (Clean Energy, 2020, STRATEGIES FOR 2020–2023, pg. 26)
- "Promote localization of workforce development and economic benefit opportunities to strengthen socio-economic resiliency in our State's transition to the CLCPA goal, particularly in low-income and disadvantaged communities." (Clean Energy, 2020, STRATEGIES FOR 2020–2023, pg. 26)
- There is a "pressing need for high voltage transmission investment in New York". (Getting Greener, 2019, Introduction, pg. 19)
- "To reduce reliance on old, inefficient fossil fuel-based in-city generators, and to benefit from a more renewables-based grid, the City will need a coordinated expansion of transmission capacity statewide." (NYC 1.5C, 2017, Key Actions to Clean Energy, pg. 12)
- "Promote the development of community energy projects, including microgrids and district systems, to provide social, environmental, and economic benefits." (NYC 1.5C, 2017, 2020 Climate Actions, pg. 20)

- “This policy promotes the development of low-carbon renewable energy resources in New York over the period from 2015–2030 by increasing incentives and removing existing barriers for grid-connected renewable energy resources. This policy is intended particularly to increase investment in and development of in-state renewable energy resources such as wind (both onshore and offshore), solar photovoltaic (PV), low-carbon sustainable biomass/biofuels, and others.” (CAC Report 2010, Chapter 8, page 15)

Discussion and Analysis

- “New York State aims to modernize the electric grid in ways that improve resilience to disruption, enable greater flexibility, reduce costs, and support the integration of higher volumes of distributed and renewable energy resources.” (Clean Energy, 2020, Clean Energy Economy, pg. 25)
- “Improving grid flexibility will require using a wide range of options. Our model predicts that green-energy sources such as offshore wind, onshore wind, and solar will largely replace conventional fuels and provide more than 60 percent of New York State’s electricity by 2040 (Exhibit 2). Because wind and solar power cannot run 24/7, however, a range of technologies and practices—everything from batteries to hydro to demand management—that enable the grid to function with intermittent sources of power will therefore need to be deployed, at scale, for a renewables-dominated power system to work well” (McKinsey, 2019, pg. 4)
- “The emerging story of the New York electric system is a tale of two grids — a tale of clean energy abundance and surplus generating capacity upstate and fossil-fuel dependence and high demand downstate. Limited transfer capability from upstate to downstate means that this tale of two grids is also a tale of two markets — where the expansion of clean energy resources is unable to reach downstate load centers, suppressing upstate wholesale prices to the point where the economic viability of generation needed for reliability is jeopardized.’ This highlights the pressing need for additional high voltage transmission investment in New York. As it stands now, the operation of existing wind generation projects in upstate New York have been curtailed every month between January 2015 and December 2018 due to reliability and delivery constraints. While the amount of curtailed energy is relatively small at this time, additional planned renewable generation may exacerbate this problem. The introduction of offshore wind resources and additional solar throughout the state will change the distribution of resources, but the intermittent nature of these new renewable resources will place demands on the transmission grid that have yet to be analyzed.” (Getting Greener, 2019, Introduction, pg. 19)
- “Monetize building decarbonization measures as grid integrated solutions to address and support grid needs through participation in demand management programs, such as the California Public Utilities Commission’s Load Shift Initiative.” (CA Building Roadmap, 2019, 12)
- “The second complementary policy is expanding grid flexibility to help manage electricity demand by shifting when consumers use power, reducing peak demand, and deploying grid-scale storage. The net zero pathway incorporates more than 200 GW of demand response by 2050 – about half the potential identified by the Federal Energy Regulatory Commission and less aggressive than the 200 GW by 2030 potential

identified by The Brattle Group – and encourages investments to spur an additional 5% annual battery storage capacity growth, allowing the grid to store clean electricity for when it’s most needed.” (U.S. Net Zero Emissions By 2050: Decarbonizing Electricity, 2019)

- “At the building level, there has been a lack of knowledge and incentives to encourage building design and operations that minimize grid costs and carbon impacts, or enhance grid operation. The status quo for designers and owners is to think of the power grid as an infinite battery of power supply that can be drawn on. Current thinking on the topic is fragmented with various players using different language to discuss and coming from a variety of perspectives.” (NY to Zero, 2019, Beyond the Meter, pg. 33)
- “In this transformation, the electric grid becomes more diverse and bidirectional, and the role of IOUs evolves to serving as “distributed system platforms” that encourage consumer-sited generation (referred to as distributed energy resources or DER), energy efficiency, and demand reduction planning, in addition to owning and operating transmission and distribution assets.³⁹ As a result, customer-sited DER such as solar, wind, combined heat and power, and energy storage assets will become integrated into the electric grid and will necessarily be relied on to improve overall energy efficiency, reliability, and resiliency objectives.” (Kanyuck, 2018, 223)
- “When planning for the distribution grid of the future, the broader concept of “Smart Communities,” or “Smart Cities,” merits consideration. “Smart” in this context means using information communication technology (ICT) to connect the people and businesses of a jurisdiction with their residences, commercial buildings, infrastructure, and public services. David Owens, a former executive for operations and regulatory affairs at Edison Electric Institute, describes smart communities as a “partnership of the energy industry with the transportation, communications, and water sector.”²⁷ The “internet of things” creates tremendous opportunities for upgrading the electric distribution system in concert with other systems in New York City. These potential synergies may offer ways to finance smart infrastructure in a joint fashion, using public-private partnerships to create cost efficiency and new revenue streams. When developing policies that support the smart city of the future, the City should include ICT leaders and stakeholders as well as energy policy and utility personnel in the discussions.” (Kass, 2018, 52)
- “A joint distribution grid planning process between the City and Con Edison needs to be established. The demand requirements for the distribution system of the future are ambiguous at best. The City and Con Edison need to come to a working understanding and jointly develop a forecasting model for how the 80% reduction is going to be attained. How much will energy efficiency reduce demand, and by when? How much electrification of heating systems will happen by 2050? What is the adoption rate of solar PV, storage, and microgrids going to look like? With these answers, we can then assess the investment in the distribution system that is needed and leave time to plan for ratepayer cost impacts.” (Kass, 2018, 55)
- “Currently, New York State’s transmission system does not enable renewable energy produced in northern and western portions of the state to flow into NYC... As New York State ramps up to its target of 50 percent renewable energy under the Clean Energy Standard’s 50 x 30 renewable energy target, the City will work toward integrating

renewable energy into NYC's energy supply, continue to advocate for new transmission to bring upstate renewable power into the city, and continue to work with utilities to encourage technologies that create a more flexible, distributed grid in order to increase the share of renewable energy in NYC. The City will also work to increase energy storage, laying the groundwork for a more flexible grid that can adapt to a greater reliance on intermittent renewable energy. Benefits include supporting economic and technological innovation, improving air quality and health from reduced fossil fuel-based energy, and fortifying system resiliency." (NYC 1.5C, 2017, Key Actions to Clean Energy, pg. 12)

- "Specified targets would be identified for both offshore wind and grid-based solar power. The State could achieve these goals through a variety of policy mechanisms, starting with the continuation and expansion of an RPS program using funds raised through charges on utility bills. Achieving the goals outlined above, including the diversity in renewable resources, may benefit from supplementing existing funding mechanisms with other incentives, such as power purchase agreements, whereby the New York Power Authority and Long Island Power Authority purchase power or renewable attributes from renewable energy providers, and renewable energy payments (also known as feed-in tariffs) for specific categories of smaller renewable energy projects. These incentives can be designed to assist in the implementation of developing and emerging technologies. The State should continue to monitor changes in the price differential between grid-based solar power, offshore wind, and other renewable sources so that incentives can be adjusted in accordance with their economic and technical viability." (CAC Report 2010, Chapter 8, page 15)
- "In order to further encourage these clean energy resources, New York State should examine any remaining barriers that prevent market-based development of utility-scale renewable energy generation projects. Possible policy approaches include: (1) specific standards and fees for interconnecting renewable energy resources into the grid, (2) establishment of renewable energy development zones that allow for concentration of transmission grid upgrades to efficiently deliver renewable power to end-user consumers, and (3) specific regional siting policies for technologies such as offshore wind." (CAC Report 2010, Chapter 8, page 15)
- "In the next two decades, this renewables incentive policy will be the primary mechanism to facilitate the development of the renewable resources needed to move New York to a lower carbon power sector. Over time, this policy could be phased out in favor of programs such as the low-carbon portfolio standard and an expanded regional cap-and-invest program. The Federal Energy Regulatory Commission (FERC) has exclusive jurisdiction under the Federal Power Act to regulate rates and conditions of sales for resale of electric energy in interstate commerce. The States are preempted from setting wholesale power rates that exceed utility avoided costs. New York's utility-based incentive programs for supply from renewable sources will need to be developed in compliance with this federal requirement. (Source: FERC, Order on Petitions for Declaratory Order, issued July 15, 2010)." (CAC Report 2010, Chapter 8, page 16)
- "The investment of funds in support of this goal is likely to create large numbers of jobs installing and maintaining renewable energy systems. Early investment in emerging technologies will contribute to lowering the price of such technologies so that they can be more competitive in the future." (CAC Report 2010, Chapter 8, page 17)

- “The distribution system serves as an enabling technology to allow for greater market penetration of customer-sited low-carbon technologies (rooftop PV, electric vehicles [EVs]). Improved distribution monitoring, diagnostics, and interactive communication systems would be necessary to realize carbon reduction targets and concurrently maintain system integrity. Accurate monitoring of upstream transmission system status and downstream end-use conditions in real-time represents an essential component of the smart distribution network, and secure data exchange protocols would need to be simultaneously implemented at both ends of the system. Smart distribution also improves system reliability and can improve the efficient operation of distribution circuits with voltage conservation and improved reactive power control. To accommodate high-penetration EV charging, some upgrades to the distribution system at the local level involving distribution transformers and customer service will be required. Stationary electrical storage may be necessary to deploy fast charging of EVs without negative grid impacts.” (CAC Report 2010, Chapter 8, page 25)
- “The PSC has instituted a proceeding aimed at establishing a strategic vision and plan for investing in smart grid technology for New York that will guide future research, development, and demonstration in New York in support of the policy objectives stated herein. In addition, the following initiatives should be pursued to support these policy goals: Pilot projects should be undertaken to both quantify energy efficiencies from various approaches to smart distribution and to establish best practices. PSC rate cases could require regulated utilities to consider the use of smart grid distribution technologies that would support the achievement of lower GHG emissions. The New York State Smart Grid Consortium’s strategic roadmap should be used to guide smart grid roll out. Utilities regulated by the PSC could have load factor targets and incentives to implement appropriate technologies to achieve them. Develop and implement improved distribution circuit performance indices that better incorporate distribution automation and/or smart grid operations. New rate tariffs could be established that provide incentives to customers to improve their power factor.” (CAC Report 2010, Chapter 8, page 25)

Other Resources

Related Topics in this Document: Transmission

Storage

New York Actions

- “In the 2018 Energy Storage Order, the Commission adopted a statewide energy storage goal of installing up to 3,000 MW of qualified storage energy systems by 2030, with an interim objective of 1,500 MW by 2025.²² To advance this goal, the Commission directed the State’s IOUs to issue Requests for Proposals (RFPs) to procure dispatch rights from bulk-level energy storage systems sited within their service territories. The Commission further required the IOUs, in evaluating storage bids, to consider local environmental benefits derived by reducing use of peaking units. Those RFPs were

issued in 2019 and, per the Energy Storage Order, must result in minimum quantities of operational resources by December 2022.” (CES White Paper, 2020, 14)

- “New York State has established statewide advanced energy storage targets of 1.5 gigawatts by 2025 and 3 gigawatts by 2030, as determined by the PSC in its December 13 Order. This RGGI-funded initiative will allow NYSEERDA to provide energy storage project incentives on Long Island for retail energy storage projects (including customer-sited storage and value of distributed energy resources (VDER) value stack compensated projects) and for bulk storage projects connected into the transmission, sub-transmission, and distribution system. This will enable geographic deployment of the NYSEERDA energy storage retail and bulk incentive offerings in all areas of the State, with the rest of State supported by PSC authorized funds. These incentives will be delivered according to the Energy Storage Market Acceleration Incentives Implementation Plan filed on March 11, 2019 with Department of Public Service.” (RGGI Operating Plan, 2019, pg. 19)
- “The City has committed to a Resilient Solar Track which would install solar-plus-storage on critical facilities in hurricane evacuation zones.” (Bautista et al, 2019, 5)
- “NYSEERDA, in conjunction with Con Edison and the New York City Fire and Building Departments, recently published guidelines for permitting outdoor lithium-ion storage systems within New York City.¹⁰³ Similar efforts for indoor systems in New York City are anticipated by the end of 2018.” (Kanyuck, 2018, 227) *Note: have not been passed as of July 2020*

LPDD Recommendations

- *“States should consider including pumped storage hydro as transmission assets entitled to cost-of-service rate recovery in their transmission planning as an alternative to construction of new transmission lines.”*
- *“State PUCs should direct their regulated electric utilities to evaluate the need for and benefits of grid-scale storage such as pumped storage hydro.”*
- *“The state should adopt laws or regulatory policies to create additional flexibility for how to classify energy storage projects for purposes of ratepayer recovery, or other means of rewarding energy storage initiatives, to facilitate greater integration of renewable energy into the grid. Further development of these policies should be a key goal of the Energy Storage Deployment proceeding (18-E-0130).”*
- *“RTOs can help facilitate both demand response and energy storage through creating rules, incentives, and frame-works to encourage investment in these technologies.”*
- *“States should include in their RPS mandates: (1) solar energy, specifically from distributed generation sources; (2) energy storage and microgrid capacity; and (3) thermal energy systems that can contribute to decarbonization.”*
- *“States can fund additional research, technology, and development on a range of distribution network and smart grid developments, including energy storage.”*
- *“State legislatures should adopt building or electrical code standards that support the use of on-site energy storage to allow more-efficient usage of renewable energy generated on-site at new buildings.”*
- *“State legislatures should mandate energy storage or provide incentives for utilities and consumers to provide energy storage for grid-connected solar PV.”*

Related LPDD Database Pathways

- Energy Storage: <https://lpdd.org/pathway/energy-storage/>
- Promoting Pumped Storage Hydro Facilities: <https://lpdd.org/pathway/promoting-pumped-storage-hydro-facilities/>

Other Recommendations

- “Introduce energy storage and on-site generation as a measure to provide resilience in disadvantaged communities.” (Clean Energy, 2020, Energy Affordability and Equity, pg. 31)
- “Make energy storage planning a priority in the City. New York City, in cooperation with NYSERDA, should issue an energy storage roadmap that delineates the impediments and opportunities associated with grid-level energy storage development in New York City. As indicated in a recent report by the New York Battery and Energy Storage Technology Consortium, some of New York City’s most polluting and expensive peaking fossil fuel generation could be retired with the addition of some large-scale energy storage projects at a very limited cost to Consumers.⁴⁴” (Kass, 2018, 56)
- “To accelerate market deployments to meet 2025 goals, the Roadmap recommends bridge incentives for both customer sited and distribution/transmission-sited projects to accelerate the market learning curve to lower soft costs, with a focus on storage paired with solar photovoltaic projects and “non-wire alternatives”⁹⁶ projects.⁹⁷ The rationale for bridge incentives focuses on lowering soft costs since, as more systems are installed, permitting authorities will have more familiarity with energy storage, which should mitigate some of the permitting challenges for energy storage projects.⁹⁸” (Kanyuck, 2018, 227)
- “Recognizing the need for dual market participation as a marketwide issue, in February 2018, the Federal Energy Regulatory Commission (FERC) ordered, and the Roadmap recommends, that regional transmission operators (RTOs) and independent system operators (ISOs) (including NYISO) remove barriers to dual market participation. FERC directed “each RTO/ISO . . . to establish a participation model consisting of market rules that, recognizing the physical and operational characteristics of electric storage resources, facilitates their participation in the RTO/ISO markets.”⁸⁶ The Roadmap also recommends adoption of a range of related market improvements at the wholesale level to facilitate energy storage participation and meet the objectives of the Energy Storage Program.⁸⁷” (Kanyuck, 2018, 226)
- “The Roadmap recommends continuing collaboration between NYSERDA and local authorities to share technological developments and develop clear permitting processes for energy storage systems.¹⁰⁵” (Kanyuck, 2018, 227)
- “A thorough assessment should be conducted to evaluate the energy storage, transmission, and distribution requirements that will support the expanded use of renewable power generation and electric vehicle technologies in a reliable manner, for the 40 by 30 benchmark and the 80 by 50 goal. This should include an engineering and economic analysis, identification of institutional barriers and financing strategies, and identification of New York-specific needs for technology improvements. The expertise resident in both the New York Smart Grid Consortium and the New York Battery and

Energy Smart Technology Consortium will be valuable in this assessment. In addition, given the significant need for fundamental improvement in Energy Smart cost and performance, New York State should advocate for substantial and increased federal investment in research and technology development.” (CAC Report 2010, Chapter 8, page 29)

Discussion and Analysis

- “Advanced energy storage deployment will also play an important role in New York’s future electricity system. Even after accounting for the declining effective load carrying capability as storage penetration increases, battery storage additions can help meet New York’s growing peak demands, and along with end use load flexibility, battery storage will also play a critical role in renewables integration and intraday balancing needs.” (NY Pathways, 2020, pg. 36)
- “Energy resiliency strategies such as battery storage are another critical community preparedness strategy elevated by the working group. Solar-plus-storage— also called Resilient Solar—can have extensive environmental and health benefits, particularly for communities vulnerable to extreme weather events and other hazards. Resilient Solar can provide power during emergencies, blackout periods, and peak demand, especially to vital facilities such as emergency shelters, hospitals, and schools. This technology has the strong potential to displace generation from inefficient and polluting peaking plants, thus significantly reducing air pollution in environmental justice communities that have been historically exposed to noxious pollutants generated from traditional energy infrastructure.” (Bautista et al, 2019, 5)
- “Battery storage is the lowest-cost capacity resource available to address system peaks of limited duration. For this reason, it is deployed on a significant scale even in the Baseline scenario which has no carbon constraints (Figure 14). We find that significant amounts of new electricity storage are needed in all 350 ppm-compatible scenarios starting in 2030, and this storage is deployed with an average duration of four to six hours. Without a significant technological breakthrough, however, the high cost of stored electricity limits its value as a long-duration balancing resource (i.e. on scales from days to months of energy shortfalls from renewables). Thus, it operates primarily as a diurnal resource, using excess solar generation in the middle of the day on a consistent basis to avoid curtailment and to displace thermal generation off-peak (capacity and energy).” (350 PPM Pathways, 2019, 44)
- “As fossil capacity retires, electric energy storage technologies are deployed at a modest scale for reliability and to assist with diurnal balancing between electricity supply and demand. The phrase ‘modest’ is used because energy storage technologies cannot cost effectively replace all types of other dispatchable generation without a major cost breakthrough in long duration storage. Just like in the 2020s, some new gas power plant capacity is needed. When the duration of need for dispatchable capacity is less than 8 hours, energy storage will most likely be the most cost-effective option, for anything longer than 8 hours, gas turbines are the cheapest option for the system.” (350 PPM Pathways, 2019, 67)

- “Increasing energy demands, aging infrastructure, and increasing capacity from intermittent renewable energy sources will require the integration of substantial energy storage capacity into the electric grid.” (Kanyuck, 2018, 222)
- “Energy storage’s potential role in the electric grid’s evolution is substantial. Energy storage can smooth out the intermittent nature of wind and solar generation and make it dispatchable so that these resources can meet peak demand.⁴² Energy storage can provide the capability for consumers or grid operators to shift load by consuming and storing power during off-peak periods and discharging power during peak demand.⁴³ Energy storage can provide relief from upstate-to-downstate transmission constraints by storing power downstate when the transmission system is not constrained, lessening the load on the transmission system during peak demand periods.⁴⁴ Energy storage can provide the frequency regulation services⁴⁵ that will become more necessary to manage the variability of wind and solar resources during the course of the day.⁴⁶” (Kanyuck, 2018, 223-4)
- “New York currently has in place about 1,460 MW of energy storage capacity—1,400 MW of this being long-duration storage (10 hours) from two NYPA pumped hydropower facilities, one located in Lewiston and the other at Blenheim-Gilboa in the Catskills.⁵⁰ When electricity prices or demand are low, a pumped hydroelectric storage facility uses electricity to pump water to an elevated reservoir. When prices or demand are high, the water is released through a turbine to generate electricity.⁵¹... While pumped hydropower facilities can store massive amounts of energy, their role in expanding the use of energy storage in New York will likely be limited because of limited siting opportunities.⁵⁶” (Kanyuck, 2018, 224)
- “The remaining 60 MW of energy storage in place in New York includes flywheel technology, on-site thermal energy storage, and battery (chemical) storage.⁵⁷ The flywheel system, located in Stephentown, is rated for 20 MW and 5 MW-hr (i.e., a 15-minute duration) and is used for frequency regulation.⁵⁸ Flywheels are kinetic energy storage devices that accelerate a cylindrical rotor (flywheel) to a very high speed and maintain the energy in the system as rotational energy. When generated power on the electric grid exceeds load, the flywheel speeds up; when load exceeds generation, the flywheel is slowed to convert the energy to electricity for distribution to the grid.⁵⁹ While flywheels are effective for grid services such as frequency regulation because of their high power rating, the short duration associated with their energy capacity limits their ability to store off-peak power for use during periods of peak demand.⁶⁰” (Kanyuck, 2018, 224)
- “The remaining energy storage systems currently in operation in New York are battery energy storage systems that use large batteries to charge during off-peak periods and discharge during periods of peak demand.⁶⁵ Newer or soon-to-be-deployed systems typically use lithium-ion batteries, which have benefitted from cost declines driven by their use in electric vehicles, but lead acid technologies have also been used, and demonstration projects for advanced technologies such as zinc air, zinc nickel-oxide flow batteries, vanadium redox flow batteries, and zinc manganese dioxide either have been implemented or proposed.⁶⁶... Battery systems likely have the broadest potential for new energy storage system deployment.⁶⁹ This is because they can participate in a broad variety of potentially compensable grid services and are modular so that they can be deployed at a broad range of scales, and also because the costs, while currently

expensive, have been rapidly declining. Recognizing this potential market opportunity, considerable research and development funding has been focused on battery energy storage technologies that lower costs, improve performance, and mitigate safety and environmental risks.⁷⁰” (Kanyuck, 2018, 225)

- “Other energy storage technologies may play a role in meeting Energy Storage Program objectives, but are not currently deployed in New York and may have barriers to broad implementation. Compressed air energy storage (CAES) provides long- duration energy storage capability similar to pumped hydro by using electricity from the grid or generated by intermittent renewables to compress air into a storage tank or underground cavern (such as salt caverns).⁷¹ As the air is released, it is expanded and heated to improve the efficiency of natural gas turbines by 30% and enable the natural gas turbines to provide a range of energy storage services.⁷² While commercially viable sites for CAES may exist in western New York and potential technology development may provide for systems that do not need to be integrated with natural gas-fired generators, the regulatory treatment of CAES plants could pose a substantial barrier to CAES development, as could the permitting necessary to site such facilities in depleted salt caverns or abandoned oil and gas fields.⁷³” (Kanyuck, 2018, 225)
- “Additionally, the use of battery energy storage in electric vehicles could be capable of providing energy storage services to the electric grid (referred to as “vehicle to grid”) by charging during low-demand periods (e.g., at night) and connecting to stations during peak-demand periods (e.g., while parked during daytime periods in parking garages) that would use the electric vehicle storage capacity to provide additional electric supply to the grid.⁶⁸” (Kanyuck, 2018, 226)
- “The Energy Storage Program’s potential benefits for the electric grid are substantial. Integration of storage with renewable energy resources will enable a greater deployment of clean energy assets.⁸⁰ The use of energy storage as a source of generation during periods of peak demand can cause dirty oil- and natural gas-fueled “peaker” plants to be made more efficient or sidelined, thereby reducing the emissions and inefficiencies associated with these facilities.⁸¹ Charging energy storage systems during off-peak periods for discharge during periods of peak demand will reduce greenhouse gas emissions because the greenhouse gas emissions rate for off-peak generation is typically much lower than generation during peak demand.⁸² Finally, energy storage systems may present opportunities for the deferral of upgrades to the transmission and distribution networks that would otherwise be needed to meet peak demands.” (Kanyuck, 2018, 226)
- “Because energy storage resources are hybrid technologies that act as both a consumer and producer of electricity, the wholesale markets currently are not structured to fully compensate energy storage resources for the services they can provide. The existing wholesale markets are generally structured for large centralized generation assets that have indefinite run time and participate only in wholesale markets, whereas energy storage assets may possess the physical ability to participate in both wholesale and distribution markets.⁸⁵” (Kanyuck, 2018, 226)
- “Permitting for energy storage systems is complex because of multi-stakeholder approval processes based on building, electric, and fire codes, and industry standards, which is further complicated by evolving energy storage technologies.⁹⁹ At a minimum, building

and electrical permits are required, and some jurisdictions require fire department approval.¹⁰⁰ Large energy storage projects such as pumped hydropower and CAES likely would require land use permits, New York State Department of Environmental Conservation permits, and associated environmental impact statements.¹⁰¹ (Kanyuck, 2018, 227)

- “A particular challenge, since a substantial opportunity exists for deployment of battery systems in New York City, is that permitting processes for dominant (e.g., lithium-ion) and emerging battery chemistries are not formally established or are evolving as permitting agencies gain new knowledge. These nascent processes increase project risk and lag time.¹⁰²” (Kanyuck, 2018, 227)
- “One of the most important challenges that the state’s electric system faces is the need to assure that system reliability is maintained. At present, balancing system load and supply conditions, and addressing short and long term system disruptions, are addressed by calling on various load- following fossil fuel generation plants and/or demand response for reduced load. One challenge the State will face in meeting the 80 by 50 GHG reduction goal will be the need to find clean energy substitutes for the set of fossil fuel generation facilities that are called upon to address those circumstances. For example, the prospect of minute-to-minute rapid changes in the output of the state’s generation mix remains likely while, at the same time, the types of fossil fuel generation historically relied on to address fluctuations in demand may no longer be operating.” (CAC Report 2010, Chapter 8, page 29)
- “Energy storage—in its many forms—can be used to help ensure that the State will be in a position to implement these strategies in ways that maximize the potential contribution of intermittent renewable generation, maintain reliability at every level of the electric system, and make full use of market efficiencies. Energy storage facilities of sufficient capacity as measured in megawatts and total energy as measured in MWh, whose output may need to be called upon for hours, days, weeks, or even months, as well as facilities that could respond to system changes almost instantaneously but only briefly (labeled Limited Energy Storage Resources by the NYISO), will likely be critical to support routinely reliable operation of the electric system and to respond to system contingencies when and where they occur.” (CAC Report 2010, Chapter 8, page 29)
- “As renewable energy supplants larger quantities of fossil energy, the role of storage may transition to providing capacity and energy to compensate for sudden changes in the output of wind and solar generation caused by short term weather changes. While the state already has two large pumped storage facilities, studies will need to be undertaken to identify other potentially feasible sites for additional large pumped-storage facilities including options outside of New York’s borders. CAES facilities are an option, but also require appropriate underground geologic structures (e.g., salt domes) and proximity to both natural gas supply and transmissions capacity.” (CAC Report 2010, Chapter 8, page 30)
- “At the distribution system level, storage facilities—primarily batteries—could provide ancillary services and provide clean energy alternatives to generation facilities in load pockets. Installation of local storage systems could also avoid the need to make potentially more costly distribution system enhancements.” (CAC Report 2010, Chapter 8, page 30)

Other Resources

Related Topics in this Document: EVs, Demand Management

Rates

New York Actions

- “The New York State Public Service Commission on Thursday approved an alternative to net metering for residential and small commercial customers, laying out new monthly fees and rules but delaying implementation until 2022 due to the impacts of COVID-19. The new system will charge solar customers between \$0.69 and \$1.09 per kW based on the utility, customer class and compensation option. Existing net energy metering customers will be unaffected by the change. The decision will ease cost shifts identified in a December PSC white paper, but does not wholly satisfy the solar industry or utility sector. New York power companies wanted to see net metering replaced with charges based on customer demand, while solar companies say the per-kilowatt charge could slow market growth and reduce the benefits of installing panels.” (Wallen, 2020)

Rates - Incentivizing DER

LPDD Recommendations

- *“The state should remove caps on the number of homeowners that can participate in net metering and allow customers to lock in rates for the energy they feed back into the grid at the time of investment.”*
- *“The state should continue expanding the value of distributed energy resources to account for the full value these resources provide to the grid, ratepayers, individual communities, the environment, and society at large.”*
- *“The PSC should expand special electricity rates customized to homes with geothermal systems, as they have in the case of some individual utilities.”*

Related LPDD Database Pathways

- Net Metering and Value of Solar: <https://lpdd.org/pathway/net-metering-and-value-of-solar/>

Rates - Changing Customer Behavior

LPDD Recommendations

- *“Utilities should develop and adopt rate structures that incentivize load-shifting, whether through demand response, energy storage, or the development of more robust regional energy imbalance markets, in order to enable the further deployment of renewable energy generation.”*
- *“Where regulatory requirements and subsidies are not financed through public taxes, state utility commissions should presumptively favor per kWh customer charges rather than fixed fees or cost adders in setting customer energy charges.”*
- *“State PUCs should require time-of-use rates, or transactive rates if possible.”*

Related LPDD Database Pathways

- Time of Use Rates: <https://lpdd.org/pathway/time-of-use-rates/>
- Customer Behavior Strategies: <https://lpdd.org/pathway/customer-behavior-strategies/>
- Reducing Fixed Electricity Charges: <https://lpdd.org/pathway/reducing-fixed-electricity-charges/>

Rates - Changing Utility Behavior

LPDD Recommendations

- *“State utility commissions could, depending on the utility’s cost-of-service and ratemaking rights under that state’s law, offer a lower rate of return on fossil-fueled power plants and a higher return on plants that rely on renewable fuels.”*
- *“The state should expand performance-based ratemaking designs that include incentives for superior utility energy-efficiency performance. The further development of Earnings Adjustment Mechanisms under the Reforming the Energy Vision proceeding at the PSC is key to this end.”*

Related LPDD Database Pathways

- Reducing Fixed Electricity Charges: <https://lpdd.org/pathway/reducing-fixed-electricity-charges/>
- Rate Restructuring, Grid Modernization, and Utility Reform: <https://lpdd.org/pathway/rate-restructuring-and-utility-reform/>

Rates for EVs

LPDD Recommendations

- *“State legislatures could request assistance from PUCs in promoting EV infrastructure by including EV charger costs in electric rates.”*
- *“State utility commissions could allow for incentive rates or provide other encouragement to facilitate use by the grid of electricity from EV batteries. Utilities should consider allowing ratepayers’ vehicles to charge during low-demand times and discharge the power back to the grid during peak times, serving as forms of grid batteries, as ConEd is exploring through its Electric School Bus V2G demonstration project.”*

Related LPDD Database Pathways

- EV Charging Rate Design: <https://lpdd.org/pathway/promoting-off-peak-ev-charging/>
- Using EVs as a Grid Resource: <https://lpdd.org/pathway/using-evs-as-a-grid-resource/>

Other Recommendations

- *“Establish a prioritization system to pursue renewables that provide the greatest GHG reductions at lowest cost.” (Getting Greener, 2019, Executive Summary, pg. 5)*

Discussion and Analysis

- *“Renewables are and must be an increasing part of the state’s energy portfolio; however, policymakers should allow price signals to determine how much wind capacity, distributed solar, utility-scale solar, and hydropower is built rather than mandating*

specific technologies. All these projects should be put on a common basis of cost to consumer for tons of GHG avoided and those with the lowest net cost should be prioritized for development and contracts. A balanced portfolio of resources and contract term lengths will provide New York with the greatest security and stability to reach its long-term GHG reductions goals. This also will allow for competition from new resources so that if newer projects can be completed at lower cost, New York will reap the benefits. It also allows for the possibility that leaps in technology will be able to fill the mix rather than being locked into old technology for 20 years.” (Getting Greener, 2019, Executive Summary, pg. 5)

- “Future electricity systems must accommodate rapid load growth from electrification, increasingly flexible demand, and increasingly inflexible supply resources. Fossil generation in the future without carbon capture will operate for far fewer hours than today making capacity markets more and more attractive. In those capacity markets the need to distinguish resources that can offer capacity over long durations will become important. Future energy markets must also compensate balancing services, with full symmetry between supply and demand side balancing.” (350 PPM Pathways, 2019, 66)

Other Resources

Related Topics in this Document: EVs, Financing

Clean Energy Standard

New York Actions

- “Clean Energy Standard - As authorized by the PSC, these funds are realized by NYSERDA through the sale of Tier 1 Renewable Energy Credits (RECs), Offshore Wind Renewable Energy Credits (ORECs), and Zero Emission Credits (ZECs) as well as receipt of Alternative Compliance Payments from New York’s Load Serving Entities (LSEs). Through PSC orders, LSEs are obligated to meet annual compliance obligations for RECs, ORECs and ZECs. As needed, utility financial backstop collections may be called upon to meet funding shortfalls.” (Clean Energy, 2020, Funding Commitments, pg. 38)
- “This White Paper proposes that fuel cells be ineligible under the CES except when they utilize a non-fossil fuel resource, such as hydrogen (or other fuel) that has been produced using a “renewable energy system” as a primary energy source.” (CES White Paper, 2020, 11)
- “Subtracting the estimated 17,868 GWh/year of additional offshore wind energy from the overall total of 42,858 GWh/year, yields an estimated balance of 24,990 GWh/year that must be realized through other RES programs, chiefly Tier 1. As explained below, this White Paper proposes the creation of Tier 4 of the CES for the environmental attributes of renewable energy delivered to zone J.” (CES White Paper, 2020, 22)
- “To ensure that selected projects are operating in 2030, these amounts should be procured in total no later than 2026. Assuming a 20% attrition rate for selected Tier 1 projects, statewide procurement totals will need to average almost 4,500 GWh annually over the 2021 to 2026 period in order to meet the 2030 Target.³⁹ While both jurisdictional LSEs and non-jurisdictional entities may self-procure a portion of this

amount, to the extent the full procurement role would be fulfilled by NYSERDA, this would constitute roughly 40% increase over procurement levels over the past three years, during which NYSERDA has averaged about 3,200 GWh/year.” (CES White Paper, 2020, 27)

- “Having assessed LSE participation, this White Paper proposes that NYSERDA next revise the average annual procurement target through the Divergence Test. This analysis will adjust the procurement totals based on new information regarding attrition among selected projects, changes in load, and project development under other programs, such as the Offshore Wind Standard, NY-Sun, and Tier 4, if approved. Due to the depth of analysis that will be required annually to ensure progress toward the CLCPA goals and the newly required biennial review process, the current Triennial Review process will become both duplicative and untimely. Accordingly, this White Paper recommends ending the Triennial Review process after 2020. Finally, this White Paper proposes that NYSERDA no longer be required to conduct make-up solicitations if the average target is not met.⁴² As described, to be useful the annual targets must be subject to periodic change. Make-up solicitations, if required, would threaten NYSERDA’s ability to prepare the required analyses for each solicitation in a timely fashion and would compromise the efficacy of portfolio-level assessments. Instead, the following year’s regular solicitation would provide the opportunity to address any shortfall.” (CES White Paper, 2020, 28)
- “First is the recommendation that the Commission authorize NYSERDA to reject a proposal outright upon a unanimous determination by the Technical Evaluation Panel (TEP) that the project is not presently viable. The TEP will be instructed to make that determination if it finds that (i) the project is in such a state of immaturity that it is impossible to ascertain whether it is viable, or (ii) the project appears to be predicated on unrealistic economic or regulatory assumptions, or faces serious economic or regulatory risks for which the project developer has not provided satisfactory mitigation plans.” (CES White Paper, 2020, 30)
- “This White Paper recommends this change on the grounds that, while the 10% weight allocated to project viability is sufficient for differentiating among projects that have a reasonable likelihood of success, it is inadequate for screening out projects unlikely to succeed.” (CES White Paper, 2020, 30)
- “Consolidate Project Viability, Operational Flexibility and Peak Coincidence Evaluation Factors for Tier 1 solicitations and broaden portfolio risk factors.” (CES White Paper, 2020, 31)
- “The challenge of increasing the penetration of renewable energy in New York City lead NYSERDA and Staff to propose the creation of a new Tier 4 within the CES which is proposed to be distinct from the Offshore Wind Standard. Tier 4 would confront this challenge directly by extending financial support for renewable energy delivered into zone J and would be procured through a separate process than the procurement of offshore wind attributes. This White Paper is not recommending a separate tier with respect to Long Island at this time.” (CES White Paper, 2020, 47)
- “For all non-hydropower eligible resources under the CLCPA, this White Paper proposes to ensure additionality through a Tier 4 vintage requirement that an eligible project’s date of commercial operation must be on or after the date of any Commission order that may result from this White Paper.” (CES White Paper, 2020, 47)

- “This White Paper proposes an additionality requirement for Tier 4 that consists of two components, each of which must be satisfied: (i) a supplier energy baseline requirement, and (ii) a supplier Greenhouse Gas baseline requirement.” (CES White Paper, 2020, 48)
- “Because the purpose of the Tier 4 program is to increase the penetration of renewable energy within zone J, the only environmental attributes that would create Tier 4 RECs would be those associated with demonstrable increased delivery of renewable energy into zone J. Applicants may satisfy the delivery requirement in two ways: by locating a utility-scale eligible resource directly in zone J, or by demonstrating that the eligible resource will be delivered using a new transmission interconnection into zone J.” (CES White Paper, 2020, 50)
- “This White Paper further proposes that the Commission direct NYSERDA to include a provision in any agreement with Tier 4 generators that would acquire without compensation any RECs generated in hours in which the real-time zone J energy price averages below zero. Further, as a consequence of this provision, it is recommended that the Index REC reference energy price formula exclude any such negative LBMP hours. This White Paper also proposes that any Tier 4 procurement authorized by the Commission be subject to a price cap. The purpose of this proposal is to increase the penetration of renewable energy in zone J by broadening the set of eligible resources, not by increasing REC prices.” (CES White Paper, 2020, 51)
- “This White Paper proposes that the administrative funding for all programs be combined into one comprehensive annual funding request. Under this proposal, NYSERDA would identify and quantify the funds to be used to cover NYSERDA’s costs and fees to administer the RES, ZEC, and OREC programs for each calendar year. NYSERDA would also include the Competitive Tier 2 and Tier 4 programs in this CES budget, if adopted.” (CES White Paper, 2020, 70)
- “100% Renewable Electricity For City Operations - City operations are responsible for 8 percent of NYC’s total GHG emissions from electricity use. To encourage the transition to a renewables-based electric supply, the City must lead by example by greening its operations. The City is committed to powering its operations with 100 percent renewable electricity as soon as sufficient supply can be brought online. The City will also explore the feasibility of mechanisms that pool purchasing power of residents and businesses to procure additional low-cost renewable energy. Benefits include catalyzing local renewable energy markets, improving health outcomes by reducing the use of fossil fuel-based in-city generators, strengthening the resiliency of the electricity supply, and expanding access to clean renewable power.” (NYC 1.5C, 2017, Key Actions to Transition to Clean Energy, pg. 12)

LPDD Recommendations

- *“The state should include in its CES mandate: (1) solar energy, specifically from distributed generation sources; (2) energy storage and microgrid capacity; and (3) thermal energy systems that can contribute to decarbonization.”*
- *“States should participate in regional efforts to align RPS, to improve enforcement and minimize carbon leakage.”*
- *“The PSC should eliminate non-waste forms of biomass as qualifying renewable resources in the CES.”*

- “State governments should consider the designation of carbon removal technologies as an accepted method to attain CES targets.”
- “The state should include combined heat and power in the CES or energy-efficiency resource standards. The state should provide in the CES a stronger incentive for CHP facilities that are fueled by biogas rather than natural gas.”
- “The state should allow all duly licensed and exempted nonfederal hydropower to qualify for an appropriate level of support to secure long-term operation under the CES.”

Related LPDD Database Pathways

- CCS Carveouts in State RPS’s: <https://lpdd.org/pathway/ccs-carveouts-in-state-rpss/>
- Hydro in State RPS’s: <https://lpdd.org/pathway/hydro-in-state-rpss/>
- Incorporating DERs, Microgrids, and Thermal Energy into Renewable Portfolio Standards: <https://lpdd.org/pathway/incorporating-der-microgrids-and-thermal-energy-into-renewable-portfolio-standards/>
- Renewable Portfolio Standards: <https://lpdd.org/pathway/renewable-portfolio-standards/>

Other Recommendations

- “The Alliance for Clean Energy New York and other clean energy industry groups call for a consistent minimum procurement schedule for Tier 1 RECs that are not lessened by Tier 4 awards and a deadline of releasing requests of May 1 each year. The Alliance opposes allowing NYSERDA to procure RECs for zero dollars when energy prices in an area are negative.” (French, 2020)
- “A group of “big green” environmental advocates including NRDC, Sierra Club, Environmental Advocates of New York and NYLCV, is largely supportive of the whitepaper but raises some issues. The coalition calls for a re-evaluation of the projected statewide load in 2030, saying it understates demand growth as other programs push beneficial electrification to reduce emissions. The advocates also propose more guidelines to make sure NYSERDA doesn’t fall too far behind in procuring the estimated 4,500 GWh per year needed to achieve the state’s goals. On Tier 4, the advocates support extra weighting for in-state renewables being delivered into the city over Canadian hydropower. They also call for a specific prohibition on new or expanded water impoundments qualifying for Tier 4 and capping the price of Tier 4 RECs at the price of Tier 1 RECs.” (French, 2020)
- “The company [OneGrid] urges further consideration of various aspects of the program and proposes instead paying a “renewable transmission credit” to cover transmission costs, separate from the REC eligible resources carried on a line might get. The clean energy industry groups also back this approach.” (French, 2020)
- “The Real Estate Board of New York, whose members are interested in purchasing RECs as an alternative to making energy efficiency upgrades or paying penalties to comply with Local Law 97, also wants more clarity and discussion around Tier 4. REBNY also notes that electricity demand is likely to continue rising while peaker plants are set to retire due to DEC regulations in 2023-2025, suggesting a study of the demand for RECs from various sources and their availability. Both OneGrid and REBNY suggest allowing

renewable resources to transition from Tier 1 RECs for new renewables to Tier 4 RECs for renewables delivered to New York City to avoid delaying new renewables waiting on transmission projects to come online. REBNY also wants NYSEERDA to re-sell Tier 4 RECs at-cost to private parties.” (French, 2020)

- “The clean energy industry groups do not want Tier 4 RECs that are sold to private building owners to count toward the state’s 70 percent renewable by 2030 goal, as seems to be the proposed approach. “Facilitation of building owner’s compliance with Local Law 97 is a worthy objective but that REC is then owned by the building owner and used for its compliance and should not also count towards the 70%,” the groups write.” (French, 2020)
- “Multiple Intervenors, which represents large electricity customers primarily upstate, opposes socializing the costs of Tier 4 (a benefit for New York City) to all ratepayers statewide. “If, arguendo, a special program/tier is needed to promote more renewable generation in a specific region of the State, such effort should be funded primarily — if not exclusively — by the customers in that region, not socialized on a statewide basis,” the group argues. They also want more clarity on when the price of Tier 4 RECs would not be capped because of transmission costs.” (French, 2020)

Discussion and Analysis

- “Carbon-free electricity standard (85% of abatement): Many policy options exist for decarbonizing U.S. electricity generation, but the most effective are clean energy standards (CES) or renewable portfolio standards (RPS). These policies require a certain share of generation to come from zero-carbon electricity by a specific date. As states and regions begin to set standards in the 80-100% range, they have generally shifted to “clean” energy rather than “renewable” energy standards. This broadens the qualifying resources to include hydro, nuclear, or any other zero-carbon electricity source that can win on cost in the marketplace to begin operation before the policy end-date. To fully decarbonize electricity generation, the net zero pathway sets a 100% CES by 2050. The challenge may seem daunting, but the U.S. is already at 38% clean electricity, and 29 states plus the District of Columbia have already established an RPS or CES. Nine of these states, plus the District of Columbia and Puerto Rico, target 100% clean electricity by 2050 or earlier.” (U.S. Net Zero Emissions By 2050: Decarbonizing Electricity, 2019)
- “The actions drive by State-level policies will not, however, be enough to reach 80x50. New York City’s Roadmap to 80 x 50 asserted that the CES will need to be exceeded to reach the 2050 target.³⁴ The requirement that generation facilities within New York City’s own borders be capable of meeting 80% of peak demand keeps the city somewhat more reliant on existing and conventional power plants (for economic reasons, if not technical ones), due to space constraints and limited potential for renewable energy development beyond small distributed generation. In a few years, nearly 75% of the in-city generation assets will be 50 years old or older, which jeopardizes reliability and exacerbates air pollution and greenhouse gas emissions.³⁵ With the potential for significant load increases due to electrification of building heating systems and motor vehicles, the in-city requirement could fetter city ratepayers to dormant conventional fossil-fuel powered generation even if demand is generally being met with clean energy sources.” (Kass, 2018, 54)

- “Under this policy, utilities and other LSEs would be required to provide a specified portion of their electricity sold from low-carbon sources (renewable, nuclear, fossil with carbon capture and sequestration). Currently, approximately 50 percent of the electricity generated in New York would qualify as low-carbon. That portion would have to grow to close to 100 percent by 2050. The policy would likely be implemented through low-carbon electricity credits that would be sold to LSEs by developers of low-carbon electricity. Imports could be treated the same as power generated within New York. Implementation of this policy would provide strong market signals for the development of renewable energy and other low-carbon sources of electricity.” (CAC Report 2010, Chapter 8, page 17)
- “Implementing strong complementary measures directed at the power sector, such as the LCPS and RPS, will have a tendency to reduce the cost of emission allowances under the cap-and-invest program, thereby reducing the cost to New York ratepayers. However, if other states participating in a regional cap-and-invest program do not make similar investments, this benefit will be diluted, thereby raising the cost of the cap-and-invest program to New York. Therefore, New York would need to work with its partners in the RGGI to seek deployment of similar programs in the other RGGI states and explore the possibility of regional implementation of an LCPS. Another possible way of ensuring that New York reaps the benefits of its other policies is to base the percentage allocation of allowances that New York receives in a regional program on state emissions baselines that do not consider the emission reductions that will result from other policies, such as implementation of the LCPS, expanded RPS and other complementary measures.” (CAC Report 2010, Chapter 8, page 20)

Other Resources

Related Topics in this Document: Regional Greenhouse Gas Initiative, Financing

Carbon Capture and Sequestration

CCS - Financial Incentives

LPDD Recommendations

- *“States could enact legislation to encourage private investment in CCS technology via private activity bonds.”*
- *“To help subsidize the higher cost of electricity generated by CCS-equipped plants, state governments could authorize and enter into power purchase agreements and contracts for differences with such plants.”*
- *“State PUCs can help stabilize and subsidize prices for CCS-generated electricity by a variety of mechanisms, including approvals of rates to help defray the cost of CCS and power purchase agreements.”*

Related LPDD Database Pathways

- Tax Incentives for CCS: <https://lpdd.org/pathway/tax-incentives-for-ccs/>

- Loan Guarantees for CCS Projects: <https://lpdd.org/pathway/loan-guarantees-for-ccs-projects/>
- CCS Subsidies: <https://lpdd.org/pathway/ccs-subsidies/>

CCS Carveouts in RPSs

LPDD Recommendations

- “States could expand their RPS laws to become clean energy standards, mandating not just the purchase of renewable energy, but also energy produced by coal-fired and natural gas combined-cycle (NGCC) plants that are equipped to capture CO₂.”

Related LPDD Database Pathways

- CCS Carveouts in State RPSs: <https://lpdd.org/pathway/ccs-carveouts-in-state-rpss/>

CCS - Driving CCS through Emissions Standards

LPDD Recommendation

- “States can impose restrictions on CO₂ emissions to drive CCS. For example, states can adopt carbon emissions standards on new sources that require full CCS on new coal-fired units by the early 2020s, and partial and full CCS on new NGCC units by the mid-2020s and early 2030s, respectively.”

Related LPDD Database Pathways

- State CO₂ Emissions Standards: <https://lpdd.org/pathway/state-co2-emissions-standards/>

CCS - Pipelines

LPDD Recommendation

- “States and/or regions could form and fund agencies akin to public utilities to conduct siting analyses, acquire property access rights, and otherwise coordinate and facilitate expansion of the CO₂ pipeline network.”

Related LPDD Database Pathways

- Expanding CO₂ Pipelines: <https://lpdd.org/pathway/expanding-co2-pipelines/>

CCS - Geological Sequestration

Related LPDD Database Pathways

- Reducing Liability for Sequestration Projects: <https://lpdd.org/pathway/reducing-liability-for-sequestration-projects/>
- CO₂ Injection and Pore Space Regulations: <https://lpdd.org/pathway/co2-injection-regulations/>

Other Recommendations

- “Focusing on offsetting rather than reducing emissions at the source may incentivize the use of high risk technology, such as “carbon capture and sequestration” (CCS) technology, which essentially captures excess CO₂ from large emitters, like power plants, and stores it underground by injecting it into a geological formation. This technology is

neither reliable nor cost-effective, and does not address the problems of co-pollutants. In addition, the long-term impact of injecting carbon into geological formations underground are unknown.” (NYC EJA, 2020, pg. 11)

Discussion and Analysis

- “The most promising technology options today that might be used to decarbonize industrial heat are CCUS and H₂. They are both among the cheapest choices for all assessed industries. CCUS is intuitive and universal and can also deal with process emissions. H₂ can provide enough quality of heat for all industries and appears viable for many applications, especially glass and petrochemicals... Application of CCUS on SMR units is actionable in many settings and could pave the way toward green hydrogen in the future. CCUS, on the other hand, is intuitive and straightforward and remains a proven and viable solution. For some cases (e.g., reaction emissions from clinker production and lime production), CCUS still serves as the only way toward decarbonization. Depending on costs for specific industries and sites (whether a storage site is available), CCUS appears the lowest cost solution for net-zero carbon emission. Applying CCUS on existing plants could prove more straightforward and easier than the electrification and nuclear approaches.” (Low Carbon Heat, 2019, Preliminary Technology Ranking, pg. 52)
- “Many options for low-carbon heat do not appear competitive with CCUS retrofits on heat production systems or full plants. Based on current data, CCUS retrofits appear to have better costs than many options (including biofuels, electrification, and green hydrogen). CCUS retrofits on the entire facility, including byproduct emissions from key processes like coking and calcining, appear to be lower in cost than many options that don’t deal with process emissions. While these estimates have large uncertainties, including estimates for CCUS retrofits, this finding may prove robust under additional assessment.” (Low Carbon Heat, 2019, Findings and Conclusions, pg. 60)
- “Today, low-carbon hydrogen appears the most versatile and lowest cost. The lowest cost, most universal option across sectors appears to be hydrogen from natural gas partially or fully decarbonized through application of CCUS on the production facility (blue hydrogen). Blue hydrogen appears to provide the easiest pathway to substitute in many facilities, especially those using natural gas today, and is straightforward to scale. Finally, blue hydrogen creates an on-ramp for green hydrogen, which may become more cost competitive as renewable power for electrolysis drops in price.” (Low Carbon Heat, 2019, Findings and Conclusions, pg. 60)
- “CCUS is likely to prove important. In the near term, CCUS appears to be both an important enabler of low-carbon heat options (including biofuels) and may prove to be cheaper and simpler than substitution of many heat options. Given that, governments and industrial leaders should accelerate assessment of CCUS as an option for their enterprises and consider investing in both infrastructure and deployment” (Low Carbon Heat, 2019, Findings and Conclusions, pg. 60)
- “Some materials absorb carbon from the atmosphere during certain stages of their lifecycle. Timber products and other biomaterials like bamboo and hemp present possibilities for capturing and storing carbon sequestered during growth – known as biogenic carbon. Managed harvesting of mature timber for use in construction – making

space for new growth – has the potential to make a significant contribution to decarbonisation efforts²⁶. Deforestation is still a major source of global carbon emissions and forests must be replanted and responsibly managed to ensure sequestered carbon is effectively offsetting other sources of embodied carbon. Using timber from certified sustainable sources, where best practice forest management is applied, is key to preventing this. Treatment of timber at end of life can have a significant effect on its embodied carbon, particularly if it is sent to landfill. Sending timber to landfill is banned or restricted in many countries and methane capture technologies at landfill sites can also mitigate the effects. However, timber reuse or recycling should be always be promoted as this extends the time period over which biogenic carbon is stored.” (Embodied Carbon, 2019, pg. 26)

- “Regarding carbon capture and sequestration, a regulatory and statutory framework should be considered for the development and use of CCS technology. One aspect of such framework is to amend the existing major transmission facility siting process (reflected in Article VII of the Public Service Law) to establish a mechanism for the review and siting of a captured carbon transmission pipeline. In addition to this PSC-led activity, legislation could provide the New York State Department of Environmental Conservation with responsibility for CCS oversight, including a review process for obtaining a carbon sequestration permit, the injection of captured carbon into a reservoir, and the observation and monitoring of the carbon sequestration reservoir and its buffer zone boundaries.” (CAC Report 2010, Chapter 8, page 22)

Other Resources

Related Topics in this Document: Carbon Sequestration in Forests/Agriculture

Power-to-Gas (Zero Emission Gas)

Other Recommendations

- “Lower operating and capital costs and higher system efficiency are necessary to make Power2Gas costs competitive.” (Low Carbon Heat, 2019, Options for Low Carbon Heat, pg. 27)

Discussion and Analysis

- “In this technology, the excess power that renewables sometimes generate is converted to hydrogen in an electrolysis plant, then combined with CO₂ emissions from existing sources, such as landfills and factories, to create methane, the major component of natural gas. This can then be used to generate electricity.” (McKinsey, 2019, pg. 5)
- “One possibility to address the need for natural gas but to deliver it at a net-zero carbon level and provide the final stretch of full decarbonization is power-to-gas technology (or “zero-emissions gas”). While power-to-gas technology has been proven and a few plants exist, costs will need to drop considerably if it is to be deployed on a large scale.” (McKinsey, 2019, pg. 5)
- “Regarding Power2Gas, the technology remains immature and costly—even with low cost renewable power, costs are estimated to be \$12–\$30/MMBtu.⁵⁷ Current systems

are mostly bench scale.⁵⁸ There are a few pilot systems (e.g., the Sunfire project in Italy), but challenges remain regarding longevity, corrosion, selectivity of electrocatalytic reactions, and overpotential requirements.” (Low Carbon Heat, 2019, Options for Low Carbon Heat, pg. 27)

- “Like many of the challenges facing the energy system today, the growing issue of energy storage will need multiple solutions. Governor Cuomo recently announced that New York will develop 9 gigawatts (GW) of offshore wind by 2035. It is likely that a significant portion of that development will be dedicated to New York City, for which demand peaks at around 11.5 GW in July and August. It is not difficult to envision that much of the offshore wind generation will have nowhere to go at certain times and that large-scale storage solutions will be needed to balance the system. Introducing hydrogen into the gas network could be the scalable solution needed to integrate large-scale renewable generation into the energy system. Germany, which is already experiencing excess power generation from offshore wind, is leading in development of P2G technology.” (Chahbazpour, 2019, pg. 69)
- “P2G will drive more investment in renewable electricity by increasing utilization of those assets and addressing the biggest weakness of solar and wind: intermittency and storage. Rather than being curtailed during cool and sunny days or windy nights, solar and offshore wind will be converted to hydrogen or methane to help decarbonize other sectors. In this scenario the gas network will operate like a gigantic battery that provides long-term storage over weeks or even months. P2G offers a solution that integrates the decarbonization of the gas and electric systems, and the two decarbonized systems complement each other. In addition to P2G, production of RNG from biomass not only utilizes existing waste streams but also promotes sustainability and helps close the carbon loop.” (Chahbazpour, 2019, pg. 69)

Other Resources

Related Topics in this Document: Storage, Offshore Wind, Closure of Existing Natural Gas Plants

Demand Management

New York Actions

- “The Con Edison Demand Management Program offers enhanced incentives for energy efficient technology that will reduce system wide peak electric demand on the hottest weekdays from 2-6pm. Incentives: Incentives vary based on \$/kW and vary based on project.” (Retrofit Accelerator, 2020)
- “Con Edison - Smart Usage Rewards for Reducing Demand, The Con Edison Smart Usage Rewards Program allows building owners to earn money in response for reducing electricity usage during peak demand. Incentives: Earn up to \$18,000/year for every 100 kilowatts (kW) reduced.” (Retrofit Accelerator, 2020)

LPDD Recommendations

- “Utilities should develop and adopt rate structures that incentivize load-shifting, whether through demand response, energy storage, or the development of more robust regional energy imbalance markets, in order to enable the further deployment of renewable energy generation.”
- “State PUCs should require time-of-use rates, or transactive rates if possible.”
- “States, particularly those that are traditionally regulated, could allow industrial and commercial energy users to participate directly in wholesale demand response programs, where they exist, and allow third-party demand response aggregators to operate in those jurisdictions.”

Related LPDD Database Pathways

- Time of Use Rates: <https://lpdd.org/pathway/time-of-use-rates/>
- Customer Behavior Strategies: <https://lpdd.org/pathway/customer-behavior-strategies/>
- Reducing Fixed Electricity Charges: <https://lpdd.org/pathway/reducing-fixed-electricity-charges/>
- Demand Response: <https://lpdd.org/pathway/demand-response/>

Other Recommendation

- “The foregoing analysis suggests that electrification of transportation and heating could add nearly 90,000 Gwh to statewide consumption, which was approximately 160,000 Gwh in 2015 but is projected by NYSERDA to fall to 141,000 by 2030. This new energy will have to be provided from non-emitting sources in order to reduce GHG emissions and will be in addition to the offshore wind resources and distributed solar presently mandated by the CLCPA. To meet the CLCPA’s goals New York will need to add 55,600 Gwh (refer to Table 3) for existing electric use; this 90,000 Gwh would be additive to that total.” (Getting Greener, 2019, 3.4.1 A Note on the Impact of Long-Term Electrification, pg. 36)

Discussion and Analysis

- “Today, gas-fired generators, dispatchable hydro and pumped hydro storage are a key source of flexibility. Gas-fired generators can be used less in the future due to carbon mandates. A clean future system will include large amounts of wind and solar generation, whose output is primarily driven by weather, thus reducing the amount of flexibility provided by generation. The future system will require more flexibility across all timescales (hourly, multi-day, seasonal) to balance intermittent renewables and more volatile load. Short-duration storage, such as batteries, can help provide balancing across hourly and daily timescales. Flexible loads, such as controllable electric vehicles and HVAC, can provide limited balancing in the hourly time frame. New technologies will be needed to provide seasonal storage or zero-emission, dispatchable supply.” (Brattle, 2020, 13)
- “Our analysis shows that electricity demand in New York may increase by 65% or 80% relative to current load levels (Figure 16), which is consistent with the range found in our literature review (20%-120% by 2050). This range depends significantly on the scale and timing of electrification; whether there is a Pathways to Deep Decarbonization in New

York State significant role for bioenergy; and the potential for synthetic fuels, such as hydrogen, that are produced from electrolysis.” (NY Pathways, 2020, pg. 29-30)

- “This transformation will change the timing and magnitude of consumers’ electricity demands and create a “winter peaking” system in New York, owing to new demands from electric space heating, as described previously. We find that the shift to a winter peak occurs around 2040 and is driven by the timing of heat pump and electric vehicle adoption. Flexibility in electric vehicle charging patterns and building loads can significantly reduce peak demands and the need for new electric generating capacity. Flexible loads can serve a similar role to battery storage, shifting demand to times of high renewables output.” (NY Pathways, 2020, pg. 30-31)
- “By 2035, in all scenarios, peak energy use shifts toward the winter state-wide, even with limited amounts of heating electrification. This is due to efficiency improvements in air conditioning technologies that offset growth in cooled floorspace, reducing the traditional summer daytime peak; at the same time, winter temperatures reduce EV battery efficiency and therefore increase charging needs. Overnight charging combined with some electric heat pump adoption produces a growing early morning winter system peak in NYS. Winter peaks are expected to be significantly larger than current summer peaks.” (Electrification Scenarios, 2020, 28)
- “Market structures will need to change. New York State has a variable and sometimes harsh climate; there could be times when the weather creates imbalances between power demand and supply (Exhibit 4). Battery storage could help, particularly as its cost falls and its efficiency rises. There will likely, however, be times where conventional power-generation assets, such as combined-cycle natural-gas plants, are the best solution to fill the gaps. To keep these assets available, the structure of compensation will need to change to ensure that they can serve as backup power, even if their day-to-day utilization is low.” (McKinsey, 2019, pg. 5)
- “Managing demand will likely become more important. Building a cost-effective power system requires smoothing out the peaks and valleys of demand. In a future in which the greater use of clean power increases the intermittency of the power supply, that will mean implementing effective demand response and load-shifting programs that incentivize consumers to curb their use of power when needed to balance the grid. As more EVs hit the road, vehicle-to-grid approaches could play an increasingly important role as EV users and charging stations work with utilities to manage demand. For example, when renewables generation is low, a signal could be sent to EV owners to stop charging; they could be paid for cooperation. Moreover, it is possible to sell excess energy stored in EV batteries back to the grid. There are a few vehicle-to-grid projects, but working out the most effective market mechanisms is going to be difficult.” (McKinsey, 2019, pg. 6)
- “There is also likely to be an increase in peak supply requirements for some segments of the distribution network as certain areas switch from a light summer peak for air conditioning to winter peaking for heating. This could be especially problematic in areas upstate that now experience limited air conditioning loads but have cold winters which could require much greater electricity deliveries than in the past.” (Getting Greener, 2019, 3.4.1 A Note on the Impact of Long-Term Electrification, pg. 36)

- “Wind, solar, and some hydropower are intermittent energy sources, meaning they are not always available. The time of day and season when electricity is being used are becoming more important to the operation of the grid and achieving GHG reduction goals. For example, New York City’s electricity emissions profile varies both seasonally and by hour of the day. This variability is driven both by demand and the generation mix in operation: fossil-fuel thermal plants versus hydro and nuclear plants. However, other regions that already have high renewable penetration are beginning to see much greater variability. In California, marginal carbon emissions ranged from nearly zero up to levels similar to New York, and they occasionally had to curtail (turn off) renewable generation due to oversupply. California’s highly dynamic emissions profile may offer a window that allows us to see the future of New York’s electricity grid. As renewable penetration grows, particular times of the day and the year will likely offer electricity at substantially lower emissions rates. The buildings sector can either add to the problem or be part of the solution, creating an urgent need to take grid interaction and impacts into consideration during both the design and operation phase of buildings.” (NY to Zero, 2019, Time-Dependent Greenhouse Gas Emissions, pg. 29)
- “The use of electricity to produce hydrogen from the electrolysis of water plays a key role in balancing the electricity system during periods of renewable energy overgeneration. The hydrogen produced is then used to create synthetic fuels that can be used in applications that are difficult to electrify...The production of electrolytic hydrogen and synthetic fuels provide the primary method of long-duration energy storage for a system with high penetrations of renewable generation. When peak electricity generation exceeds demand, the extra electricity is used to synthesize these fuels. These fuels can be used directly to meet demand for liquid and gaseous fuels and— to a limited extent— also be used to produce electricity at times of fallow renewable production.” (350 PPM Pathways, 2019, 48: on overgeneration)
- “In many studies of low-carbon electricity systems, the principal resource used to balance these types of systems is electricity storage (batteries, pumped hydro, etc.). However, this is an incomplete toolkit, specifically when dealing with imbalances that can persist over days and weeks... How a resource contributes to electricity balancing is a function of its unique characteristics. Thermal generation and hydro contribute to balancing the system by generating during periods of some combination of low renewable output and high load; storage moves energy from overgeneration periods to hours where thermal generation would otherwise be needed; flexible fuel production and direct air capture balance the system by soaking up overgeneration and turning it either into electric fuels or sequestering carbon directly; finally, renewable curtailment balances the system by reducing overgeneration when there is no economic case for utilizing it. The relative contributions are unique to each case and resource build, but there are commonalities. First, the scale of balancing needs in 2050 compared to 2020 is drastically different. That’s because the net-load signal that the system is trying to balance is significantly more volatile, as renewables make up a larger portion of generation.” (350 PPM Pathways, 2019, 55)
- “The demand-side transformation, especially rapid electrification in buildings, transportation, and industry, will also require sectorally integrated planning both to ensure that new generation resources are developed to meet the growing demand, and

also to plan distribution system upgrades and charging infrastructure, and to leverage the ability of new electric loads (specifically, space heating, water heating, and vehicle charging) to operate flexibly.” (350 PPM Pathways, 2019, 61)

- “Currently, because wind and solar power have variable power generation and are unable to be dispatched, they are managed by the system operators through a combination of predictive output modeling, ramping conventional generation resources up or down, and curtailing renewables production, with some impact to the efficiency of the overall system. Therefore, the key to a cleaner, reliable power grid in New York is not only cleaner generating capacity, but also the ability to dispatch clean power to meet peak demand to prevent dirtier generating resources from being deployed.” (Kanyuck, 2018, 221)

Other Resources

Related Topics in this Document: Storage, Electric Vehicles

Agriculture and Forestry

Carbon Sequestration in Forests/Agriculture

(supporting markets for use of wood for building materials and others)

(support forest growth and sequestration through increased access to low grade materials)

Other Recommendations

- “Increase Agricultural Soil Carbon Sequestration to Reduce GHG Emissions” (Methane Reduction Plan, 2017, pg. 12-13)
- “Convene a working group of DAM, SWCC, and DEC staff, with consultation from experts, to assess the potential for net greenhouse gas reductions through agricultural soil carbon storage. [DEC, DAM, SWCC]” The working group should (1) “Identify challenges of maintaining permanence of carbon and avoiding related GHG emissions (e.g., nitrous oxide from fertilizer applications)” and (2) “Recommend program/policies to increase effective soil carbon sequestration in New York State. 12” (Methane Reduction Plan, 2017, pg. 12-13)
- “Develop communication and funding strategies to effectively identify and promote the benefits of soil carbon sequestration including how managing soil carbon fits in with reducing fertilizer use and reducing nitrous oxide emissions. [SWCC, DAM, DEC]” (Methane Reduction Plan, 2017, pg. 12-13)
- “Shift from annual crops to perennial crops.” (Carbon-Neutral Agriculture, 2017, pg. 8)
- “Expand silvopasture.” (Carbon-Neutral Agriculture, 2017, pg. 11)
- “Tax policy should be used at all levels of government to discourage agricultural practices that increase greenhouse gas emissions and to encourage practices that decrease emissions and sequester carbon. Likewise, lending institutions operated or subsidized by

the federal government should offer more favorable rates to farmers utilizing climate-friendly practices.” (Carbon-Neutral Agriculture, 2017, pg. 13)

- “Replacing a portion of the current farm safety net with a PES program would reduce or eliminate payments for crops with high climate impacts, especially those grown for animal feed, while increasing payments for crops with lower climate impacts, thus helping to make healthy food more affordable. Adopting a progressive payment system could also help small and mid-sized farms, thus increasing the economic well-being of rural communities, and reduce costs. Limiting payments to the first 1,000 acres of a farm, for example, would reduce the number of eligible acres by more than one-half.” (Carbon-Neutral Agriculture, 2017, pg. 24)
- “Finally, state and local governments should improve on current federal regulations by passing their own legislation designed to reduce emissions from agricultural operations.” (Carbon-Neutral Agriculture, 2017, pg. 25)
- “New York may have the geology appropriate for sequestration of carbon, and characterizing and testing this potential for the purposes of sequestering carbon from fossil-fired power plants is an avenue of research that New York can undertake at reasonable cost. New York can partner with the federal government to support the development of carbon capture and sequestration projects in New York.” (CAC Report 2010, 19)

Discussion and Analysis

- “With nearly 20 million acres of forest, New York State’s natural and working lands sink is projected to sequester between 23 to 33 MMT CO₂e, depending on the outlook for advances in forest regeneration and land management practices.⁷ The extent of the contributions from natural and working lands is subject to substantial uncertainty and additional analysis is needed to improve the characterization of emissions sources, emissions sinks, and carbon sequestration opportunities.” (NY Pathways, 2020, pg. 46)
- “Agricultural activities not only emit greenhouse gases but can change the amount of carbon stored in soils, thus effectively releasing or absorbing carbon dioxide. Scientific studies have identified a number of agricultural practices that could help to slow climate change by capturing carbon. For example, in 2016, researchers concluded that the expansion of existing U.S. Department of Agriculture (USDA) conservation practices could lead to the sequestration of 277 million metric tons of carbon dioxide equivalent annually by 2050. ²⁸ Capturing this volume of carbon in the soil would cut net agricultural greenhouse gas emissions in half.” (Carbon-Neutral Agriculture, 2017, pg. 4)
- “Similarly, agroforestry (incorporating trees and shrubs into cropland and pastureland) and perennial agriculture (plants that live year-round and do not need annual replanting, thus disturbing the soil less) offer significant climate benefits by locking carbon in the perennial biomass of the plant roots and shoots and stimulating a more biodiverse ecosystem that stores more carbon. According to a 2012 study, the widespread adoption of agroforestry practices in the United States could sequester 530 million metric tons of carbon dioxide equivalent each year, thereby transforming agriculture into a carbon sink. ²⁹” (Carbon-Neutral Agriculture, 2017, pg. 4)
- “However, policies must recognize that biological sequestration is reversible and limited. Climatic events, such as droughts or wildfires, or human actions, such as resumed tillage,

increased grazing, or deforestation, can quickly destroy biomass and disrupt soils, thereby releasing stored carbon. 33 In addition, gains in soil carbon slow as soils approach a new equilibrium under improved management practices.34 ... Current levels of atmospheric carbon are so dangerously high that we cannot choose between reducing emissions and sequestering carbon.36 We must do both.” (Carbon-Neutral Agriculture, 2017, pg. 4)

- “Shift from annual crops to perennial crops. As with agroforestry, perennial crops offer a way to substantially improve upon the carbon storage potential of annual crops. They eliminate the need for tillage, generally reduce irrigation and fertilizer needs, and sequester additional carbon through their considerable biomass and deep root systems. In the United States, there are several common perennial crops grown, mostly in monocultures, including grapes, apples, blueberries, stone fruits, citrus, and almonds and other nuts.” (Carbon-Neutral Agriculture, 2017, pg. 8)
- “Expand silvopasture. Silvopasture refers to the practice of planting woody perennials on grazing lands. As with agroforestry on cropland, silvopasture offers significant greenhouse gas mitigation potential. Adding trees to pasture and rangelands adds a substantial new source of carbon storage, while also increasing livestock productivity (due to additional shade and reduced heat stress loss) and, in some cases, adding an additional source of income for producers. Silvopasture systems have the potential to sequester more carbon than either forests or grasslands, since they can integrate perennial grasses and trees, each of which offers distinct sequestration avenues, as described above. 131 A 2012 literature review estimated that silvopasture systems would sequester an average of 2.5 metric tons of carbon dioxide equivalent per acre annually in the United States through both additional biomass and increased soil carbon storage. 132 USDA’s estimated range for sequestration rates for silvopasture systems, while substantially lower, still markedly outperforms conventional grazing. 133” (Carbon-Neutral Agriculture, 2017, pg. 11)
- “State extension services have proven remarkably effective at disseminating and perpetuating new agricultural practices. 200 No-till farming has spread more deeply and more rapidly, for example, in states where extension services have advocated for its use. 201 Research also indicates that farmers are more receptive to learning new information and practices from extension programs than they are from other government bodies. 202 While extension’s importance has diminished over the past half century as agribusiness advisers and consultants have grown in number and influence,203 extension services will be needed to foster carbon farming practices.” (Carbon-Neutral Agriculture, 2017, pg. 17)
- “A payments-for-ecosystem-services (PES) program is one that provides incentives to farmers or other landowners for provisioning such services. A 2014 study examining the societal value of soil carbon determined that farmers should be compensated at a rate of \$16 an acre for implementing best management practices. 296 It would cost less than \$15 billion annually to implement a PES program at this rate for all 914 million acres of farmland in the United States—billions less than we currently spend on crop insurance, commodity, and conservation programs each year. Carbon farming will require new infrastructure and equipment, both off and on the farm. Paying farmers for implementing climate-friendly practices will facilitate this transition, helping to offset

decades of experience and sunk costs in conventional agricultural practices. Reducing the waste that runs through the entire agriculture and food system would provide ample land and resources for a PES system. 297” (Carbon-Neutral Agriculture, 2017, pg. 24)

- “The California State Legislature, for example, passed a law in 2014 directing the California Air Resources Board (ARB) to develop a comprehensive strategy to reduce short lived climate pollutants, including methane. 329 Subsequent legislation required ARB to begin implementing the plan by 2018. 330 ARB’s strategy calls for significant decreases in emissions from dairy manure management with reductions of at least 20% in 2020, 50% in 2025, and 75% in 2030. 331 In 2015, Minnesota passed a pioneering law requiring permanent vegetative buffers on farmland abutting lakes and streams. 332 The law was designed to reduce runoff, but will also increase soil carbon sequestration on the new strips, thereby reducing greenhouse gas emissions within the state.” (Carbon-Neutral Agriculture, 2017, pg. 25)
- “There are a variety of practices that state legislatures and environmental agencies and local governments should require—such as riparian buffers—or prohibit—such as spreading manure on frozen land—in order to further reduce the environmental harms of modern industrial agriculture. This would provide models for future federal initiatives, while also producing immediate climate and environmental benefits.” (Carbon-Neutral Agriculture, 2017, pg. 25)

Other Resources

Related Topics in this Document: Carbon Capture and Sequestration

Nutrient Management & Growing Practices

New York Actions

- Assembly Bill A2718 (In Committee as of July 2020), Relates to establishing a carbon farming tax credit for farmers, Establishes a tax credit for farmers who maximize carbon sequestration potential through a "carbon farming" land management strategy; directs DEC to develop regulations related to certifying the amount of carbon sequestered or emissions reduced.
- “Climate Resilient Farming (CRF) Program is to reduce the impact of agriculture on climate change (mitigation) and to increase the resiliency of New York State farms in the face of a changing climate (adaptation). Program grant funds are available for projects that mitigate the impact of agriculture on climate change for greenhouse gas emissions reduction and carbon sequestration, in addition to enhancing the on-farm adaptation and resiliency to projected climate conditions due to heavy storm events, rainfall, and drought.” ([https://agriculture.ny.gov/soil-and-water/climate-resilient-farming#:~:text=The%20goal%20of%20the%20Climate,a%20changing%20climate%20\(adaptation\).&text=State%20funds%20come%20from%20the%20New%20York%20State%20Environmental%20Protection%20Fund.](https://agriculture.ny.gov/soil-and-water/climate-resilient-farming#:~:text=The%20goal%20of%20the%20Climate,a%20changing%20climate%20(adaptation).&text=State%20funds%20come%20from%20the%20New%20York%20State%20Environmental%20Protection%20Fund.))
- “The statewide New York Soil Health initiative, which began in 2017, has provided a communication and collaboration framework to encompass the full diversity of interests,

events, resources, and priorities of the many stakeholder groups involved in the soil health movement (Fig. 4). New York Soil Health is funded by the NYS Environment Protection Fund, administered by the NYS Department of Agriculture and Markets (NYSDAM), and coordinated by personnel at Cornell University.” (NYSH, 2019, 18)

- “US Climate Alliance- Natural and Working Lands Challenge (New York is one of 17 states part of this initiative) (www.usclimatealliance.org/nwlchallenge)
- Birds and Bees Protection Act (2018) which prohibits the sale of certain pesticides and requires the commissioner of environmental conservation to report on the use of certain pesticides; and requires the department of environmental conservation to make recommendations to the department of transportation on the species of plantings and the application of pesticides. Explicitly prohibits the sale of clothianidin, imidacloprid, thiamethoxam, dinotefuran, acetamiprid, thiacloprid, nithiazine, or fipronil within the state.
(https://assembly.state.ny.us/leg/?default_fld=&bn=A11093&term=2017&Summary=Y&Actions=Y&Text=Y&Committee%2526nbspVotes=Y&Floor%2526nbspVotes=Y)

LPDD Recommendations

- *“State, local, and federal governments should consider requiring farm owners to comply with basic climate-friendly practices, such as installing buffer strips next to streams, in order to receive tax benefits for agricultural activities or ease-ments.”*
- *“State and federal governments should use tax policy to discourage agricultural practices that increase GHG emissions and to encourage practices that decrease emissions and sequester carbon.”*
- *“State and local governments should condition tax reductions for agriculture on the adoption of more climate-friendly practices, perhaps targeting more stringent requirements on larger farms or those with a larger than average (perhaps analyzed by size range) carbon impact.”*
- *“State governments should impose a GHG price through a carbon tax or fee, or through a cap-and-trade program, that allows agricultural producers to earn revenue by storing soil carbon or reducing methane or nitrous oxide emissions.”*
- *“State legislatures should consider adopting a fertilizer fee that could both encourage more judicious use of fertil-izer and help fund training on how to ensure no yield losses with less fertilizer and other climate-friendly agri-cultural practices.”*

Related LPDD Database Pathways

- Healthy Soils: <https://lpdd.org/pathway/healthy-soils/>
- Reducing Agricultural Emissions through Source Regulation: <https://lpdd.org/pathway/reducing-agricultural-emissions-through-source-regulation/>
- Tax Incentives for Agricultural Carbon Sequestration: <https://lpdd.org/pathway/tax-incentives-for-agricultural-carbon-sequestration/>

Other Recommendations

- “Institutionalize the “New York Soil Health” effort, which has been coordinated by Cornell CALS as New York State’s land grant partner, to provide a platform for sharing

the full diversity of interests, resources, events and priorities of the many stakeholders involved in soil health.” (NYSH, 2019, 23)

- “A key role of this statewide program will be to establish a direct communication channel with policymakers and bring attention to and speak with one voice regarding specific soil health goals, and policy priorities to meet those goals” (NYSH, 2019, 23)
- “Seek consensus where possible and promote a consistent message on soil health goals, and strategies to reach those goals, including research, and outreach priorities” (NYSH, 2019, 23)
- “Identify and capitalize on opportunities for research and outreach synergy across groups with similar goals and/or activities, including farmer-to-farmer training” (NYSH, 2019, 23)
- “Update New York State Soil and Water Conservation Districts Law to explicitly support soil health practices for attaining agricultural and environmental goals” (NYSH, 2019, 24)
- “Facilitate communication among all county, state and federal agencies regarding the integration of soil health with broader environmental goals, programs, and policies” (NYSH, 2019, 24)
- “With input from stakeholders, identify specific soil health goals and priorities” (NYSH, 2019, 24)
- “Increase support for soil health programming within existing state agencies” (NYSH, 2019, 24)
- “Ensure regulatory consistency across agencies to facilitate reaching soil health goals” (NYSH, 2019, 24)
- “Facilitate agribusiness ventures and farm credit opportunities that provide low cost loans, technical assistance, equipment rental, or related soil health services to farmers” (NYSH, 2019, 24)
- “Evaluate the potential for farmers to gain a reputational benefit from adoption of soil health practices, for example by marketing a “Soil Health Grown” label” (NYSH, 2019, 24)
- “Integrate soil health programming with climate change policy initiatives, such as the “natural and working lands” component of the U.S. Climate Change Alliance, and expand support for the Climate Resilient Farming component of the state Agricultural Environmental Management (AEM) framework” (NYSH, 2019, 26)
- “Provide grant or cost-share support to focus on soil health management for meeting New York climate change resiliency and mitigation goals” (NYSH, 2019, 26)
- “Provide grant opportunities for basic and applied soil health research and outreach” (NYSH, 2019, 26)
- “Further integrate soil health programming within conservation planning and cost share opportunities of the state AEM framework, including nutrient management planning for Concentrated Animal Feed Operations (CAFO) regulated by NYSDEC” (NYSH, 2019, 27)
- “Fund and create incentives to support research and new business ventures focused on developing value-added soil amendments, including composts, biochar and other products, from manure and other sources” (NYSH, 2019, 27)

- “Work with NYSERDA and other state programs to expand research, policies, and incentives to encourage on-farm energy generation from manure waste” (NYSH, 2019, 27)
- “Improve management practices for synthetic fertilizers.” (Carbon-Neutral Agriculture, 2017, pg. 5)
- “Apply Fertilizers so that nitrogen supply is only as needed” (Carbon-Neutral Agriculture, 2017, pg. 5)
- “Focus on timing and placement to limit GHG emissions” (Carbon-Neutral Agriculture, 2017, pg. 5)
- “Fertilize in the cropland in the season the crop will be seeded, as to not leave fertilized land over the winter to lose nitrous oxide into the atmosphere” (Carbon-Neutral Agriculture, 2017, pg. 5-6)
- “Practice “split application”—that is, applying small amounts of fertilizer early in the planting season and, again, when nitrogen demand is highest, typically after plants emerge from the ground, which reduces GHG emissions” (Carbon-Neutral Agriculture, 2017, pg. 6)
- “Take advantage of technology like Precision agriculture and subsurface drip irrigation, which improve the placement of the fertilizers” (Carbon-Neutral Agriculture, 2017, pg. 6)
- “Research nitrification inhibitors further, since their implementation might lead to more pollution and less benefits than split application methods” (Carbon-Neutral Agriculture, 2017, pg. 6)
- “Reduce or eliminate tillage.” (Carbon-Neutral Agriculture, 2017, pg. 6)
- “Increase carbon inputs from plants through cover crops and crop rotations.” (Carbon-Neutral Agriculture, 2017, pg. 7)
- “Additionally, a type of charcoal called biochar may be able to store even more carbon than traditional organic amendments.” Implement new technology to sequester more carbon. (Carbon-Neutral Agriculture, 2017, pg. 7)
- “Employ organic farming and other more climate-friendly farming systems” (Carbon-Neutral Agriculture, 2017, pg. 7)
- “Add soil amendments.” (organic materials like compost) (Carbon-Neutral Agriculture, 2017, pg. 11)
- “Since most producers routinely apply excess fertilizer, federal or state legislators should consider adopting a fertilizer fee that could both encourage more judicious use of fertilizer and help fund training on how to ensure no yield losses with less fertilizer and other climate-friendly agricultural practices.” (Carbon-Neutral Agriculture, 2017, pg. 25)
- “Programs to reduce nitrate runoff from fields into rivers would (depending on the precise practices incentivized) likely reduce nitrous oxide emissions; programs to reduce erosion and sediment pollution from grazing could likely increase soil carbon; and programs to change manure management could reduce methane emissions” Expand such already existing programs. (Carbon-Neutral Agriculture, 2017, pg. 25)

Discussion and Analysis

- “EXPAND THE USE OF FALL/WINTER COVER CROPS — This increases the total annual plant uptake of carbon dioxide through photosynthesis, which significantly increases soil organic matter compared to leaving land fallow during the fall to early

spring period. The roots of cover crops help hold the soil in place and thus provide resilience to soil erosion during heavy wind or rainfall events. Some cover crops have deep and extensive root systems that move carbon deep into the soil profile, and can break up compacted soil layers to improve infiltration and drainage. Over the past two decades we have learned that plant roots can be quite “leaky”, releasing sugars and other substances that can build up populations of beneficial soil organisms for themselves or the following crop. Some plant species also release trace amounts of allelopathic substances that can suppress weeds, insects and/or soil-borne disease organisms.” (NYSH Roadmap, 2019, 10)

- “DIVERSIFY WITH CROP ROTATIONS — This breaks pest cycles, adds nutrients or organic matter, maximizes soil biodiversity, and provides other benefits. A classic example of crop rotation that farmers have been using for centuries is growing nitrogen-fixing legume plants (e.g., soybeans) in alternation with non-legumes (e.g., corn). When possible, integration of perennial or semi-perennial (e.g. alfalfa) plants into a cropping system, where and when possible, is an effective strategy for reducing soil disturbance and remediating degraded soils.” (NYSH Roadmap, 2019, 10)
- “REDUCING TILLAGE — This practice slows the pace of organic matter decomposition so that nutrient release happens gradually, matching crop nutrient needs. Excessive tillage not only breaks up soil aggregates and exposes more of the soil organic matter to decomposition, but also pumps excessive amounts of oxygen into the soil, accelerating microbial decomposition activity. Excessive tillage as a means of remediating soil compaction can lead to a chronic soil compaction problem³, a result of decreased organic matter, poor aggregate stability, and increased plow layer compaction.” (NYSH Roadmap, 2019, 11)
- “USING COMPOST, MANURE, BIOCHAR OR OTHER SOIL AMENDMENTS — This is a way of utilizing high organic matter and carbon-rich “waste” materials for soil health benefits. These amendments tend to improve soil structure, water and nutrient retention, water infiltration rate and drainage, and can promote beneficial soil organisms. Biochar is a highly stable carbon substance produced by burning biomass or organic wastes at low oxygen in a pyrolysis unit. Energy can be captured and utilized during pyrolysis, and the biochar can be added to soil to sequester carbon and improve soil structure and function.” (NYSH Roadmap, 2019, 11)
- “Like cropland, rangeland used for livestock grazing can also sequester carbon. Overgrazing has damaged vegetation and degraded soil quality across the western United States, resulting in the release of carbon that would otherwise remain locked in organic matter. ³⁰ However, reducing the intensity of use and adjusting the timing of grazing to facilitate plant growth can repair these landscapes³¹ and restore their function as carbon sinks. ³²” (Carbon-Neutral Agriculture, 2017, pg. 4)
- “Improve management practices for synthetic fertilizers. Because plants utilize nitrogen from the soil and crops carry it away from the field after harvest, fields must eventually be replenished. This is typically accomplished through the application of synthetic or organic nitrogen fertilizer. However, farmers routinely apply fertilizer at higher rates than crops require for a variety of reasons—as a form of insurance or risk avoidance, hope for a great year, over-focus on yield over return, habit, and misinformation. ³⁸ On

average, only 50% of the nitrogen applied as fertilizer to annual grains is removed at harvest. 39” (Carbon-Neutral Agriculture, 2017, pg. 5)

- “Reduce or eliminate tillage. To prepare for planting, farmers routinely till their land by plowing or otherwise breaking up the soil and eliminating unwanted material. This process accelerates the breakdown of organic matter in the soil, increasing emissions of carbon dioxide. Thus, farmers and others are examining ways to prepare soil for planting with no, or reduced, tillage. No-till agriculture, which completely eliminates tillage, uses herbicides or other methods to control weeds instead of tillage, and leaves the soil physically undisturbed, protecting organic matter from soil microbes that could otherwise accelerate the carbon cycle by returning soil carbon to the atmosphere as carbon dioxide. 56 Reduced tillage practices that integrate some amount of plant residue into soils may also reduce nitrous oxide emissions and further increase carbon sequestration. 57” (Carbon-Neutral Agriculture, 2017, pg. 6)
- “Increase carbon inputs from plants through cover crops and crop rotations. Farmers can also foster soil carbon by increasing carbon inputs from plants. Cover crops are plants grown to enhance soil conditions rather than to produce an agricultural product. They are generally grown during the late fall and winter when common commodity crops such as corn, wheat, and soy are not in season. In addition to increasing soil organic carbon by increasing carbon inputs, cover crops have also been shown to significantly reduce nitrate loss, thereby indirectly reducing nitrous oxide emissions. 70 Cover cropping with legumes also increases biological nitrogen fixation, reducing the need for nitrogen fertilizers. 71” (Carbon-Neutral Agriculture, 2017, pg. 7)
- “Additionally, a type of charcoal called biochar may be able to store even more carbon than traditional organic amendments. 81 Biochar is produced by pyrolysis—the thermal decomposition of organic material at high temperatures in the absence of oxygen. This process results in a carbon-rich char that is more stable than uncharred plant material, although local environmental conditions, such as climate and soil type, play an important role in determining how long it persists in soils. 82 Biochar primarily reduces emissions by stabilizing and adding to carbon stores in the soil⁸³; however, it may also reduce nitrous oxide emissions and fertilizer requirements. 8” (Carbon-Neutral Agriculture, 2017, pg. 7)
- “Employ organic farming and other more climate-friendly farming systems. There are several agricultural systems, including organic agriculture, permaculture, agroecology, and regenerative agriculture, that are built upon the fundamental premise that soil health and natural ecological systems, such as the nutrient cycle between livestock and crops, are paramount to long-term productivity. This subsection focuses on organic agriculture, since it is well-studied and there are already USDA national organic standards in place,⁸⁵ making it easier to classify. However, certified organic operations are not necessarily more climate friendly than non-certified operations implementing these other models; all can have significant climate benefits.” (Carbon-Neutral Agriculture, 2017, pg. 7)
- “Add soil amendments. New research has demonstrated that organic soil amendments like compost may be able to boost carbon sequestration on grazing land. Over the course of three years, researchers found that a single application of composted organic matter to rangeland increased net carbon storage by 25-70%,¹²⁹ while also increasing the

production of grass for feed and thereby making rangelands more productive. 130” (Carbon-Neutral Agriculture, 2017, pg. 11)

- “The majority of agricultural emissions are from nitrous oxide produced in soils, much of which is caused by the application of nitrogen fertilizer. Since most producers routinely apply excess fertilizer, federal or state legislators should consider adopting a fertilizer fee that could both encourage more judicious use of fertilizer and help fund training on how to ensure no yield losses with less fertilizer and other climate-friendly agricultural practices. Evidence indicates that rising fertilizer prices have made farmers examine fertilizer use more carefully. 301 A 2011 study in the United States estimated that for every 1% increase in price for synthetic fertilizers, demand for the product would drop 1.87%. 302 At this rate, a 10% tax on nitrogen fertilizers would reduce application rates by 2.4 million tons annually, 303 and result in hundreds of millions of dollars of revenue, while having an insignificant effect on overall costs and prices. 304” (Carbon-Neutral Agriculture, 2017, pg. 25)
- “Federal and state governments can also reduce greenhouse gas emissions as incidental to their regulation of water or other pollution. Programs to reduce nitrate runoff from fields into rivers would (depending on the precise practices incentivized) likely reduce nitrous oxide emissions; programs to reduce erosion and sediment pollution from grazing could likely increase soil carbon; and programs to change manure management could reduce methane emissions” (Carbon-Neutral Agriculture, 2017, pg. 25)

Other Resources

Related Topics in this Document: Research and Development

Livestock Management & Non-Regulatory Methods for Reducing GHG Emissions from Livestock Operations

New York Actions

- NYSERDA Grants for Anaerobic Digestion: <https://attra.ncat.org/event-calendar/new-york-anaerobic-digester-grants-1/>
- 2017 New York State Methane Reduction Plan (Referred to as “Methane Reduction Plan” in this document, linked in “Key to Sources”)

LPDD Recommendations

- “States could establish their own funding programs for anaerobic digester projects.”
- “State agricultural agencies could provide funding for, and otherwise support, research into new methane emissions reduction techniques from enteric fermentation.”
- “Environmental agencies should regulate methane emissions from manure management, as suggested in the NYS Methane Reduction Plan.”
- “States should introduce initiatives aimed at improving agricultural and livestock management practices to control nitrous oxide emissions, including binding regulations, economic incentives, reputational incentives, and/or technical support.”

- “State environmental authorities should seek to regulate nitrous oxide emissions from agriculture and livestock through management standards, rather than direct emission caps, due to the complexities of monitoring, verifying, and enforcing compliance with emissions caps for these sectors.”

Related LPDD Database Pathways

- Controlling Methane from Manure: <https://lpdd.org/pathway/controlling-methane-from-manure/>
- Nitrous Oxide Management Plans: <https://lpdd.org/pathway/state-and-local-nitrous-oxide-management-plans/>

Other Recommendations

- “SB 1383: adopt regulations to reduce methane emissions from livestock manure and dairy manure management operations by up to 40 percent below the dairy sector’s and livestock sector’s 2013 levels by 2030, including establishing energy infrastructure development and procurement policies needed to encourage dairy biomethane projects. The regulations will take effect on or after January 1, 2024.” (CA Scoping Plan, 2017, 90)
- “Add soil amendments.” (Carbon-Neutral Agriculture, 2017, pg. 7)
- “Improve grazing management.” (Carbon-Neutral Agriculture, 2017, pg. 10)
- “Optimize feed, breed, and herd health. Grazing practices have been the subject of significant attention and debate; however, ranchers can also take important steps to reduce net emissions through improved feed, breed, and animal health management. (Carbon-Neutral Agriculture, 2017, pg. 10)
- “Reincorporate animals into croplands. The most effective way to reduce emissions from AFOs would be to replace them with well-managed integrated crop-livestock systems. (Carbon-Neutral Agriculture, 2017, pg. 11-12)
- “Transition to dry manure management systems. Dairy and swine operations accounted for 90% of methane emissions from manure management in 2015,149 largely due to their reliance—in the United States, at least—on liquid management systems... In dry management systems, by contrast, aerobic conditions are maintained and methane emissions are minimized” (Carbon-Neutral Agriculture, 2017, pg. 12)
- “Eliminating routine antibiotic use may reduce emissions.” (Carbon-Neutral Agriculture, 2017, pg. 13)

Discussion and Analysis

- “Dairy Farm Opportunities - Dairy farms in New York can serve as positive examples of coupled animal and crop production. While manure is often viewed as an inherent environmental problem, this dairy waste is rich in organic matter and nutrients. New York has a unique opportunity for developing and demonstrating ways in which manure handling and land application can be optimized to minimize negative environmental impact and improve soil health. New York can also lead the way in exploring potential for energy generation from manure waste, and innovative processing of excess manure for value-added manure products for application to degraded soils.” (NYSH, 2019, 21)

- “CARB and CDFA and other agencies are working together to solicit input from industry, environmental, and community groups to encourage early and meaningful action to reduce emissions from the livestock sector.” (CA Scoping Plan, 2017, 107)
- “Add soil amendments. Soil application of amendments such as manure or other organic fertilizers can lower emissions by decreasing manure waste, reducing emissions from the production of synthetic fertilizers,⁷⁸ and increasing soil carbon stocks. ⁷⁹ While livestock manure remains the dominant source of organic fertilizer for agriculture, the United States has large amounts of compostable solid waste and solid residues from sewage treatment plants, called biosolids, which also can be, and now often already are, used as soil amendments. ⁸⁰” (Carbon-Neutral Agriculture, 2017, pg. 7)
- “Improve grazing management. ... Management systems that rotate livestock through a series of pastures, if implemented well, may improve soil conditions and grassland productivity, thereby increasing soil organic carbon. ¹²⁰ At the same time, continuous systems, which allow unrestricted grazing, are more likely to lead to poor soil quality and carbon loss. ¹²¹

The USDA Natural Resources Conservation Service (NRCS) calls rotational systems that rotate livestock in order to foster optimal plant and animal health “prescribed grazing.” There are different types of prescribed grazing systems, such as management-intensive grazing and less intensive forms of rotational and planned grazing. While not widely adopted, there are numerous such operations that appear to be successful in restoring rangelands, increasing soil carbon, and enhancing other ecological benefits while producing livestock. ¹²² These can be viewed as models for other farms, education programs, and government incentives.” (Carbon-Neutral Agriculture, 2017, pg. 10)

- “Optimize feed, breed, and herd health. Grazing practices have been the subject of significant attention and debate; however, ranchers can also take important steps to reduce net emissions through improved feed, breed, and animal health management. By carefully managing their herds’ feed and forage options, operators may be able to decrease enteric emissions. ¹²⁷ Operators can also reduce emissions by maintaining herd health and choosing or developing breeds best adapted to the local environment. ¹²⁸ The capacity of different breeds to thrive in local conditions, such as weather and native plant communities, affects how quickly they mature. Breeds optimized for local conditions will therefore reach slaughter weight more quickly, reducing their impact on emissions.” (Carbon-Neutral Agriculture, 2017, pg. 10)
- “Reincorporate animals into croplands. The most effective way to reduce emissions from AFOs would be to replace them with well-managed integrated crop-livestock systems. Traditionally, most farms incorporated animals into cropping systems by allowing them to forage on well managed grasslands or plant residues after harvest, but early agricultural scientists and extension agents discouraged this practice, perceiving it as archaic and inefficient. As scientists have begun to understand the ecology of agriculture better, however, they have started to encourage it as an environmentally friendly way to intensify agricultural production. ¹⁴⁶ Some even argue that crop-livestock farms are economically and environmentally optimal, creating an efficient nutrient cycle between plants and animals. ¹⁴⁷ Mixed crop-livestock systems encourage crop and animal rotations and also help break down plant residue, all of which increases soil health and

carbon sequestration. They can substantially reduce methane emissions from manure management since manure in integrated systems is typically left to decompose aerobically. 148 However, both animal growth rates and enteric emissions must be taken into account when comparing net emissions from different systems of animal agriculture.” (Carbon-Neutral Agriculture, 2017, pg. 11-12)

- “Transition to dry manure management systems. Dairy and swine operations accounted for 90% of methane emissions from manure management in 2015,149 largely due to their reliance—in the United States, at least—on liquid management systems. 150 Nearly all hog producers, for example, wash waste into giant “lagoons” or hold it in large “slurry pits” below the slatted floors of production facilities until it is applied to land, ostensibly as nitrogen fertilizer. 151 In dry management systems, by contrast, aerobic conditions are maintained and methane emissions are minimized. 152 For example, manure may be drained and dried, or dry matter like straw may be added to absorb moisture and solidify it. 153 Solids can then be stacked until land application. 154” (Carbon-Neutral Agriculture, 2017, pg. 12)
- “Eliminating routine antibiotic use may reduce emissions. Antibiotics are routinely administered to animals in confined production facilities to increase animal growth rates and to prevent disease,168 altering the microbiota of confined animals and affecting their health and physiology,169 and may increase the amount of methane producing microflora. 170” (Carbon-Neutral Agriculture, 2017, pg. 13)

Other Resources

Related Topics in this Document: Solid Waste Management

Farm Management

New York Actions

- “Expand implementation of Climate Resilient Farming: Continue funding existing program areas, explore additional scoring criteria (e.g., gas capture and energy generation), and evaluate funding additional program areas (e.g., enteric fermentation). [SWCC, DAM, NYSERDA]” (Methane Reduction Plan, 2017, pg. 11-12)
- “Agricultural Nonpoint Source Grant Program: Propose application criteria in the next round (Round 24, 2018) to encourage the design and construction of manure management storage systems that easily facilitate retrofitting with cover and methane capture systems. [SWCC]” (Methane Reduction Plan, 2017, pg. 11-12)
- “NYSERDA will coach projects that are developing on-farm digesters to consider the ability of proposed digesters to accept organic waste in priority regions of the state, e.g., areas with high waste production or limited access to landfills with gas capture.” (Methane Reduction Plan, 2017, pg. 11-12)
- “Cornell Cooperative Extension (CCE) offices and other local partners already provide outreach and education to farms on best management practices for feeding, but State action may further help adoption. State agencies will convene a learning session with CCE and relevant experts on 1) the potential for improved animal feeding for reducing this source of methane, 2) strategies and barriers to adoption, and 3) how to measure

emission reductions as well as the economic value to farms. [DEC, DAM, SWCC]" (Methane Reduction Plan, 2017, pg. 11-12)

Recommendations

- "Expand agroforestry. Agroforestry is a collective name for agricultural systems that integrate management of woody perennials and agricultural crops or animals on the same piece of land." (Carbon-Neutral Agriculture, 2017, pg. 8)
- Expand "row crop production integrated with strategically placed native perennial grasses, called prairie strips," a method developed by scientists at Iowa State University (Carbon-Neutral Agriculture, 2017, pg. 8)
- "Shift to more ecologically efficient crop use. Analyses of agricultural productivity generally focus on inputs, including labor, and crop yield. While these factors are important, they fail to provide an accurate account of whether a crop is a truly efficient use of land and energy from the perspective of fulfilling human needs." (Carbon-Neutral Agriculture, 2017, pg. 9)
- "Optimize flood irrigation and drainage in rice cultivation." Adopt a protocol similar to California's to allow "rice farmers to quantify reductions at the farm level as the basis for generating credits under the state's cap-and-trade program, which may incentivize the adoption of mitigation practices in the rice industry." (Carbon-Neutral Agriculture, 2017, pg. 9-10)
- "States and local governments can also discourage carbon-intensive practices through taxation... States and local governments should condition tax reductions for agriculture on the adoption of more climate-friendly practices, perhaps targeting more stringent requirements on larger farms or those with a larger than average carbon impact. 306" (Carbon-Neutral Agriculture, 2017, pg. 25)
- "Incorporate methane reduction into New York State programs related to manure management." (Methane Reduction Plan, 2017, pg. 11-12)
- "Propose funding criteria to stimulate methane reductions and to promote economic benefits such as sales of marketable products (e.g., postdigester fiber) and reductions in fertilizer use, electricity demand, municipal waste/organics, and nitrous oxide emissions from land application." (Methane Reduction Plan, 2017, pg. 11-12)
- "Evaluate and promote new financing mechanisms (e.g., carbon trading offsets) and opportunities described in the Clean Energy for Agriculture Task Force Strategic Plan. [DEC, NYSEDA, SWCC, DAM] 21." (Methane Reduction Plan, 2017, pg. 11-12)
- "Expand education and outreach programs through the Cornell Cooperative Extension about farm management. (Methane Reduction Plan, 2017, pg. 11-12)
- "Improve greenhouse gas accounting and climate change impact considerations in the Agricultural Environmental Management (AEM) framework that farms use to identify best practices. [SWCC]" (Methane Reduction Plan, 2017, pg. 11-12)
- "Address data gaps and prioritize research needs so that the State is able to monitor progress at reducing greenhouse gas emissions and to direct resources to successful programs in the agriculture sector. Specific gaps include lack of detailed information on manure management and feeding practices on farms and the resulting methane emissions. [DEC, DAM, SWCC]" (Methane Reduction Plan, 2017, pg. 112)

Discussion and Analysis

- “Expand agroforestry. Agroforestry is a collective name for agricultural systems that integrate management of woody perennials and agricultural crops or animals on the same piece of land. 92 By adding trees to agricultural lands, agroforestry increases both annual sequestration rates and the overall amount of carbon that a piece of land can store. As a result, agroforestry’s per-acre sequestration potential is far higher than that found in annual crop systems. 93 Over time, agroforestry can also reduce indirect emissions of nitrous oxide by reducing nitrogen runoff. 94

In the United States, agroforestry typically involves the use of trees and shrubs to act as windbreaks, buffers, and hedges on otherwise conventionally managed cropland; however, it also includes alley cropping, the side-by-side planting of annual crops with trees in adjacent rows. USDA estimated that alley cropping generally sequesters about one to two metric tons of carbon dioxide equivalent annually per acre through additional biomass. 95 This is roughly the equivalent of taking one car off the road for every three to six acres thus managed; if done on just one-quarter of U.S. cropland, it would be the equivalent of taking 26 million cars off the road.” (Carbon-Neutral Agriculture, 2017, pg. 8)

- “Although not a form of agroforestry, a system of row crop production integrated with strategically placed native perennial grasses, called prairie strips, was developed by scientists at Iowa State University and modeled on agroforestry practices. The project, Science-Based Trials of Rowcrops Integrated With Prairie Strips (STRIPS), is designed to create a scalable, resilient, and environmentally responsible system of agriculture in the Midwest. 96 Further research is needed to accurately measure its impact on net emissions, but scientists estimate that prairie strips sequester approximately one metric ton of carbon dioxide equivalent per acre, about three times the sequestration rate of no-till farming. 97” (Carbon-Neutral Agriculture, 2017, pg. 8)
- “Shift to more ecologically efficient crop use. Analyses of agricultural productivity generally focus on inputs, including labor, and crop yield. While these factors are important, they fail to provide an accurate account of whether a crop is a truly efficient use of land and energy from the perspective of fulfilling human needs. A crop with high yields and low labor requirements may be inefficient if it is integrated into an energy-intensive value chain, such as grain destined for a feedlot, or if it does not provide consumers with a nutritious end product, such as corn processed into high-fructose corn syrup.” (Carbon-Neutral Agriculture, 2017, pg. 9)
- “Optimize flood irrigation and drainage in rice cultivation. Rice cultivation results in methane emissions due to flood irrigation of rice fields, which creates anaerobic conditions in which methane-producing bacteria thrive. 114 Rice farmers can reduce methane emissions by reducing the continuous flooding during the growing season by alternate wetting and drying. Periodic drainage temporarily restores aerobic conditions, which rapidly diminishes the amount of methane-producing bacteria and stimulates other bacteria that metabolize methane for energy. 115 The Intergovernmental Panel on Climate Change (IPCC) estimated that, on average, draining once per season reduces emissions by 40%, while draining multiple times reduces emissions by 48%. 116 In 2016, California approved a protocol for rice farmers to quantify reductions at the farm level as the basis for generating credits under the state’s cap-and-trade program, which may

incentivize the adoption of mitigation practices in the rice industry. 11” (Carbon-Neutral Agriculture, 2017, pg. 9-10)

- “States and local governments can also discourage carbon-intensive practices through taxation. Many states and local governments currently provide significant property tax reductions for farm owners, regardless of how large or profitable their farm operations are. 305 While protecting farmland from development can have climate benefits, states should also take farm practices into account when assessing farmland values. Highly profitable, highly polluting hog CAFOs are often eligible to receive agricultural use exemptions, for example. States and local governments should condition tax reductions for agriculture on the adoption of more climate-friendly practices, perhaps targeting more stringent requirements on larger farms or those with a larger than average carbon impact. 306” (Carbon-Neutral Agriculture, 2017, pg. 25)
- “(1) to develop comprehensive, farm-specific plans to reduce GHG emissions, increase carbon sequestration, and address agricultural adaptation challenges resulting from a changing climate; and (2) to implement the necessary suite of practices to achieve those objectives... Providing producers with a suite of possible practices to improve on-farm environmental performance ensures that the diversity inherent in New York State agriculture is recognized and that the potential synergies among climate, air quality, and water quality benefits of individual practices and technologies are captured and capitalized upon...As the primary means of delivering outreach, education, and technical assistance to the agricultural community, this policy is designed to incorporate significant components of adaptation to climate change within individual farm GHG management plans.” (CAC Report 2010, Chapter 9, pg. 18-19)

Other Resources

Related Topics in this Document: Carbon Taxation and Pricing

On Farm Renewable Energy & Energy Efficiency

Other Recommendations

- Create “a State-level Agricultural Energy Program be established to facilitate energy efficiency and renewable energy efforts at the distributed generation level to achieve this aggressive policy.” (CAC Report 2010, Chapter 9, page 20)
- “The program would be responsible for coordinating and administering comprehensive energy audits, coordinating efforts to streamline federal and state funding opportunities to maximize energy efficiency and renewable energy implementation as identified in the comprehensive energy audit, coordinating with utilities to facilitate interconnection, offering grant application assistance to interested farmers, tracking implementation and documenting results, supporting and coordinating research efforts related to energy efficiency and renewable energy, and technology improvements required to achieve farm-level carbon efficiency.” (CAC Report 2010, Chapter 9, page 20)
- Adopt an adaptable strategy to dealing with electricity usage on farms, dependent on “heat stress” (CAC Report 2010, Chapter 9, page 20)

Discussion and Analysis

- “Employing a coordinated approach that addresses all forms of on-farm energy consumption including embedded energy. These efficiency gains can be realized through a comprehensive energy audit, which is a multi-disciplinary approach to energy-use analysis including equipment, structural, and management related energy use, as well as identification of renewable energy opportunities. Deployment of these energy efficiency measures will require shifts in farm-level management practices.” (CAC Report 2010, Chapter 9, page 20)
- “The agricultural sector’s natural capacity (sun, wind, land area, available biomass) to generate energy exceeds its energy demand. This policy also seeks to capitalize on agriculture’s ability to produce energy using multiple sources and renewable energy technologies. Included in this policy is recognition that multiple technologies at varying scales can be co-located at individual operations. As an implementation mechanism it is recommended that a State-level Agricultural Energy Program be established to facilitate energy efficiency and renewable energy efforts at the distributed generation level to achieve this aggressive policy. A sector-specific approach is necessary due to the unique nature of the agricultural sector. One of the challenges in meeting these changes is the diversity of the agricultural sector. The numerous types of operations (the dairy segment alone has multiple production systems each having very different infrastructure requirements) have very specific energy needs and present specific energy efficiency opportunities. The diversity within any given segment of the sector is due to a number of variables including age, location, and size of operation. This is very different from other sectors in which standardization of production and retail sales is the norm. The age of the agricultural building stock and infrastructure alone presents a significant opportunity for energy efficiency improvements.” (CAC Report 2010, Chapter 9, page 20)
- “The second challenge is financing on-farm energy efficiency and renewable energy measures. Farmers operate in very volatile markets with high risk and relatively small returns. Dairy, the primary segment of our agricultural economy, operates in a controlled market (i.e., price of milk is set at the federal level). The ability to invest significant amounts of planning time and capital in energy efficiency and renewable energy measures with rates of return that span multiple years predicated on unknown climatic (e.g., weather, disease, pest) and market forces (e.g., commodity recall unrelated to individual farm) completely outside of the control of individual farms is severely limited. An Agricultural Energy Program would begin to address these challenges. The program would be responsible for coordinating and administering comprehensive energy audits, coordinating efforts to streamline federal and state funding opportunities to maximize energy efficiency and renewable energy implementation as identified in the comprehensive energy audit, coordinating with utilities to facilitate interconnection, offering grant application assistance to interested farmers, tracking implementation and documenting results, supporting and coordinating research efforts related to energy efficiency and renewable energy, and technology improvements required to achieve farm-level carbon efficiency.” (CAC Report 2010, Chapter 9, page 20)
- “There may be significant interconnection and reliability concerns related to the scale of distributed generation in rural areas. This policy represents an adaptation strategy

regarding heat stress in livestock, which results in decreased milk yields and reproduction rates. Increasing the cooling capacity in livestock housing will increase energy usage. Energy efficiency and renewable energy technologies can mitigate negative impacts resulting from increased energy uses. This policy also provides significant workforce development and community-scale energy opportunities in rural areas.” (CAC Report 2010, Chapter 9, page 20)

Other Resources

Related Topics in this Document: Sustainable Feedstock for Biofuel Production/Conversion

Food Processing

New York Actions

- “Environmental Protection Fund (EPF) funding for municipalities and Food Banks – Funding for food donation and food scraps recycling. Eligible projects include increasing cold storage devices for edible food and infrastructure for food scraps recycling such as composting or anaerobic digestion facilities.” (Methane Reduction Plan, 2017, pg. 8-9)
- “Empire State Development (ESD) funding for Food Banks – Funding for the New York State Food Bank Association to provide statewide assistance for additional food donation including new collection trucks and other items.” (Methane Reduction Plan, 2017, pg. 8-9)
- “Clean Energy Fund – NYSERDA will align State programs that coach the development of anaerobic digesters at farms, wastewater facilities, food and beverage production facilities, and merchant-type treatment facilities, to highlight methods for and the financial value of reducing organic waste that would otherwise be deposited in landfills or exported out-of-state (also see Agriculture Sector actions).” (Methane Reduction Plan, 2017, pg. 8-9)
- “DEC will continue to develop and conduct outreach and other programs and policies to encourage large generators of food waste to donate edible food or compost, anaerobically digest or otherwise recycle what is not donated.” (Methane Reduction Plan, 2017, pg. 8-9)

Recommendations

- “Develop strategies for aligning future funding such as EPF budget categories to best support organics diversion goals and other methane emission reduction objectives” (Methane Reduction Plan, 2017, pg. 8-9)
- Create a cataloguing system to track the post production greenhouse gas emissions from the food processing industry. (Carbon-Neutral Agriculture, 2017, pg. 29)

Discussion and Analysis

- “Postproduction greenhouse gas emissions, while significant, have not been comprehensively catalogued in the United States. The main contributors to emissions beyond the farm gate are energy expenditures associated with food processing, packaging, marketing, and distribution. Food waste contributes to emissions indirectly,

through emissions resulting from the production, distribution, and marketing of the wasted food, and directly, through methane emissions from landfills.” (Carbon-Neutral Agriculture, 2017, pg. 29)

Other Resources

Related Topics in this Document: Food Waste, Landfill Methane Capture

Local Food Production

Recommendations

- “Increasing the availability of locally produced foods to New York State residents can reduce the energy required for transportation, packaging, and marketing; enhance rural economic development; improve health and nutrition; and increase food security and food safety” (CAC Report 2010, Chapter 9, page 26)
- “In the short term, increased public funds will be needed to expand existing direct marketing programs” (CAC Report 2010, Chapter 9, page 27)
- “Support initiatives that add both economic and nutritional value to New York State agricultural products through the development of new products (such as sauces, jams, juices, etc.). This includes processing and packaging initiatives that help make fresh foods more accessible and convenient. Recognize that minimally processed products often preserve optimal nutritional benefit.” (CAC Report 2010, 10, 25)
- “Support the development of a system for State agencies and State-owned facilities that purchase food and food products to identify the percentage of locally produced agricultural products purchased throughout the fiscal year; and track and report locally produced agricultural products purchased on an annual basis.” (CAC Report 2010, Chapter 10, page 25)

Discussion and Analysis

- “Recently the U.S. Department of Agriculture Economic Research Service (ERS) released a comprehensive literature review of the current understanding of local food systems. Local food markets account for a small but growing share of total U.S. agricultural sales... The study had the following key findings: Production of locally marketed food is more likely to occur on small farms located in or near metropolitan counties; Consumers who value high-quality foods produced with low environmental impact are willing to pay more for locally produced food; Empirical research has found that expanding local food systems in a community can increase employment and income in that community.” (CAC Report 2010, Chapter 9, page 26)
- “This policy option promoting increasing the availability of local foods is complementary to several other GHG mitigation policy options, including AFW-5 and TLU-11 by encouraging an alternative land use to development in those areas experiencing the greatest land-use conversion pressure; TLU-10 by enhancing local open space conservation efforts; and AFW-3 by encouraging minimal processing and packaging of locally produced food. Direct to consumer sales also provide producers with a higher rate of return, which further reduces the rate of land conversion to developed uses and better

positions producers to cope with potentially costly adaptation strategies.” (CAC Report 2010, Chapter 9, page 27)

- “Several of the proposed policy initiatives involve significant levels of federal funding and subsidies including food assistance programs and school meal programs. State policies that encourage or incentivize local foods within these programs must be consistent with federal policies. Currently New York-specific data quantifying food miles traveled and the resulting benefits have not been thoroughly studied. Additionally, it must be recognized that food-mile reductions must be assessed on a product-by-product basis that includes life-cycle analyses of the numerous crop specific inputs and concomitant production methods. In the short term, increased public funds will be needed to expand existing direct marketing programs; this may be somewhat problematic during austere budget times regardless of the benefits.” (CAC Report 2010, Chapter 9, page 27)

Other Resources

Related Topics in this Document: Food Waste, Food Processing

Encouraging Plant-Rich Diets

Related LPDD Database Pathways

- Low Carbon Dietary Guidelines: <https://lpdd.org/pathway/low-carbon-dietary-guidelines/>
- Dietary Guidelines: <https://lpdd.org/pathway/dietary-guidelines/>

Other Recommendations

- “Shifting away from such high reliance on heavily processed foods could further reduce inefficiencies in the food system and result in substantial health as well as climate benefits.” (Carbon-Neutral Agriculture, 2017, pg. 9)
- “Prioritize climate change in procurement contracts as it has prioritized other values... prioritizing low-carbon agricultural products for all government bodies” (Carbon-Neutral Agriculture, 2017, pg. 31)
- “In addition, restaurants should offer an expanded range of low-carbon options, helping to make climate-friendly diets more convenient and affordable.” (Carbon-Neutral Agriculture, 2017, pg. 31)

Discussion and Analysis

- AB 479, also known as the ‘Healthy Climate-Friendly School Lunch Act’ created the California School Plant-Based Food and Beverage Program on February 12, 2019 - “Upon appropriation by the Legislature in the annual Budget Act or another statute for purposes of this section, a local educational agency may apply for reimbursement in an amount of up to twenty cents (\$0.20) per meal for meals that include a plant-based food option and up to ten cents (\$0.10) per meal for meals that include a plant-based milk option.”
(http://www.leginfo.legislature.ca.gov/faces/billCompareClient.xhtml?bill_id=201920200AB479&showamends=false)

- “In addition, the U.S. diet now relies heavily on processed and “ultra-processed” foods¹⁰⁹; an estimated 75% of the average person’s calories comes from such food. ¹¹⁰ Heavily processed foods largely rely on corn, wheat, and soy as well as some animal products, leading to a “commodity-based diet” in wealthy countries. ¹¹¹ These diets are deficient in nutrients and other beneficial compounds found in whole or minimally processed foods. ¹¹² The production of an adequate supply of nutritious foods without a corresponding reduction in production of commodities used in processed foods will place additional pressure on the land base. Shifting away from such high reliance on heavily processed foods could further reduce inefficiencies in the food system and result in substantial health as well as climate benefits.” (Carbon-Neutral Agriculture, 2017, pg. 9)
- “Congress and other governments should also prioritize climate change in procurement contracts as it has prioritized other values. The 2008 Farm Bill, for example, directed USDA to pass regulations encouraging institutions participating in child nutrition programs to purchase local agricultural products. ³⁸⁶ Additionally, Congress could pass legislation prioritizing low-carbon agricultural products for all government bodies, including large-scale purchasers such as the U.S. Department of Defense. States and local governments, of course, should pass similar laws.” (Carbon-Neutral Agriculture, 2017, pg. 31)
- “In addition, restaurants should offer an expanded range of low-carbon options, helping to make climate-friendly diets more convenient and affordable. ³⁹¹ Almost one-third of all calories consumed in the United States are from foods prepared away from home. ³⁹² Studies also show that people tend to consume more calories and meat when eating out. ³⁹³ In this environment, climate-friendly diets are unlikely to catch on unless consumers have easy and inexpensive access to prepared foods that are climate-friendly. Currently, the average restaurant menu, whether fast food or sit-down, principally offers carbon-intensive meat options for entrées.” (Carbon-Neutral Agriculture, 2017, pg. 31)

Other Resources

Related Topics in this Document: Local Food Production, Food Processing

Forest Management

New York Actions

- DEC Forest Action Plan (Awaiting Publishing, 2020)
https://www.dec.ny.gov/docs/lands_forests_pdf/nysfap.pdf

LPDD Recommendations

- *“To the extent necessary to remove fire hazards (dead trees, heavy fuel loads), states may consider streamlining environmental permitting requirements for activities such as tree removal and prescribed fires and encouraging use of the biomass for energy production.”*
- *“State foresters should use existing authority to recognize the importance of considering carbon capture, geologic sequestration, and climate change adaptation in*

management decisions regarding state forests, as called for in NYS DEC's Forest Action Plan (2020)."

- *"State legislatures should also purchase abandoned land for reforestation or afforestation."*
- *"State legislatures should amend state forestry laws to recognize the importance of considering carbon capture and climate change adaptation in management decisions regarding state forests."*
- *"Through tax deductions and tax credits, state and local governments could provide significant incentives to corporations and private individuals who manage forestland to sequester carbon."*

Related LPDD Database Pathways

- Federal and State Forest Management Programs: <https://lpdd.org/pathway/federal-and-state-forest-management-programs/>
- Conservation Incentives: <https://lpdd.org/pathway/conservation-incentives/>
- State Level Commercial Forest and Agricultural Resource Management: <https://lpdd.org/pathway/state-level-commercial-forest-and-agricultural-resource-management/>
- Preservation of Forests and Carbon Sinks: <https://lpdd.org/pathway/preservation-of-forests-and-carbon-sinks/>

Other Recommendations

- Develop "a natural and working lands carbon inventory" to monitor carbon sequestration (CA Scoping Plan, 2017, 33)
- "Policy actions will be led by developing and implementing a system for identifying recently unmanaged or neglected and degraded forest lands that are not stocked with trees to full potential. A similar system will be developed for identifying vacant rural land that is unsuitable for agriculture but suitable for reforestation with native trees." (CAC Report 2010, Chapter 9, page 24)
- "Developing forest management plans and applying methods and technologies that increase overall forest productivity, health, and benefits while increasing the rate and levels of carbon sequestration in trees, soil, and durable wood products" (CAC Report 2010, Chapter 9, page 24)
- "Increasing forest cover and associated carbon stocks by planting native tree species on vacant lands that are unsuitable for agricultural use" (CAC Report 2010, Chapter 9, page 24)
- "After establishment, employing forestry practices that maintain and enhance the ability of the forest to sequester carbon and provide forest related benefits" (CAC Report 2010, Chapter 9, page 25)
- "Maintaining and improving the health and longevity of existing trees in urban settings and increasing tree cover area by planting new trees" (CAC Report 2010, Chapter 9, page 25)
- "Developing and supporting prevention, early detection, and rapid response programs that prevent invasive and destructive forest pests and mitigate or eradicate the impacts

of current or future introductions that threaten forest carbon stores.” (CAC Report 2010, Chapter 9, page 25)

- “Support the development of a comprehensive inter-agency database to store baseline and monitoring data on land and forest management and the condition of the state’s agricultural and forest land resources. As well as develop and implement a system for identifying recently unmanaged or neglected/degraded forest stands that are under stocked by 2015.” (CAC Report 2010, Chapter 9, page 25)
- “Develop and implement a system for identifying recently unmanaged or neglected/degraded forest stands that are under stocked by 2015.” (CAC Report 2010, Chapter 9, page 25)
- “By 2025, identify and treat, using necessary and appropriate methods, 25 percent of all appropriate (i.e., poletimber and sawtimber size classes) timberland acres...” (CAC Report 2010, Chapter 9, page 25)
- “Develop and implement programs that alter traditional cultural and commercial conventions that have proved to spread destructive pests.” (CAC Report 2010, Chapter 9, page 25)
- “Develop and implement a system for identifying owners of vacant idle land that is unsuitable for agriculture but suitable for reforestation by 2015.” (CAC Report 2010, Chapter 9, page 25)
- “By 2025, identify and reforest 50 percent of all suitable vacant idle land.” (CAC Report 2010, Chapter 9, page 25)
- “Establish benchmark sites, suitable for measurement of soil carbon and other parameters; integration of remote sensing data and application of new technologies for more rapid less expensive measurement of carbon stocks and GHG fluxes; and improvements in forecasting future agricultural GHG emissions and sinks.” (CAC Report 2010, Chapter 9, page 25)
- Create “State-level monitoring to document trends and predict forest composition changes; research to focus on identifying tree species that will be suitable for the anticipated changes in climate.” (CAC Report 2010, Chapter 9, page 25)
- “Develop and support prevention, early detection, and rapid response programs that seek to prevent the introduction of exotic and invasive forest pests and mitigate/eradicate the impacts of current or future introductions. In addition, develop and support programs that reduce the potential for and severity of wildfire.” (CAC Report 2010, Chapter 10, page 26)

Discussion and Analysis

- “Assembly Bill 1504 (AB 1504) (Skinner, Chapter 534, Statutes of 2010): Forest resources: carbon sequestration
Requires the Board of Forestry and Fire Protection to adopt district forest practice rules and regulations in accordance with specified policies to, among other things, assure the continuous growing and harvesting of commercial forest tree species.
Requires the Board of Forestry and Fire Protection to ensure that its rules and regulations that govern the harvesting of commercial forest tree species consider the capacity of forest resources to sequester carbon dioxide emissions sufficient to meet or

exceed the sequestration target of 5 million metric tons of carbon dioxide annually, as established in the first AB 32 Climate Change Scoping Plan.” (CA Scoping Plan, 2017, 25)

- “A natural and working lands carbon inventory is essential for monitoring land-based activities that may increase or decrease carbon sequestration over time. CARB staff is working to develop a comprehensive inventory of GHG fluxes from all of California’s natural and working lands using the Intergovernmental Panel on Climate Change (IPCC) design principles.” (CA Scoping Plan, 2017, pg. 33)
- “Storing carbon in trees, other vegetation, soils, and aquatic sediment is an effective way to remove carbon dioxide from the atmosphere. This Scoping Plan describes policies and programs that prioritize protection and enhancement of California’s landscapes, including urban landscapes, and identifies next steps to ensure management actions are taken to increase the sequestration potential of those resources.” (CA Scoping Plan, 2017, pg. 36)
- “Concerns: Price of fee and easements can vary greatly with location of the parcel and the terms of an easement; Viability of farm operations is vitally linked to the health of available markets for farm products; Ability of agricultural land and forestland to produce current crop species is climate dependant. Shifts in climate may alter the species that can be grown. The flux of sequestered carbon in a shift of plant species is an uncertainty; Leakage in the case of forest land protection is a concern because development could still happen on unprotected acres within the state, or could be shifted out-of-state. Connecting this policy with smart growth strategies is of upmost importance to avoid leakage issues; Existence of wetlands is dependent on climate and rainfall patterns. If these patterns shift, existing wetlands may disappear and new wetlands may form. The balance of this flux remains uncertain.” (CAC Report 2010, Chapter 9, page 23)
- “This policy option seeks to develop a renewed and improved stewardship ethic among decision makers that control rural forest lands and existing and potential urban planting spaces. Through a wide variety of incentives, education, and technical assistance and support, both proven and innovative practices could be applied to New York’s forests and urban areas to sequester additional carbon, save energy, and, at the same time, supply New Yorkers with additional and improved co-benefits supplied by improved forest management and green infrastructure related practices. Policy actions will be led by developing and implementing a system for identifying recently unmanaged or neglected and degraded forest lands that are not stocked with trees to full potential. A similar system will be developed for identifying vacant rural land that is unsuitable for agriculture but suitable for reforestation with native trees.” (CAC Report 2010, Chapter 9, page 24)

Other Resources

Related Topics in this Document: Carbon Sequestration in Forests/Agriculture, Other Tree Planting

Urban Trees

New York Actions

- “The same year that New York City launched its Million Trees NYC program, it planted its millionth new tree in 2015, two years ahead of schedule. 128 Two years later (in the wake of a heat wave), New York City committed an additional \$82 million to plant street trees, especially in areas facing the greatest heat risks.129” (Heat Waves, 2018, pg. 531)

Other Recommendations

- “We continue to urge that the City expand the Cool Neighborhoods NYC street tree commitment, and renew the successful Million Trees NYC program to increase urban canopy coverage and ensure the long-term maintenance and health of the city’s urban forests” (NYC EJA, 2020, pg. 60)
- “Support the planting, care, and maintenance of trees in your community.” (Just Nature NYC, 2020, pg. 3)
- “The City must reduce the amount of time it takes to plant trees. According to DPR, tree planting requests submitted to DPR currently may take over a year to fulfill.” (Securing Our Future, 2020, 61)
- “Sustainability measures could include planting trees as protective barriers on the borders of playgrounds and play areas that are adjacent to highly-trafficked roadways.” (Securing Our Future, 2020, 62)
- “The City Council will consider legislation requiring the City to conduct an assessment of dead ends, analyzing conditions and determining the feasibility of converting these areas into a bioswale or similar green space that would support the planting of trees and other vegetation. Identified areas would be transformed into green spaces, which would capture stormwater, improve air quality, and beautify neighborhoods.” (Securing Our Future, 2020,63)
- “Cities should plant large numbers of trees on public property, and maintain them well, ideally with community assistance. Cities should also require private developments to preserve as many trees as possible, and to have extensive landscaping and vegetation, both horizontal and vertical.” (Heat Waves, 2018, 544)

Discussion and Analysis

- “Trees not only have the ability to store and absorb carbon emissions that are driving the climate crisis, but also absorb harmful co-pollutants like particulate matter that affect respiratory health.118 Furthermore, trees provide cooling by mitigating the urban heat island effect through evapotranspiration and shading.119

Given the important role that trees can provide to reduce the impacts of environmental and climate risk faced by EJ communities, trees need to be a key strategy to combat climate change. While OneNYC 2050 highlights the crucial benefits of street trees and the broader urban forest, particularly for combating extreme heat, it does not commit to further investment in this critical project. We continue to urge that the City expand the Cool Neighborhoods NYC street tree commitment, and renew the successful MillionTreesNYC program to increase urban canopy coverage and ensure the long-term maintenance and health of the city’s urban forests” (NYC EJA, 2020, pg. 60)

- “The urban forest provides multiple benefits that include improving human health, environment, mitigating climate change impacts, and increasing community resilience,

particularly in communities that generally lack green and open space.² When trees are planted and maintained equitably, the urban forest can help address systemic inequalities and improve the quality of life for New York City’s most vulnerable residents, often part of environmental justice communities. As we face the increasingly challenging and dangerous reality of climate change locally, New York City must realize a creative, robust, and equitable vision for leveraging nature-based solutions.” (Just Nature NYC, 2020, pg. 1)

- “Trees, when properly selected and planted, provide numerous benefits to our city that can help reduce the impacts of environmental and climate risks in EJ communities.⁹

Trees can:

Reduce Climate Change Risks

- Provide urban green space cooling effect¹⁰ and reducing the urban heat island effect
- Provide shade
- Absorb and store carbon emissions that are driving the climate change crisis

Improve Air & Water Quality

- Absorb pollution blocking particulate matter (fine dust, ash, pollen, smoke) that impacts respiratory health
- Mitigate health issues including respiratory diseases (by lowering air pollution) and skin cancer (by providing shade from UV rays).
- Improve water quality by retaining stormwater during rainfalls to reduce discharges from flooded sewer pipes

Increase Energy Efficiency

- Reduce energy use needed to cool down surrounding buildings by offering shade and lowering overall temperatures in the summer ^{11, 12}
- Reduce emissions of pollutants from power plants due to lower energy use citywide

Provide Social Benefits

- Promote an active lifestyle and wellbeing¹³
- Improve mental health by providing visible vegetation¹⁴
- Make outdoor spaces for people to congregate in the neighborhoods more comfortable and increase opportunities to build social cohesion
- Create new jobs to build and maintain nature-based solutions

Biodiversity

- Increase the biodiversity of our city by creating space for other species, including many birds, pollinating insects like bees and butterflies, and various types of plants” (Just Nature NYC, 2020, pg. 3)
- “The health and quality of our urban forest must be maintained to maximize benefits to frontline communities. City, state, and federal agencies manage much of New York City’s urban forest which is on public land and often need more resources to do so. Also, many trees in NYC grow on private property where they are largely unprotected and inconsistently managed. This diffuse jurisdiction makes trees – critical public health infrastructure – more vulnerable to inconsistent care and protection. While community based organizations continue to advocate for more high-quality parks, new street trees, and jobs in their communities, New Yorkers should support them and also demand more

investment in street trees, parks, community gardens, and all forms of nature based solutions as well as better rules and incentives to ensure private property is green as well.

Here are some ways you can help to improve NYC's urban forest: Support your local grassroots organization's efforts to advocate for more open and green space... increase the budget for NYC Parks... make the planting, care and protection of trees a budget priority... support the planting, care, and maintenance of trees in your community." (Just Nature NYC, 2020, pg. 3)

- "The City must reduce the amount of time it takes to plant trees. According to DPR, tree planting requests submitted to DPR currently may take over a year to fulfill. To address this delay and achieve the goal of filling tree pits throughout the city, DPR should work to plant trees in the next planting season, so that no more than one planting season elapses before a request for a street tree is resolved... the City's tree canopy is not evenly distributed, with industrial and low-income areas often having the lowest percentages of tree canopy cover." (Securing Our Future, 2020, 61)
- "Sustainability measures could include planting trees as protective barriers on the borders of playgrounds and play areas that are adjacent to highly-trafficked roadways. Exposure to fine particulate matter air pollution has been linked to cognitive side effects and developmental delays in children, and the presence of trees has been linked to reductions in airborne levels of fine particulate matter. Furthermore, planting trees as protective barriers around playgrounds will furnish important shade and reduce noise, providing a calmer area for children and their families." (Securing Our Future, 2020, 62)
- "While urban density is environmentally positive in many ways—it helps make mass transit feasible, consumes less land, allows for more energy efficient buildings—the heat island effect is a negative. Cities have many microclimates; the temperature can change several degrees in just a few blocks, depending mostly on whether the neighborhood is entirely buildings and pavement, or whether it has ample trees and other vegetation.¹¹⁸ This is correlated with income—in many cities, more affluent districts have more greenery and are cooler. One study estimated that "mean surface temperature in census tracts decreased by 0.5°F for every \$10,000 increase in median income for a summer day in Phoenix . . . In other words, affluent people 'buy' more favorable microclimates."¹¹⁹ In contrast, poor neighborhoods—disproportionately minority—have higher temperatures and less air conditioning... The urban heat island effect has local origins, and it also has two local partial solutions: trees and roofs. With respect to trees, on hot days it may be up to 45°F cooler in the shade than in the open; and evapotranspiration from trees can reduce peak temperatures by 2–9°F. If half of New York City buildings installed green roofs, the entire city's surface temperature could go down by more than 1°F." (Heat Waves, 2018, pg. 530-1)
- "Several cities have programs to require or directly undertake tree planting. For instance, Seattle adopted minimum landscaping guidelines in 2007, which demands that certain new developments have 30% vegetative cover.¹²⁷ The same year that New York City launched its Million Trees NYC program, it planted its millionth new tree in 2015, two years ahead of schedule. ¹²⁸ Two years later (in the wake of a heat wave), New York City committed an additional \$82 million to plant street trees, especially in areas facing the greatest heat risks.¹²⁹ Phoenix imposes tree requirements for common areas around housing developments or commercial sites.¹³⁰ Many volunteer organizations run tree

planting campaigns. Moreover, planting the trees is only the start; they must be properly maintained. Insects and improper pruning are common threats.¹³¹” (Heat Waves, 2018, pg. 531)

Other Resources

Related Topics in this Document: Carbon Sequestration in Forests/Agriculture

Land Conservation

New York Actions

- “The NYS Division of Local Government Services has a set of policies already about the transfer of development rights for “flexible land use control”. (Transfer of Development Rights, 2015)
- “In addition to adhering to the Department of Agriculture and Markets' guidelines for solar energy projects and all applicable regulations as part of the State's new siting process, awarded projects that impact certain classes of prime agricultural soils may be responsible for making an agricultural mitigation payment to a designated fund, ensuring that New York can pursue its priority objectives to accelerate clean energy while protecting the state's valuable natural resources and working lands.” (Cuomo Solicitation)

LPDD Recommendations

- *Land conservation agencies should incorporate climate change mitigation into easement purposes, ensuring that easement conditions encourage climate-friendly practices and that farmers' efforts to mitigate climate change do not conflict with their easements.*
- *“Local governments could assist the use of conservation easements for afforestation through dedicated taxes and bond funds directed at acquisition of conservation easements.”*
- *“To maintain forest and agricultural lands, New York should promote the transfer of development rights where it serves land conservation purposes.”*

Related LPDD Database Pathways

- Protecting Forests through Conservation Easements: <https://lpdd.org/pathway/protecting-forests-through-conservation-easements/>
- Preservation of Forests and Carbon Sinks: <https://lpdd.org/pathway/preservation-of-forests-and-carbon-sinks/>
- Agricultural Land Conservation: <https://lpdd.org/pathway/agricultural-land-conservation/>

Other Recommendations

- “Natural and working lands can be better incorporated into California's climate change mitigation efforts by encouraging collaboration with local and regional organizations and increasing investment to protect, enhance, and innovate in our rural landscapes and

communities... California's forests should be healthy carbon sinks that minimize black carbon emissions where appropriate, supply new markets for woody waste and non-merchantable timber, and provide multiple ecosystem benefits. Rehabilitating and strengthening wetlands and tidal environments, and incorporating natural landscapes into urban environments will also help make natural and working lands part of the state's climate solution." (CA Scoping Plan, 2017, 17)

- "Land disturbance due to increased renewables through utility scale wind and solar and transmission can release GHGs from soil and disturb grasslands and rangelands that have the potential to sequester carbon." (CA Scoping Plan, 2017, 35)
- "Increase New York State agricultural land, as defined by the National Agricultural Statistics Service, 25 percent by 2050 without converting mature forest." (CAC Report 2010, Chapter 9, page 22)
- "Restore 475,000 acres of agricultural land (25 percent of the acreage lost since 1984) by 2020 and restore a total of 950,000 acres of agricultural by 2030." (CAC Report 2010, Chapter 9, page 22)
- "Permanently protect, through the State's Farmland Protection Program, 200,000 acres by 2020 and 400,000 additional acres by 2030 of agricultural land with the highest risk of conversion to higher-carbon intensive uses." (CAC Report 2010, Chapter 9, page 22)
- "Maintain or increase forestland acreage, without converting agricultural land to forest, unless the agricultural land would have higher carbon sequestration potential." (CAC Report 2010, Chapter 9, page 22)
- "Extend protections to an additional 700,000 acres of forestland under threat of conversion by 2030 through a number of tools, including private land stewardship programs, working forest conservation easements, and tax incentives. Work to maintain or increase the parcel size of private forestland." (CAC Report 2010, Chapter 9, page 22)
- "Protect and restore freshwater and tidal wetlands through acquisition of fee or easement and regulation to prevent releases of GHGs which will allow existing freshwater and tidal wetlands to continue to sequester carbon and mitigate the effects of more intense storm events caused by climate change." (CAC Report 2010, Chapter 9, page 22)

Discussion and Analysis

- "Environmental and other off-farm benefits of soil health are becoming more widely recognized.²⁰ Some of these are summarized in Table 2. One important example is the intersection of soil health with water quality. Implementation of good soil health practices on working lands will minimize sedimentation and nutrient and chemical losses into our lakes, streams, and groundwater. This is closely linked with maintaining a supply of safe drinking water and current concerns about Harmful Algal Blooms (HABs) in New York lakes." (NYSH, 2019, 15)
- "Lack of open space, waterfront access, stormwater management, and the destruction of wetlands are significant environmental justice concerns for many overburdened and low-income communities. Many of the specific proposed actions in this policy area could help to address one or more of these concerns in such communities." (CAC Report 2010, Chapter 9, page 23)

- “Co-benefits include water quality protection, flood mitigation through riparian buffers, wetlands and stormwater retention, clean air and reduced pollutants, improved quality of life, wildlife habitat protection and connectivity for migration and adaptation, and avoided additional costs of sprawling development.” (CAC Report 2010, Chapter 9, page 23)
- “Concerns: Price of fee and easements can vary greatly with location of the parcel and the terms of an easement; Viability of farm operations is vitally linked to the health of available markets for farm products; Ability of agricultural land and forestland to produce current crop species is climate dependant. Shifts in climate may alter the species that can be grown. The flux of sequestered carbon in a shift of plant species is an uncertainty; Leakage in the case of forest land protection is a concern because development could still happen on unprotected acres within the state, or could be shifted out-of-state. Connecting this policy with smart growth strategies is of utmost importance to avoid leakage issues; Existence of wetlands is dependent on climate and rainfall patterns. If these patterns shift, existing wetlands may disappear and new wetlands may form. The balance of this flux remains uncertain.” (CAC Report 2010, Chapter 9, page 23)

Other Resources

Related Topics in this Document: Nutrient Management, Facility Siting, Carbon Sequestration in Forests/Agriculture

Waste, Landfills, and Recycling

Landfill Methane Capture

New York Actions

- “Reducing Emissions From Landfills: proposed Part 360 revisions – The proposed Part 360 revisions would require horizontal gas collection systems to be installed in new landfills and subsequent developments of existing landfills. These revisions would help increase gas collection efficiencies at landfills, including those smaller facilities that are not currently required to capture gas and require additional monitoring to protect human health and the environment. DEC will finalize these regulations after assessment of public comments.” (Methane Reduction Plan, 2017, 9-10)
- Active and Closed Landfills 10 – The majority of municipal waste currently being disposed in New York is disposed at landfills that capture gas for energy generation. However, the total emissions from all waste are unknown and gas capture systems do not capture 100% of emissions. Additionally, not all inactive or closed landfills are capturing or destroying their methane emissions. DEC will pursue actions, including potential outreach and educational efforts, which will suggest best management practices for enhancing methane capture at landfills that are required to and/or voluntarily collect

landfill gas to ensure that the maximum feasible amount of landfill-generated methane is captured and destroyed.” (Methane Reduction Plan, 2017, 9-10)

- DEC Policy DMM-SW-04-16 Landfill Gas Collection and Treatment Systems - “Municipal owners or operators of landfills who have incurred costs associated with the design and construction of active landfill gas collection and treatment systems will be eligible to recover up to 50 percent of the associated costs, up to a maximum of two million dollars. Eligible costs would include the cost of designing and constructing the gas collection and conveyance systems, including blowers and other associated devices necessary to ready the gas for further use or treatment. In addition, the costs associated with purchasing and installing stationary flares, internal combustion engines or turbines used to treat (burn) the landfill gas would also be eligible.” (DEC Policy DMM-SW-04-16 2004)
- DEC - Adopted Part 208, Landfill Gas Collection and Control Systems for Certain Municipal Solid Waste Landfills - “The new federal EG is designed to reduce emissions of landfill gas containing non-methane organic compounds and methane by lowering the emission threshold at which a landfill must install and operate a landfill gas collection and control system. The Department is required to revise its State Plan to reflect the new EG and submit the State Plan to EPA for review and approval.” (DEC Adopted Part 208 2019)

LPDD Recommendation

- *“States and the federal government should adopt programs to fund gas management systems at both municipal and private landfills, and prioritize awards to landfills investing in landfill gas-to-energy systems.”*
- *“State environmental agencies should adopt regulations addressing methane emissions from municipal solid waste landfills.”*

Related LPDD Database Pathways

- Methane in Waste Management: <https://lpdd.org/pathway/methane-in-waste-management/>

Other Recommendations

- “LANDFILL GAS is generated from residential, industrial, and commercial organic waste—like leftover food, yard clippings, or paper—breaking down in landfills. Recommendation for Bio Gas: “Support in the near term only, given the organics already in existing landfills. Landfill gas is not a renewable resource. This is a viable source of biogas in the near term, but going forward organic materials should be diverted from landfills to make best use of these materials. When biogas is processed so that it can be injected into a pipeline, leakage occurs in processing and transportation. These accidental methane emissions must be monitored and controlled.” (“Renewable” Gas – A Pipe Dream or Climate Solution?, 2020, 3)
- “Under RCRA, all states are required to have regulatory agencies to oversee MSW landfills and ensure those landfills are in compliance with EPA regulations.⁹ Within this framework, some states have chosen to create more stringent LFG regulations than are required by federal law. Notably, California regulates emissions from MSW landfills

under the state's Global Warming Solutions Act, more commonly known as Assembly Bill (AB) 32.10 Regulations on LFG came into effect in June 2010 and apply to MSW landfills with at least 450,000 tons of waste and an LFG heat input capacity of greater than 3 million British thermal units/hour (MMBtu/hr). Landfills affected by the regulations must collect LFG emissions – they have the option to flare the LFG, to use the LFG to produce electricity, or to route the gas to a treatment facility for sale.¹¹” (EESI, 2013, 2)

- “The cost of an LFG project depends on a number of factors, including the size, location, and layout of the landfill. Major capital outlays include designs, permits, and installation; major operation and maintenance costs include parts and materials, financing, and administration. Typically, one million tons of landfill waste emit approximately 432,000 cubic feet of LFG per day, enough to produce either 0.78 MW of electricity or 216 MMBtu of heat.¹⁹ Approximately 70 percent of LFG projects generate electricity, primarily via internal combustion engines, gas turbines, and microturbines.²⁰ Costs vary, but internal combustion engines (ICEs) smaller than 1 MW typically cost \$2,300/kW to install, with annual operation and maintenance costs of \$210/kW, and ICEs larger than 800 kW typically cost \$1,700/kW, with annual operation and maintenance costs of \$180/kW. Revenue depends on electricity buy-back rates that are specific to local electric utilities, but typically range between 2.5 and 7 cents/kWh. The vast majority of the remaining 30 percent of LFG projects involve direct use of the gas. Equipment for compression and treatment of the gas to remove non-methane trace compounds typically costs \$960 per standard cubic feet per minute (scfm) of capacity to install. Annual operation and maintenance costs are an additional \$90 per scfm of capacity. The major cost in direct use projects is the pipeline, which costs an average of \$330,000 per mile to install, although maintenance costs are negligible. Revenue from direct use projects varies depending on location and agreements with the end-user, but typically range between \$4.00 to \$8.00 per MMBtu (\$0.38 to \$0.75 per megajoule). ²¹ A small fraction of LFG energy projects produce pipeline quality gas. The majority of this high quality gas is used as an alternative vehicle fuel. One popular cost-effective option is to use the gas on-site to fuel vehicles that service the landfill. ²²” (EESI, 2013, 3)
- “The return on investment for LFG projects depends on whether the landfill already has an LFG capture system installed under EPA or state regulations. For energy projects with capture systems in place, the outlay costs are relatively small. The EPA estimates that a privately owned and operated project with a 3 MW turbine would cost approximately \$5.7 million to install and maintain, and would provide a net return of approximately \$590,000 over a 15-year lifetime.²³ A direct-use project would have a significantly lower cost (\$2.9 million) and a higher internal rate of return than the electricity project (57 percent compared to 14 percent), but direct-use projects remain less common because they require nearby facilities that can make use of the LFG.” (EESI, 2013, 3)
- “Projects that do not already have capture systems installed cost significantly more to build. The EPA estimates that a privately owned and operated project with a 3 MW turbine and no previously installed capture system would cost approximately \$8.5 million to install and maintain, and would lose approximately \$3.5 million over a 15 year lifetime. ²⁴ A direct-use project would have a significantly lower cost (\$5.0 million) and would consequently have a positive net value for the project (\$480,000). Although

electricity projects in landfills with no previously installed capture systems could be a net-loss in this scenario, these calculations do not account for tax credits and exemptions, carbon credits through a state or regional carbon exchange or cap-and-trade program, or the option to use the electricity on-site. With these additional revenue streams, projects with new capture systems can be profitable.” (EESI, 2013, 3-4)

- “Variations in the price at which the electricity or gas is sold should be accounted for in calculating the revenue from a project. In all 29 states that have Renewable Portfolio Standards, LFG is included as a renewable energy source; LFG can, therefore, often be sold for a higher price than other energy.²⁵ Additionally, many projects produce electricity for use on-site. For those projects, the calculated rate should be based on the typically higher price at which the landfill buys its electricity. Landfill gas projects also bring jobs to local communities. A typical 3 MW electricity project is estimated to directly create five construction jobs and indirectly create another 20 to 26 jobs through economic development. For a direct use project, a five mile pipeline would directly create at least seven jobs to complete the installation and would indirectly create another 17 to 22 jobs.²⁶” (EESI, 2013, 4)

Other Resources

Related Topics in this Document: Methane digesters, Solid waste management
[Landfill Gas Utilization Alternatives Study](#)

Methane Digesters

LPDD Recommendations

- “States could establish their own funding programs for anaerobic digester projects.”
- “State legislatures could make additional funds available to support the deployment of anaerobic digesters and other projects to reduce agricultural methane emissions.”
- “Each state could enact legislation requiring utilities to enter into long-term contracts with agricultural producers for the purchase of biogas and/or biogas-generated electricity, and provide funding to offset the cost of interconnecting with utility infrastructure.”

Related LPDD Database Pathways

- Financial Incentives for Renewable Gas Production: <https://lpdd.org/pathway/financial-incentives-for-renewable-gas-production/>
- Controlling Methane from Manure: <https://lpdd.org/pathway/controlling-methane-from-manure/>

Other Recommendations

- “Improve management of concentrated liquid manure. Liquid manure is typically stored in lagoons and then spread or sprayed on fields. Measures can be taken to reduce emissions from both stages. Anaerobic digesters work by converting volatile solids in organic matter to biogas and capturing it. The biogas, which is predominantly methane and carbon dioxide, releases carbon dioxide when burned for energy. Anaerobic

digesters also produce a solid residue, digestate, which can be composted and used as bedding or applied to fields as a fertilizer, thereby lowering net emissions by offsetting synthetic fertilizers and increasing carbon sequestration. Anaerobic digesters are relatively rare in the United States due to their high costs and the lax regulation of alternative management methods: for every digester in operation, there are about 100 CAFOs producing undigested waste.¹⁵⁸ Of the approximately 250 anaerobic digesters operating in the United States, almost 200 rely on dairy operations. Improvements can also be made regarding the spreading of the liquid manure. The Clean Water Act (CWA)¹⁶⁰ requires that the manure be spread at “agronomic rates”— that is, in quantities that the plants need and can use.¹⁶¹ That provision is often ignored, however, with the result that manure can pollute nearby waters and release greenhouse gases. There is some evidence that specific practices relating to manure spreading can also affect emissions and soil carbon sequestration levels. Spreading on frozen or saturated soils, for example, tends to lead to water pollution and higher nitrous oxide emissions since the manure is more likely to enter waterways instead of being incorporated into the soil.” (Carbon-Neutral Agriculture, 2017, 12)

Discussion and Analysis

- “Anaerobic digestion (AD) is a method of processing of organic materials in the absence of oxygen in an enclosed space to generate methane biogas and solid organic byproducts. The biogas can be used for heating or electricity, or converted into a type of renewable fuel. While not yet fully operational in New York City, converting food waste to energy through AD is commonplace in Europe, as well as a few cities in the United States. Better utilizing AD can help the City to avoid the direct release of methane – a potent greenhouse gas – into the atmosphere, and to decrease reliance on fracked gas and polluting fossil fuels. Another end-product is a biosolid that can be used to create compost, though the feedstocks or inputs for AD determine the quality and safety of the biosolid end-product. There are over a dozen water pollution control plants (WPCPs) in the city, but the Newtown Creek WPCPs in North Brooklyn hosts one with an active AD plant.³⁶ It has the capacity to treat 330 million gallons of wastewater each day and accepts wastewater from over one million residents. This facility combines wastewater sludge, and a bioslurry created from food scraps by a waste management company off-site, and then digests them to produce the biogas.” (NYC EJA, 2020, 27)
- “Some additional factors stakeholders must consider include properly managing the feedstocks, permitting and coordination between agencies and businesses, and purifying the biogas to remove carbon dioxide and other unwanted compounds. Furthermore, the biosolid produced is typically of lower nutritional quality than some other composts, and the presence of pharmaceuticals and other toxins in wastewater raises concerns about whether these biosolids are safe to use to grow food.” (NYC EJA, 2020, 28)

Other Resources

Related Topics in this Document: Landfill Methane Capture, Solid Waste Management

Recycling

New York Actions

- “Con Ed’s Bulk Recycling Program offers cash back and carting for bulk recycling (minimum 40 units) of refrigerators and room air conditioners. Cash back ranging from \$25-\$60 based on equipment.” (Retrofit Accelerator, 2020)
- “Financial Information Services Agency – Office Of Payroll Administration - Having implemented a recycling and e-waste program, FISA-OPA is also reducing the amount of print material it uses by encouraging City employees and vendors doing business with the City to sign up for electronic banking and digital reports.” (NYC 1.5C, 2017, Agency Highlights, 36)
- “Through its Material for the Arts (MFTA) division, Department Of Cultural Affairs (DCLA) is working with businesses and individuals to redistribute a wide variety of reusable materials to nonprofit organizations, city agencies, and public schools to divert these supplies from landfills and to direct them to those who can use them. In 2016, MFTA diverted over 1.9 million pounds of high-quality reusable goods, reducing the GHG impact associated with creating new supplies, and supporting local arts and cultural community throughout the city.” (NYC 1.5C, 2017, Agency Highlights, 38)
- “MOER is expanding its novel materials exchange program to promote local reuse of surplus material resources generated during construction. This will serve a dual purpose of reducing GHG emissions from truck transportation and provide building materials to construct flood-control structures that improve our resilience to sea level rise. MOER’s NYC Clean Soil Bank has exchanged nearly 400,000 tons of clean soil over four years – most of which has been reused to raise the elevation of flood prone land and build wetlands and berms to improve resiliency. MOER is committing to achieve more equitable distribution of environmental and social benefits of clean soil exchange and will introduce the Progressive Urban Resource Exchange program (PURE Soil) to promote clean soil distribution in low-income communities. MOER will also launch the PURE Soil Dashboard, a web-based application developed in collaboration with 100 Resilient Cities (100RC) and AMEC, to document the use of clean soil in NYC communities. MOER is expanding the use of soil and other materials exchanges by agencies. In doing so it will work with city agencies to standardize specifications for materials usage, educate agency engineers on benefits of materials exchange, and modifying contracts to facilitate use of locally sourced material.” (NYC 1.5C, 2017, Agency Highlights, 38)

LPDD Recommendations

- “States could adopt laws with more ambitious goals (e.g., zero waste), intermediate targets, and timetables for achieving these more ambitious goals, and means of achieving them.”
- “States could promulgate regulations for plastic recycling facilities to address the potential leakage of nanomaterials, sealants, dyes, and other substances.”
- “States should consider design requirements on electronic products that facilitate repurposing and recycling.”

- “States should adopt laws that other states have adopted on the waste problems posed by products, packaging, food scraps, and industrial waste.”
- “States could extend existing laws on materials, products, and waste to a broader range of materials, products, and waste categories, including construction and demolition debris.”

Related LPDD Database Pathways

- Recycling and Extended Producers Liability Laws: <https://lpdd.org/pathway/recycling-and-extended-producers-liability-laws/>
- Right to Repair: <https://lpdd.org/pathway/right-to-repair/>
- Local Product Bans, Fees, and Recycling Requirements: <https://lpdd.org/pathway/local-product-bans-fees-and-recycling-requirements/>

Other Recommendations

- “Enhance curbside collection in NYC by implementing a zone-based system for commercial waste, offering single-stream recycling, and developing a blueprint for a Save-as-You-Throw program” (NYC 1.5C, 2017, 2020 Climate Actions, 20)
- “The actions include updating, strengthening, and expanding the state’s regulatory and statutory authority; dedicating resources to build the infrastructure for reuse, recycling (including organics recycling), and composting; expanding existing, and launching new programs at the state and local levels; and coordinating cooperation from all levels of government, the private sector, and individual New Yorkers.” (CAC Report 2010, 9, 16)

Discussion and Analysis

- California Circular Economy and Pollution Reduction Act / SB-54 Solid waste: packaging and products - “The bill would require the department, before January 1, 2024, to adopt regulations that require producers, as defined, (1) to source reduce, to the maximum extent feasible, single-use packaging and priority single-use products, and (2) to ensure that all single-use packaging and priority single-use products that are manufactured on or after January 1, 2030, and that are offered for sale, sold, distributed, or imported in or into California are recyclable or compostable. The bill would require the regulations to achieve and maintain, by January 1, 2030, a statewide 75% reduction of the waste generated from single-use packaging and priority single-use products offered for sale, sold, distributed, or imported in or into the state through source reduction, recycling, or composting. The bill would authorize the department to determine which actions producers may undertake to achieve those requirements. The bill would require the department, by January 1, 2023, and before adopting the regulations, to finalize an implementation plan, as specified. The bill would require the department to establish a Circular Economy and Waste Pollution Reduction Panel for the purpose of identifying barriers and solutions to creating a circular economy consistent with the act.” (CA SB-54 2018)
- “Most of the GHG emissions that can be reduced through aggressive waste prevention and recycling are achieved through the life cycle of products and packaging; i.e., when a recycled material is substituted for a virgin material, or when a material is not manufactured at all, thereby avoiding the mining, extraction, and much of the

production impact. While many of the reductions related to organics recycling and composting would occur in-state, the export of the waste generated by half the state's population (in New York City, and Nassau and Suffolk counties) further complicates the analysis of reductions within the state's boundaries." (CAC Report 2010, 9, 17)

- "This policy has several additional benefits. This policy could result in substantial opportunities for the creation and expansion of businesses in New York State. DEC estimates that this policy could create more than 70,000 jobs. The jobs and businesses would generate much needed tax revenue for the state. In addition, reducing the amount of waste going to disposal reduces the environmental and public health impacts of waste handling, transfer, transport, and disposal. While such a reduction benefits all New York State communities, it is of particular relevance to environmental justice communities, which often bear a disproportionate burden with respect to the solid waste management facilities and infrastructure." (CAC Report 2010, 9, 17)

Other Resources

Related Topics in this Document: Solid Waste Management

[New York City Design Guidelines](#)

Food Waste

New York Actions

- "The Food Recovery and Recycling Act will make it easier for businesses to reduce food waste, in part because it will encourage development of food donation and recycling infrastructure. It will take time for recycling and food donation infrastructure in New York to expand to meet the needs of the food waste disposal ban, but the ban creates a supply of potential customers that will encourage expansion of existing infrastructure. In recognition of this issue, the New York State Department of Environmental Conservation will evaluate the available recycling infrastructure and notify affected businesses if they are required to comply with the food waste recycling requirement. A similar evaluation was performed by the City of New York Department of Sanitation when the city implemented its organics recycling law. New York's City's evaluation of available recycling infrastructure has been challenged by affected businesses, which suggests that the Food Recovery and Recycling Act may face similar challenges. Regardless, New York State's recycling infrastructure will expand, thereby reducing costs and creating more tailored options and solutions for reducing food waste." (NY Food Waste, 2019)
- "In 2019, NYS passed the Food Donation and Food Scraps Recycling law. Effective January 1, 2022, large generators of food scraps (defined as generating an annual average of two tons per week or more) must donate excess edible food and recycle all remaining food scraps if they are within 25 miles of an organics recycler (composting facility, anaerobic digester, etc.)." (LPDD 2019, <https://lpdd.org/resources/ny-food-donation-and-food-scraps-recycling-law/>)
- "New York City's Local Law 146, the Commercial Organic Waste Law, requires covered food waste generators to source-separate their organic material and either arrange for

the transportation of this material to a processing facility or process the food waste on-site. The law defines a list of categories of “covered establishments” including:

- food manufacturers with a floor area of at least 25,000 square feet;
 - food wholesalers with a floor area of at least 20,000 square feet;
 - retail food stores with a floor area of at least 10,000 square feet, or chains of three or more stores with a combined area of at least 10,000 square feet;
 - food service vendors in arenas or stadiums with seating capacity of at least 15,000 people;
 - food service establishments with a floor area of at least 7000 square feet, or chains of two or more establishments with a combined area of at least 8000 square feet;
 - food preparation establishments with a floor area of at least 6000 feet;
 - catering establishments for events greater than 100 people;
 - food service establishments in hotels with 100 or more rooms;
 - and sponsors of public events.
- The law requires the New York City Department of Sanitation (DSNY) commissioner to conduct annual assessments of organics processing capacity in the region, and to designate a subset of the “covered establishments” outlined above that must comply with the requirements of the ordinance, based on the amount of available capacity. DSNY made designations in 2016, and expanded them in 2018.” (LPDD 2018 <https://lpdd.org/resources/nycs-commercial-organic-waste-law/>)
 - “DEPARTMENT OF SANITATION - DSNY is pursuing policies to address each component of the City’s waste stream. The dramatically expanded organics program is now the largest in the nation, serving more than 2.5 million residents citywide. Through a combination of curbside collection and convenient dropoff sites, the organics program is expected to serve all New Yorkers by the end of 2018.” (NYC 1.5C, 2017, Agency Highlights, 33)
 - “When New Yorkers’ waste goes to landfills, it decomposes and sends methane, carbon dioxide, and toxins into the atmosphere. Diverting organic waste from landfills reduces GHG emissions. The City will implement citywide organic waste collection. This includes expanding the curbside organic waste collection program to all New Yorkers, increasing the number of drop off sites, helping to expand community composting sites, working with landlords to enable all residents to separate their food waste, and expanding the number of businesses required to separate organics. Benefits include improving the health and wellbeing of New Yorkers by reducing the number of rats and vermin with hard-sided, latched bins for storing organics.” (NYC 1.5C, 2017, Key Actions to Reduce Consumption and Increase Efficiency, 11)
 - “In support of the City’s goal to send zero waste to landfill by 2030, Food Policy is diverting organic waste from landfill through its work with agencies, rescue organizations, food businesses, and residents.” (NYC 1.5C, 2017, Agency Highlights, 38)

LPDD Recommendations

- *"States should adopt laws that other states have adopted on the waste problems posed by products, packaging, food scraps, and industrial waste."*

- *"States should adopt legislation banning food waste in landfills, using Vermont's Universal Recycling Law as a model."*

Related LPDD Database Pathways

- Food Waste: <https://lpdd.org/pathway/food-waste/>

Other Recommendations

- "Among many urgently needed initiatives – including divesting from single-use materials, excess packaging, and non-recyclable goods, and better food distribution and diversion from landfills and incinerators – the City should make the necessary investments to mandate residential organics as promised years ago, not just voluntary programs in a few privileged neighborhoods. This needs to finally include organized programs in NYCHA housing developments. Their educational model has been used by GrowNYC to educate residents about what goes into which recycling bins. However, today residents are still not adequately compensated for recycling projects in NYCHA developments, and are therefore unable to maintain the programs consistently for several years. Additionally, recycling bins tend to be out of the way and inaccessible. According to participants in the program spearheaded by the Sanitation Coalition, this resident-driven, door-to-door approach was particularly impactful because residents were educated by neighbors instead of by strangers, and demonstrations included strict protocols for recycling education in an approachable and respectful way. We recommend this method for future NYCHA efforts to increase recycling, as well as adequate payment for the work of the residents and others. The City should consider employing members of the existing NYCHA Green City Force Corps, which could be expanded to employ young people to take on the tasks of educating about recycling, and enacting duties of the program" (NYC EJA, 2020, 26)
- "We are troubled that the City of New York has proposed to halt organics collection for fiscal year 2021 as part of Mayor de Blasio's austerity budget. Our City should focus on stated commitments to organic waste processing and use food waste for generating compost or as a feedstock in anaerobic digestion to generate methane biogas. By converting just 5% of the land area of NYC to organics processing facilities, we could process all of the city's food waste." (NYC EJA, 2020, 24)
- "It is highly unlikely that there will ever be enough on-site processing capacity, either with local composting or micro-anaerobic digestion, to handle the City's overall organics volumes. Nonetheless, since such facilities are inherently small-scale and adapted to local conditions, they are eminently suited to pilot demonstrations in various types of locations. The City should encourage such installations with financial support, expedited permitting, and access to City-owned sites." (B. Miller, 2019, 29)
- "New, relatively large-scale facilities will need to be developed. It is most likely that these will be anaerobic digesters. The development of such facilities will require that the City be willing to provide the long-term supply commitments that their financing will require—or that such supply commitments be provided by private carters who have been awarded franchise rights of sufficient duration and scale. The City could also encourage their development by providing access to appropriate City-owned sites or by expediting the permitting and review processes that would be required for such facilities on a

private site. It is possible that a marine transfer site could be used for anaerobic digestion rather than simply as a pre-processing site, or that an anaerobic digester could be installed in conjunction with the management of other waste fractions at another first-dump site the City may develop.” (B. Miller, 2019, 29)

- “Accelerate the diversion of organics from landfills by launching a food waste reduction education program, expanding the organics program to serve all New Yorkers, and enabling the separation of all food waste” (NYC 1.5C, 2017, 2020 Climate Actions, 20)

Discussion and Analysis

- “Organics are the waste component for which on-site processing and on-site use of recovered products are most likely to be practicable in a given situation. While it is possible that an on-site solution would not achieve the most favorable overall cost-benefits in a given situation (due to economies of scale, to GHG emission rates relative to those from other technologies, to energy-conversion efficiencies, or to other case-specific factors), there are clear advantages to eliminating the need for collection and off-site transport of waste and the delivery of inbound energy and fertilizer products. On-site composting in backyards and residential complexes, and drop-off composting programs in parks and schools, are already being used to divert waste from landfills and to provide soil amendments for local use without generating truck trips. But it is also possible to recover energy as well as fertilizer ingredients on-site through anaerobic digestion. As the City’s Roadmap points out, small-scale technology for managing relatively uncontaminated food-waste streams, which is suitable for urban applications, is now becoming available. One such facility is being developed in a large building in downtown Manhattan, and, working with the New York City Economic Development Corporation, another digester of this type to serve high-volume food-waste generators in the vicinity of the High Line corridor is being proposed. By 2050, modular digesters could be expected to play a useful role in many large-scale developments or adjacent to relatively dense agglomerations of food-waste generators across the city.” (B. Miller, 2019, 25)
- “New York State alone spends \$36 million per year solely to transport and dispose of excess food. But there’s good news: a new law banning landfilling of food waste in New York State is estimated to provide a net economic benefit of nearly \$22 million per year, along with recovery of 52 million new meals a year with a 10 percent increase in food donation to 2.8 million food insecure New Yorkers. State-level initiatives are essential to reducing waste faster and more efficiently, but they are still in their infancy. New York became only the sixth state in the country to enact a statewide food waste disposal ban when Gov. Andrew Cuomo recently signed the Food Recovery and Recycling Act. Massachusetts, with a population less than half that of New York, already generated \$175 million in economic activity within the first two years of implementing a similar bill in 2014. As the third largest state economy, any law that impacts New York business will have a reverberating national economic impact. Therefore, this law has the potential to help both local and national business capture \$2 billion in increased profits from waste prevention and reduction efforts. This financial benefit is in addition to the tax incentives from the donation of unsold foods, cheaper food and hauling costs and job creation as recycling infrastructure is developed.” (NY Food Waste, 2019)

- “Many jurisdictions have demonstrated that organics can be diverted from landfills in a cost-effective and environmentally beneficial way. European Union countries were required to reduce biodegradable waste to 35% of 1995 levels by 2016, and several countries have gone beyond this requirement. Similarly, several states and municipalities have also taken action to divert organic waste from landfills. In 2012, Vermont passed the Universal Recycling Law, which enacted a complete ban on food waste in landfills. Shifting waste to composting facilities converts the waste into useful material and results in negative net emissions. San Francisco passed an ordinance in 2009 requiring all businesses and households to sort organics for collection and composting. San Francisco now collects more than 220,000 tons of organic waste each year, and is considered the country’s most successful composting program. 378 These programs provide a model for Congress, states, and localities to follow when designing legislation banning food waste in landfills.” (Carbon-Neutral Agriculture, 2017, 30)
- “A 2013 study estimated that 67% of the calories and 80% of the protein in crops produced in the United States are diverted to animal feed. 101 This represents an inherently inefficient use of potential food. For example, it typically takes six pounds of grain to increase the live weight of a beef cow by one pound,102 and only 30-40% of the animal’s live weight is consumable as beef. 103 This means that 15-20 pounds of grain are required to produce one pound of beef. 104 In the United States, approximately 70 million acres of cropland are used to produce corn and soybean for animal feed. 105 The same calories and protein currently provided by animal products could be produced with a much smaller land footprint if crops were consumed directly rather than fed to animals.” (Carbon-Neutral Agriculture, 2017, 9)

Other Resources

Related Topics in this Document: Solid Waste Management, Local Food Production, Encouraging Plant-Rich Diets

Solid Waste Management

New York Actions

- “The City is already committed to developing exclusive franchise zones for collecting commercial waste. These zones should have a significant effect on reducing the number of miles traveled by waste collection vehicles, which (for a number of reasons) are the most energy-intensive, GHG-emitting type of truck on our streets. With optimal design, the beneficial impacts of zoned collection would be greater than the effects of merely requiring that only one hauler serve a designated area using collection equipment that meets specified energy and emissions criteria.” (B. Miller, 2019, 26)
- “The City has already taken initial steps toward developing a Save-As-You-Throw (SAYT) system, which global experience suggests is the most significant single initiative it could take to reduce volumes destined for landfills. Instead of simply sticking tags on garbage bags (or implementing some functionally equivalent system), the City’s SAYT program should be designed to effect operational changes that would send an economic signal to the generator while also accomplishing the other objectives discussed above. One way to

do this would be to accompany the introduction of SAYT with a shift to containers. This would not only facilitate the identification-and-measurement tasks required by SAYT but also achieve GHG savings through some of the other means mentioned above. Using a SAYT system that relies on bags or tags—objects that are disposed of with each collection and must therefore be continuously produced and distributed and sold and monitored—is more logistically cumbersome than a system that relies on relatively fixed parameters such as the assignment of a specified number of containers of specified size to particular generators. And variable container use (numbers of set-outs by container size, weight within containers) can be more readily measured by automated systems such as RFID (radio frequency identification) readers and automated scales. RFID and other digital tracking devices could also be used to associate material volumes deposited into shared-collection equipment with specific generators.” (B. Miller, 2019, 26)

LPDD Recommendations

- *“In developing carbon markets, subnational governments could account for GHG emissions reductions achieved through materials and solid waste management.”*
- *“States could adopt laws with more ambitious goals (e.g., zero waste), intermediate targets, and timetables for achieving these more ambitious goals, and means of achieving them.”*
- *“States could extend existing laws on materials, products, and waste to a broader range of materials, products, and waste categories, including construction and demolition debris.”*
- *“States should adopt laws that other states have adopted on the waste problems posed by products, packaging, food scraps, and industrial waste.”*
- *“States should consider adopting best practice regulations for management of nanomaterials in the waste stream.”*
- *“States should adopt legislation banning food waste in landfills, using Vermont’s Universal Recycling Law as a model.”*
- *“State environmental agencies should adopt regulations addressing methane emissions from municipal solid waste landfills.”*

Related LPDD Database Pathways

- Food Waste: <https://lpdd.org/pathway/food-waste/>
- Methane from Waste Management: <https://lpdd.org/pathway/methane-in-waste-management/>
- Circular Economy Policies: <https://lpdd.org/pathway/circular-economy-policies/>

Other Recommendations

- *“Organic Components Of Municipal Solid Waste like leftover food, used paper, and yard waste are generated daily in homes, businesses, and other institutions and can be a source for anaerobic digestion. Recommendation for BioGas: “Limited support. Much of this resource should be diverted from waste streams through food waste prevention, surplus food rescue, composting, and recycling. Anaerobic digestion of food scraps should be done only using source-separated organics, and the leftover organic material*

from anaerobic digestion should be treated and applied to soil.” (“Renewable” Gas – A Pipe Dream or Climate Solution?, 2020, 3)

- “Environmental advocates, labor groups, and community-based organizations who have been involved with the Transform Don’t Trash NYC coalition will continue to advocate to ensure that the final plan and legislation take advantage of the opportunity to holistically reform the industry from top to bottom, mandating that any and every carter who secures a contract from the City to operate as one of only a few haulers within a geographic zone complies with all applicable regulations, invests in green technology, pays and treats workers fairly, has clean-burning truck fleets, meets diversion goals, employs GPS technology for smarter and more efficient routes, and only disposes of material at responsible, better-sited, and sustainable facilities.” (Iachan, 2019, 28)
- “Ideally—especially in the case of the roll-on/roll-off containers that are picked up and transported to dump sites one at a time and then carried back empty to the generator site—a pooling system would be used so that there would no longer be any need for two round trips for each pickup. Instead, the truck would always arrive at a pickup site with an empty container with which to replace the full container it was picking up. The containers would be owned and leased by a central entity—just as many U.S. rail cars are now owned by the railroads’ shared entity, TTX, or most trailer chassis that service the nation’s ports are centrally owned. While such an arrangement would require more space for maneuvering and would increase handling time at the pickup/drop-off site, it would cut truck miles and GHG emissions nearly in half.” (B. Miller, 2019, 25)
- “Existing buildings with adequate loading dock space could be offered tax or other incentives to share access to their compacting containers with adjacent buildings—as four of the high-rises in Battery Park City do for the 13 other buildings in that complex (thanks to the requirements of their property leases with the Battery Park City Authority). New buildings could be incentivized with floor-area-ratio credits or simply required to create such shared waste logistics access. In the case of neighboring buildings where none of them has either an available loading dock or exterior space in a courtyard or elsewhere, the shared container could be placed somewhere in the public realm (street, sidewalk, or other public space) where it would not interfere with emergency vehicles or otherwise conflict with necessary or desirable street uses. The widespread use of former parking spaces and other repurposed public space for Citi Bike stanchions demonstrates the feasibility of such arrangements. This type of shared collection could be used for all three separate fractions that New York City’s current waste management plans envision. The building staff in large multi-family buildings who currently manage waste set out by piling bags at the curb could instead roll the bags to the neighborhood compactors in large, tippable carts.” (B. Miller, 2019, 24)
- “Imaginatively designed uses of the public realm for fixed waste management equipment could significantly enhance the city’s public spaces. These new streetscape uses could be
- integrated with other design changes to meet other needs, such as providing public social space, street trees and plantings that promote cooling and water-runoff, and kiosks offering information, entertainment, wireless access, and lighting.” (B. Miller, 2019, 24)
- “One way that aggregated automated collection equipment might be integrated into the design of the streetscape is by submerging the container. Where underground conditions make their installation practicable, they can offer a range of advantages over above

ground receptacles. Submerged container equipment is available from a number of manufacturers and is used in dozens of European and North American cities. The containers of various types are hoisted from the ground by a truck-borne crane, swung over the loading compartment on the back of the same truck, and an opening at the bottom of the container released so that its contents drop into the truck. The bottom of the container is then reclosed and the crane sets it back in the ground.” (B. Miller, 2019, 24-25)

- “Eliminating unnecessary miles by making shorter, “higher density,” non-duplicative routes would be a significant step in the direction of reducing the negative impacts caused by commercial waste collection.” (B. Miller, 2019, 188)
- “Franchise awards, in which specific waste sheds are linked to specific first-dump sites, are the most efficient way to accomplish this end while also minimizing truck miles. This logic should be extended to garages and processing facilities, which should also be linked to specific zones. When optimally located transfer facilities are not currently available, the City should take all reasonable steps to facilitate such private developments or to offer public sites for this purpose. And where appropriate, these sites should allow shared access between different carters or between carters and the Department of Sanitation (DSNY)...Financing and developing anaerobic digestion, waste-to-energy, and other forms of materials and energy recovery facilities, either within the city or nearby, should also be requirements of franchise awards.” (B. Miller, 2019, 189-190)
- “Create a DSNY-administered escrow fund into which a specified portion of carter revenues would go as “retainage.” The nonretainage portion of revenues would be established at a level that covers all franchisee operating costs but not the full anticipated profit. This escrow fund could then be divided among all franchisees, on a weighted basis reflecting their respective contributions to the fund, but also reflecting the relative degree of diversion that they can document over the specified withholding period.” (B. Miller, 2019, 190)
- “Zone boundaries should be delineated in a way that respects critical institutional and physical infrastructure as well as geographic and demographic conditions relevant to collection and transport logistics. Certain local conditions could allow or facilitate superior, sustainable collection operations.” (B. Miller, 2019, 190)
- “If use of a City-owned or -controlled facility (garage or transfer or processing site) that has potentially available capacity would minimize transport distances from a franchise zone, the City should offer use of that site to the franchisee of any such nearby zone, and its use should be required of any such franchisees.” (B. Miller, 2019, 191)
- “Minimizing collection impacts will require shifting from door-to-door collection of plastic bags of trash and recyclables on the street toward the kind of containerized, semi-automated, aggregated collection that is practiced in many other cities. Among the possibilities are aggregated collection, on the multi-building or -block level, with compactor containers for building staff use or drop-off kiosks for residents and pedestrians; submerged containers; and collection via pneumatic tubes.” (B. Miller, 2019, 191)
- “In addition, there should be long-term efficiencies and savings accruing to private carters (as well as substantial benefits to the public) from the development of local processing and disposal capacity that is developed on private and/or public sites, with

capital financing leveraged through the supply-side commitments produced by franchise awards and facilitated through a City role in bond issuance. Such facilities should gradually reduce the need for expensive long-term transport and landfill disposal.” (B. Miller, 2019, 191)

- “There also are clear public interest arguments in favor of treating waste management as a public utility, which would preclude giving individual generators the right to choose their own provider (just as businesses often are not allowed to choose their own water or electricity provider, and New York householders generally do not have the option of choosing their waste collector).²⁰ Nonetheless, commercial generators may feel uncomfortable about having an assigned carter rather than having the ability to choose any carter at any time.” (B. Miller, 2019, 192)
- “The City’s currently planned three-stream program for regularly scheduled curbside collection—recyclables (metal/glass/plastic/paper-cardboard); compostable organics; and refuse (with separate collection of textiles and e-waste on a periodic voluntary basis)¹⁴—strikes a credible balance between the friction involved in separate truck trips (and the use of space and labor on the part of generators) and the enhanced economics and reduced GHG emissions associated with higher-grade recovered materials. A strong argument could also be made in favor of a two-stream program, in which all “wet” materials (food waste and other organics, including contaminated paper) would be put in one bin and all “dry” materials (metal / glass / plastic, dry paper, cardboard, textiles, and other packaging) would go in the other.¹⁵ In either case, the efficiency of the collection trips is a critical factor in determining whether or not this balance is indeed favorable from a GHG perspective. As the composition of the City’s secondary commodities changes, or as processing technologies or end-use markets change, the categorical delineations of the current three-stream curbside program may need to be adjusted. But they provide a reasonable starting point for present planning purposes. The primary objective of the following recommendations is maximizing collection efficiency.” (B. Miller, 2019, 22)
- “The New York City Council should pass legislation reducing the permitted capacity of waste facilities in overburdened communities as a first step toward shifting the City’s reliance away from truck-based transfer stations to marine-based ones. But such legislation, known as “waste equity legislation,” had gotten no traction in the City Council for almost a decade after the passage of the SWMP.” (Iachan, 2019, 26)
- “Waste equity bill: Included incentives for private waste companies to expand recycling and organics processing capacity, as well as incentives for investments in rail-based infra-structure to reduce the private waste industry’s reliance on diesel trucks in collecting, dumping, and exporting waste. The waste equity bill also contained a provision that ensured no other district in the city would become overburdened: it prohibited any district in the city from processing more than 10% of the city’s waste moving forward, which is a crucial protection for communities such as Sunset Park.” (Iachan, 2019, 27)
- “California law requires reducing, recycling, or composting 75 percent of solid waste generated by 2020. The State also has specific goals for diverting organic waste, which decomposes in landfills to produce the super pollutant methane. State law also directs edible food to hungry families rather than having it discarded... The State can invest in

and streamline in-state infrastructure development to support recycling, remanufacturing, composting, anaerobic digestion, and other beneficial uses of organic waste. And, it can help communities in their efforts to recover food for those in need.” (CA Scoping Plan, 2017)

Discussion and Analysis

- “While the City has taken important steps to remedy the issues of poor waste separation, excess waste generation, and disproportionate siting of poorly-operating transfer facilities, there is still a lot of work we can do to ensure that proposed and enacted legislation is carried out correctly, and that future innovations improve and localize the handling of our outsized, unjust waste footprint. NYC-EJA continues to fight for increasing equity and sustainability in waste processing locally – though a lot more can be said and done to address how the City must build support at state and federal scales to reduce the amount of waste that is generated to begin with.” (NYC EJA, 2020, 19)
- “Residents of the handful of low-income communities and communities of color that are home to the bulk of the city’s waste transfer stations and processing facilities have long advocated for policy change to reduce the burdens of waste infrastructure in their neighborhoods. Hundreds of diesel-burning trucks bring in and export garbage generated across the city, bringing with them noxious air pollution, unsafe streets, and unwanted noise. Many of the workers who collect and process this waste live in these neighborhoods as well. For decades, communities have demanded that relief for overburdened environmental justice communities be prioritized alongside investments that bring us closer to the City’s stated Zero Waste goals. Often these goals work hand in hand, as with investments in high-diversion, low-emission facilities such as the municipally run marine transfer stations.” (Iachan, 2019, 25)
- “The greatest potential for truly systemic reform, however, lies directly ahead in the coming years as the City considers a commercial waste zone plan. In 2014, DSNY commissioned an independent consultant to analyze the potential benefits to the City that a zoned commercial waste collection system could provide. The Transform Don’t Trash NYC coalition had been advocating for the City to move toward a zoned collection system, in which the city is divided into geographic zones and carters compete under an RFP system for the right to collect commercial waste in each zone. The coalition pointed to the potential environmental, equity, safety, and efficiency benefits such a system could provide. In 2016, DSNY released the results of the study, which concluded that a zoned system could reduce the greenhouse gas emissions.” (Iachan, 2019, 27)
- “It would be considerably easier to find sites suitable for the City’s waste management purposes within an hour’s transport distance from New York, but some such sites could be found within the city. The majority of them may already be owned by the City. Among the best prospective sites for these purposes— although their footprints will generally be too constrained to allow more than one fraction to be tipped at a single site— are the City’s network of current marine transfer stations, including, as possible, any potential assemblages of adjacent upland.²⁹ These facilities are well-situated for connecting waste-sheds of significant size with barge transport to secondary treatment facilities, such as WWTPs that could digest processed organic slurry. Also ideally suited are the waste-to-rail facilities that the City will no longer need for shipping waste to landfills

hundreds of miles away. Advances in rail freight-handling technology will allow driverless short-haul trains to shuttle materials between primary and secondary processing sites or to more-remote end- users, and car-moving technology will allow efficient on-site shifting of materials. These movements will produce lower GHG emissions than trucks will be able to achieve. The City's Staten Island rail-transfer site, in particular, offers a large footprint that could be repurposed for multiple interconnected uses...The City's network of abandoned incinerator sites provides other siting possibilities." (B. Miller, 2019, 28)

- "Current collection truck miles traveled are the product not only of the number of carting companies and trucks serving any given block but of the number of pickups of a given waste fraction, at different times of the day, and different days of the week, per building. Franchise agreements can require that carters do not pick up the same fraction from the same business or the same building multiple times a day unless they can show that such multiple trips do not increase truck miles traveled to collect the same volume of that material from the same generator or set of generators on a given route or routes without multiple collections per day. The agreements could also incentivize generators to accept fewer collections per week (which could be made possible with the use of compaction or densification equipment, or by providing more storage space) by reducing their collection costs in proportion to the collection savings realized by the carter due to fewer truck trips." (B. Miller, 2019, 190)
- "Though global and national trade will continue to play a major role in the city's life, more products will be produced closer to the source of consumption. And more food will be locally grown, not just in the surrounding region but within the city itself. Advanced manufacturing technologies such as 3-D printing, and advanced agricultural techniques such as vertical and hydroponic farming, may be able to absorb some of the output of the city's secondary-material processing facilities, while artisans fashioning furniture and other objects will also use secondary streams of glass, metal, fiber and other outputs from the city's waste management system. In some cases—in repurposed shipping/manufacturing/warehouse/loft districts such as the Brooklyn Navy Yard or Industry City, or reclaimed expanses such as Governor's or Riker's Island—artisans and manufacturers and sorting and processing plants will be linked by shared flows of secondary materials and recovered energy. Shortening these closed-loop transport distances will also contribute to GHG reductions." (B. Miller, 2019, 22)
- "In addition to the obvious problems they produce—they are unsightly causes of congestion for pedestrians; they leak litter, liquid, and odors that repel humans and attract rats; they conceal hazards that can cause injury or death to collection workers—they directly increase GHG emissions in a number of ways. While technology is available to hoist and empty rigid containers, bags must be lifted and slung into rear-load trucks that idle their engines and cycle their compaction blades in the middle of the street while the collection workers are vulnerably wedged between them and a line of backed-up traffic. While containers for automated collection can be large enough to serve all the businesses in a large building or all the inhabitants of a residential complex, manual rear-loading trucks need to stop to collect bags in front of every building. While large-scale, sealed, compactor-containers might need to be collected only once a week, bagged refuse needs to be collected multiple times a day or week. Finding space for large-scale

(e.g., 30–40 cubic yard (cy)) compactor-containers is a major issue. Relatively few large buildings have loading docks available for this purpose, or truck-accessible courtyards or other exterior private space. But many buildings have space to support smaller wheeled containers (e.g., 1–8 cys). As in the case of buildings capable of using larger-scale equipment, their building managers could also benefit from the avoided labor costs of multiple handlings of bags and recover space that would otherwise be used for intermediate storage. And most buildings could adapt to the use of smaller (e.g., 32–96-gallon) wheeled totes.” (B. Miller, 2019, 22)

- “It would be logical to begin an outline of suggestions for reducing GHG emissions from New York City’s waste by addressing waste prevention. But the most significant type of waste reduction measure—the economic incentives associated with Save-As-You-Throw programs (discussed below), which will catalyze the kinds of innovative techniques and behavioral commitments needed to drive discard rates down¹⁰—is based on the design of collection systems. Aspects of collection operations are discussed below. Another logical place to begin a discussion of collection would be inside the building, where the waste is “generated.” This issue poses design problems for architects, developers, building managers, and businesses that—at least in New York City—have been all but ignored until now when considering waste management.¹¹ The waste flows within the “black box” of buildings are beyond the scope of this article because on the one hand, the design conditions that affect the intricate choreography of waste handling within the building vary widely and, on the other hand, the range of options for how the waste materials leave the building for collection on the street is quite narrow. The options for getting waste from buildings to the street for collection are, however, discussed below.” (B. Miller, 2019, 22)
- “The fact that we are likely to continue to have dense populations on islands also means that the efficiency of our material transport systems—our roadways, railways, pipes, and waterways—will remain critically important... The locations of past and present waste management facilities— garages, transfer stations, processing plants—are of paramount importance in designing a low-friction system. Sites historically used for purposes such as marine transfer stations and incinerators were determined through the city’s organic evolution based on their utility in linking geographic units of population (waste-sheds) with truck, barge, and/or rail routes. They should not be abandoned for other use unless a rational alternative network capable of managing all of the city’s waste output for the indefinite future is in place elsewhere.” (B. Miller, 2019, 20-21)
- “Though their locations may not change, our streets will be used differently. On-demand livery services, self-driving cars, and shared-ownership systems for cars and bikes will reduce demand for personal vehicle ownership and for on- street parking. A virtuous circle of reduced car trips (starting with the startling percentage of in-city miles driven to find parking spaces or to comply with alternate-side street-cleaning regulations)⁷ may lead to an increase in walking and biking. Some types of freight movement (including the “first-block” movement of waste) also may go back to the future—as in the days when push carts were a primary means of delivering goods to and from the region’s rail yards.⁸ Waste collection will become increasingly automated, with real-time routing based on digital monitoring of demand, driverless trucks, and auto-mated or semi-automated pickup or emptying of containers. In combination, these shifts in logistics may have a

significant effect in reducing GHG emissions due to waste collection.” (B. Miller, 2019, 21-22)

- “The calculus must also include an awareness of the larger flow of material goods upon which the biological and economic life of the city depends. Waste is produced not only as a consequence of consumption. By far the greatest proportion of waste—60 times the amount generated by consumers 2—is created during material extraction from fields, forests, and mines, by processes of production, and through the mechanics of distribution. Diverting consumer-generated waste from landfills means exponential decreases in the energy (and GHG emissions) associated with new extraction, production, and distribution. It also means recovering materials and energy for re-use and re-production. The fact that the New York region not only contains the country’s largest concentration of consumer demand but also its largest labor pool creates the potential for further decreases in the city’s carbon footprint by keeping the outward flow of waste materials—its secondary commodities—closely looped to the city.” (B. Miller, 2019, 19)

Other Resources

Related Topics in this Document: Facility Siting Issues, Food Waste, Recycling

Wastewater Treatment

New York Actions

- “Clean Energy Fund – NYSERDA will align State programs that coach the development of anaerobic digesters at farms, wastewater facilities, food and beverage production facilities, and merchant-type treatment facilities, to highlight methods for and the financial value of reducing organic waste that would otherwise be deposited in landfills or exported out-of-state” (Methane Reduction Plan, 2017, 9)
- “NYSERDA’s CHP program offers incentives up to \$2.5 million for systems up to 3 MW in size. In order to receive an incentive, in almost all cases systems are required to be capable of independent operation during grid outages (black-start capable), and installed to provide priority power during grid outages. NYSERDA offers bonus incentives for black-start capable CHP systems installed at critical infrastructure sites. For customers interested in installing systems less than 3 MW, NYSERDA offers a packaged CHP system catalog of modules that are pre-approved for program incentives. For projects in the 1-3 MW size range, NYSERDA allows customers to choose either the catalog approach, or a custom-designed approach. The catalog provides enhanced consumer confidence for smaller projects and helps accelerate the decision making and deployment timeframes through a catalog of pre-engineered CHP systems.” (CHP Program 2018)

LPDD Recommendations

- *“States could consider means of incentivizing gas capture from wastewater treatment facilities.”*

- *“States could restructure or amend their air pollution and other laws to impose the same or stricter requirements on the venting and flaring of biogas from wastewater treatment facilities, as apply to its use in electricity generation and other applications.”*

Other Recommendations

- “WASTEWATER TREATMENT plants break down biosolids from wastewater using anaerobic digestion. Recommendation for BioGas: Support. Methane is already produced through wastewater processing, making such plants a good source of biogas. When biogas is processed so that it can be injected into a pipeline, leakage occurs in the processing and transportation. These accidental methane emissions must be monitored and controlled.” (“Renewable” Gas – A Pipe Dream or Climate Solution?, 2020, 3)
- “Expand capacity for material and renewable energy recovery at water supply and wastewater treatment facilities, including by optimizing biogas production for beneficial use, expanding food waste co-digestion opportunities, and moving toward net-zero energy at all in-city wastewater treatment plants while reducing fugitive emissions and landfilling of biosolids” (NYC 1.5C, 2017, 2020 Climate Actions, 22)
- “The 72 plants built or retrofit before 1985 should be considered high priority for retrofit for multiple reasons including increased energy efficiency and increased biogas production and use (Figure 5). Additionally, sites that discontinued incineration to meet new regulations (EPA 2012, Cornell University Legal Information Institute) may be prioritized for retrofit (Such as the Large Rochester Plant).” (Wightman, 2014, 16)
- “The 162 WWTP larger than 1 MGD could be targeted for energy production with the 86 that have some kind of Anaerobic Digestion infrastructure evaluated first. The largest plants have the greatest opportunity for total energy production, but have lower expected financial return. The smaller plants have less energy production potential per plant, but have a higher likely average financial return (Figure 4). Large plants without any reported AD infrastructure, such as the relatively large Rochester WWTP (107 MGD) should be evaluated for development of AD systems. Such a retrofit would likely be very costly since it has no reported AD infrastructure and may have space limitations. While there were 52 WWTP identified without AD (>1MGD) only 6 of them were >10 MGD” (Wightman, 2014, 16)
- “From a greenhouse gas perspective, all 143 WWTP with AD should be evaluated for adding a simple flare to destroy methane. Given that methane has an extremely high impact on climate, simple flaring should be considered as an important first step because it is relatively inexpensive and easy (For <1 MGD, See Appendix I, Figure A1---4, for plants >1MGD, See Figure 2). More complex and costly retrofitting for increased biogas production and/or use for energy should be evaluated as a second step for plants >1MGD (Figure 2). “ (Wightman, 2014, 16)
- “All plants running at less than 50% capacity should be evaluated as to the reason why. Low use poses both an opportunity and a problem. These plants could be targeted to receive food wastes or other high---strength wastes to increase capacity utilization and fill a currently untreated effluent nearby. With suitable equipment such plants could also increase methane production for electric generation. However, when a plant is running under capacity, it generally has equipment running inefficiently. Many WWTP have undergone minor energy efficiency retrofits that are very cost effective simply by

downsizing over-sized equipment. Retrofitting these plants to have some components replaced that run more efficiently is likely to be much less expensive and have a better financial return, but any proposed retrofit to a specific facility will require further detailed data collection and analysis.” (Wightman, 2014, 16)

- “While consolidation is worth considering as a strategy to improve water quality and performance, and possibly reduce costs, there are a myriad of considerations to be evaluated for a given consolidation option (see Woodbury 2014). However, proximity does indicate a level of opportunity for energy efficiency that could be advantageous if combined with other benefits.” (Wightman, 2014, 16)
- “Continue to quantify and define the energy generation potential from biogas at WWTFs throughout the United States.” (WERF, 2012, 17)
- “Develop databases, similar to that developed by U.S. EPA Region 9, of potential high-strength waste (HSW) sources that could be used to increase biogas production at WWTFs.” (WERF, 2012, 17)
- “Develop a consolidated database or repository of grant funding opportunities for CHP and biogas production projects.” (WERF, 2012, 18)
- “Update the University of Alberta Flare Emissions Calculator to include nitrogen oxides (NO_x) and carbon monoxide (CO) that are often regulated by permitting agencies to document the relative performance of these non-recovery/fuel-wasting devices against CHP technologies.” (WERF, 2012, 18)
- “Expand outreach and information exchange between the wastewater industry and power companies and natural gas utilities.” (WERF, 2012, 18)
- “Further advance understanding of how decision science and innovation diffusion theory can help guide overcoming barriers to biogas use for renewable energy at wastewater treatment utilities.” (WERF, 2012, 18)
- “Develop a centralized database of CHP installations and continue to develop case studies on successful CHP projects.” (WERF, 2012, 18)
- “Develop an economic analysis tool that uses other financial evaluation methods in addition to simple payback.” (WERF, 2012, 18)
- “Develop an education and training course to assist in the understanding of the benefits of biogas, including a course specifically for decision makers.” (WERF, 2012, 18)
- “Assemble information on the barriers to anaerobic digestion.” (WERF, 2012, 18)
- “Identify how to pursue legislation to assist in financing CHP projects.” (WERF, 2012, 18)
- “Promote research to identify less costly methods to achieve anaerobic digestion and biogas production so it can become more widely applicable particularly to small WWTFs and industrial applications.” (WERF, 2012, 18)

Analysis and Discussion

- “LCA results presented in this study serve to highlight the trade-offs in environmental performance that can accompany efforts to reduce nutrient loading to receiving waters and identify several key treatment options and management practices that can be used to effectively reduce or eliminate trade-offs. As would be expected, the upgraded treatment system realizes a consequential 25-40 percent reduction in net eutrophication impact dependent on the FeedstockAD scenario being considered. Eutrophication impacts are

generally less sensitive to scenario assumptions than are other impact categories more strongly linked to electricity use and process air emissions. The eutrophication benefit comes at the expense of an approximate 25-30 percent increase in global warming potential and acidification potential within the base case scenario.” (Life Cycle Assessment, 2017, 97)

- “Net smog formation potential, cumulative energy demand, fossil depletion potential, and particulate matter formation potential results for the upgraded treatment system are between 5 and 11 percent greater than the legacy system in the base scenario, while water use in the base scenario is reduced dramatically due to avoided fertilizer production and wastewater reuse.” (Life Cycle Assessment, 2017, 97)
- “The environmental benefits of installing AD and biosolids reuse programs accrue more quickly than do financial benefits to the utility and municipality. However, the analysis shows that even modest quantities of high strength organic waste begin to show a potential cost justification for the installation of AD, providing a quantitative justification for the concept of the resource recovery hub, its environmental benefits, and the possibility of an economic rationale if the capacity of infrastructure is maximized and markets are found for recovered energy and material resources.” (Life Cycle Assessment, 2017, 98)
- “Of 570 Waste Water Treatment Plants (WWTP) in NY there are 162 WWTP that are greater than 1 MGD. Of the 570, there are 143 WWTP with Anaerobic Digestion (AD) infrastructure. There are 86 WWTP that are both >1MGD and have some kind of AD infrastructure. It is estimated to cost \$511 million to retrofit this subset of WWTP for improved energy capture and use.” (Wightman, 2014, 2)
- “Of WWTP >1MGD, 72 have not been retrofitted in over 30 years and these would be excellent priority candidates for retrofitting, with the opportunity to include energy and greenhouse mitigation in the retrofit. Of these older plants, 42 have Anaerobic Digestion infrastructure and might be good targets for both building on existing infrastructure and improving methane destruction for GHG mitigation purposes. All 57 very small WWTP (<1MGD) that have anaerobic infrastructure should be evaluated for flaring any unused biogas for GHG mitigation.” (Wightman, 2014, 2)
- “Focusing specifically on the Mohawk/Hudson Basin there are 168 WWTP. Of these WWTP, 38 have AD infrastructure and 21 are >1MGD. Retrofitting these 21 is estimated to cost \$127 million to retrofit.” (Wightman, 2014, 2)
- “The projected cost for replacing and updating New York’s municipal water infrastructure is \$36.2 billion by 2028 (NYDEC, 2008). While funds are limited, next generation retrofits could be planned to incorporate not just improved water quality but also greenhouse gas mitigation and energy conservation and renewable energy production. After labor, energy is the 2nd most expensive cost category in WWTP. WWTP can produce biogas that can be used to produce heat and electricity and reduce energy costs.” (Wightman, 2014, 3)
- “In New York State, electricity constitutes between 25 and 40% of the budget of a typical wastewater treatment plant (NYPA 2014). Energy costs can be reduced in many ways, including: 1) energy savings from efficiency projects, 2) energy savings from installation

of renewables such as wind and solar, 3) energy savings from combustion of biogas and/or incineration of solids to displace energy inputs.” (Wightman, 2014, 4)

- There are 10 major categories of barriers to CHP plants in WWTFs: Inadequate payback/economics – the economics do not justify the investment for beneficial use of biogas; Lack of available capital – there are more pressing needs for our limited dollars; Operations and maintenance complications and concerns – concern over a lack of expertise on staff or on call to operate a CHP system; Complication with liquid streams – the improvements negatively impact liquid stream compliance and operation; Outside agents (non-regulatory: utilities, public) – “we could not work with our power and gas utilities or the public to implement CHP.”; Lack of community and utility leadership or interest in green power – the environmental benefit provides inadequate justification for the project; Difficulties with air regulations or obtaining air permit – air and greenhouse gas (GHG) regulations make it too difficult to get a CHP air permit or CHP will require a Title V permit; Plant too small – “our facility and/or biogas production is too small to justify a CHP project.”; Technical merits and concerns – technical concerns limit willingness to implement; Maintain status quo – “we like things the way they are too much.” (WERF, 2012, 16)

Other Resources

Related Topics in this Document: District Energy, Combined Heat and Power

Clean Fuels

RNG and Renewable Diesel

LPDD Recommendations

- *“States should consider adopting RPS for gas, requiring a minimum percentage of total supply to be met with biogas, hydrogen, and/or synthetic methane.”*
- *“States should enact legislation designating a single agency with responsibility for issuing all necessary permits for renewable gas production facilities. In the absence of legislative action, state agencies involved in permitting renewable gas production facilities should enter into an agreement clarifying their respective roles in the process and providing for greater cooperation, to the extent allowed by law.”*
- *“State energy agencies should work with state environmental and other agencies to formulate consistent definitions for renewable gas technologies.”*
- *“State PUCs should require pipeline operators seeking to apply stricter quality standards to renewable gas than natural gas to provide a valid justification for that choice.”*
- *“State legislatures could direct state energy agencies to make payments to facility operators for the renewable gas they produce, similar to those available under the federal Advanced Biofuel Payment Program.”*
- *“State legislatures should enact legislation authorizing the provision of loan guarantees for renewable gas projects.”*

- “State PUCs should adopt renewable gas quality standards that do not operate as a barrier to pipeline transportation.”

Related LPDD Database Pathways

- Renewable Gas Standards: <https://lpdd.org/pathway/renewable-gas-standards/>
- Financial Incentives for Renewable Gas Production: <https://lpdd.org/pathway/financial-incentives-for-renewable-gas-production/>
- Gas Quality Standards: <https://lpdd.org/pathway/gas-quality-standards/>

Other Recommendations

- “The Environmental Energy Alliance of New York, which includes the state’s investor-owned utilities and some generators, seeks more clarity on the definition of RNG. The proposed whitepaper excludes biogas and biomass generation from subsidies because of the definitions in the CLCPA. But the groups say the law should be changed as RNG from organic waste and other sources could be important in filling supply-demand gaps for downstate gas utilities and ensuring the reliability of the electric system in 2040.” (French, 2020)
- Incentivize fleets serving NYC to move to RNG fuels (Advancing Clean Air & Climate Goals With Clean Fuel Trucks Webinar, 2020)
- Research organic waste to Renewable Natural Gas, as started in 2008. Continue this with urban food and green waste, as well as municipal wastewater (Advancing Clean Air & Climate Goals With Clean Fuel Trucks Webinar, 2020)
- “Biogas and synthetic gas should be used sparingly and strategically to meet on-site gas and electricity needs (to avoid transporting methane and building new pipelines), and to reduce emissions from activities that are most difficult to power with renewable electricity, such as industrial processes, aviation, long distance transportation, and electricity generation to balance seasonal wind and solar resources.” (“Renewable” Gas – A Pipe Dream or Climate Solution?, 2020, pg. 2)
- “Target on-site use and hard-to-electrify sectors. Available biogas and synthetic gas resources should be directed to on-site use where possible (to avoid the leakage associated with transportation and the cost of new pipelines), with any excess directed to hard-to-electrify sectors such as industry, long-distance transportation, aviation, and use in electricity generation to balance seasonal wind and solar resources.” (“Renewable” Gas – A Pipe Dream or Climate Solution?, 2020, pg. 7)
- “Establish and enforce emissions standards, monitoring, and reporting. Any policy supporting the development of biogas and synthetic gas must include environmental requirements to screen the resources used, and differentiate among them through active monitoring and reporting of life-cycle carbon dioxide and methane emissions, accounting for both short-term and long-term climate impacts.” (Report: “Renewable” Gas – A Pipe Dream or Climate Solution?, 2020, pg. 7)
- “Transition to clean electricity. The limited supply of biogas and synthetic gas cannot replace the current use of fossil gas by a long shot. Given the need to substitute clean energy for fossil gas in all sectors to meet climate goals, abundant renewable electricity will be the fuel of choice in most sectors. Gas use and investment in gas infrastructure will need to decline. All states and regions urgently need to begin planning for a smaller

gas footprint to avoid the significant costs of under-used pipeline infrastructure” (“Renewable” Gas – A Pipe Dream or Climate Solution?, 2020, pg. 7)

- “Start small. Given the nascent state of this market, policies that aim to replace fossil gas with biogas and synthetic gas should start small and grow only if the resource proves to be available, economical, and environmentally sound.” (“Renewable” Gas – A Pipe Dream or Climate Solution?, 2020, pg. 7)
- “The biggest hole in RNG policy today is a lack of a mechanism to properly value RNG when consumed for thermal purposes. Until there is such a mechanism, RNG will not be used to decarbonize heat. The good news is that policymakers have started to focus on decarbonizing heat and to recognize the need to generate incentives or credits when RNG is used for thermal purposes.” (Chahbazpourr, 2019, pg. 68)

Discussion and Analysis

- “Emissions analyses of biofuel combustion often do not account for the full lifecycle of emissions – from production of the crops and materials that make up the fuels, to the tailpipe emissions from vehicles. One study showed that the lifecycle emissions of biofuels derived from soybean oil is 50% more carbon-intensive than ultra-low-sulfur diesel.⁴¹ Biofuels contribute to additional untold environmental risks when derived from unsustainable sources like palm oil, soybeans, landfills, or the massive dairy farms used to produce the necessary volume of organic waste.” (NYC EJA, 2020, pg. 29)
- There are 105 operational RNG projects around the country. They produce enough fuel for all bus fleets in the United States right now. This is a net carbon negative practice. RNG use in vehicles cuts NOx and other GHG emissions, leading to reductions in smog. This method is 90% below current EPA standards. It is proven and broadly available! 30,000 medium and heavy duty natural gas vehicles are currently operating. (Advancing Clean Air & Climate Goals With Clean Fuel Trucks Webinar, 2020)
- “While biogas and synthetic gas can be a part of the climate solution toolbox, they come with a host of limitations, such as resource availability, cost, and human health and environmental impacts. Most significantly, the potential availability of biogas and synthetic gas is dwarfed by the current level of fossil gas consumption in the United States. NRDC estimates biogas and synthetic gas from ecologically sound sources may be able to replace only roughly 3 to 7 percent of today’s gas use, at projected costs that are many times the current price for fossil gas. In addition, biogas and synthetic gas produce the same health-harming pollutants as fossil gas when burned, and leaks will still release methane—an especially harmful greenhouse gas—directly into the atmosphere.

As a result, biogas and synthetic gas should be used sparingly and strategically to meet on-site gas and electricity needs (to avoid transporting methane and building new pipelines), and to reduce emissions from activities that are most difficult to power with renewable electricity, such as industrial processes, aviation, long distance transportation, and electricity generation to balance seasonal wind and solar resources.” (“Renewable” Gas – A Pipe Dream or Climate Solution?, 2020, pg. 2)

- “Anaerobic digestion creates biogas when wet, organic material breaks down in environments without oxygen, such as when dairy cow manure is processed in an enclosed container called a digester. If left to decompose in an aerobic environment—an environment with oxygen—these organic sources would primarily release carbon dioxide

(CO₂) instead of methane. Anaerobic digestion (AD) is a simple process that has been used to generate gas for many years, although currently only at a very small scale. It can be an effective approach to extracting energy from food and animal waste, but it has potential pitfalls. For instance, it removes organic material that, if left to decompose naturally, can contribute to soil health.” (“Renewable” Gas – A Pipe Dream or Climate Solution?, 2020, pg. 2)

- “Thermal gasification is a process that breaks down dry biomass—such as waste wood, forestry and agricultural residues, and used paper and cardboard—in a high-heat, low-oxygen, controlled environment to create methane or other gases.⁸ In the absence of thermal processing, these dry organic sources would biodegrade over many years and produce mostly CO₂. Thermal gasification is a relatively new technology with limited commercial use thus far. A fundamental issue with gasification is that it can create methane where none or little would have naturally occurred. In addition, instead of gasifying biomass to create methane, there are other more benign and potentially beneficial alternatives that are in development.” (“Renewable” Gas – A Pipe Dream or Climate Solution?, 2020, pg. 2)
- “Renewable Synthetic Methane is generated through methanation of renewable hydrogen using a biogenic or air-captured source of carbon.” Recommendation: “Limited support. Renewable synthetic methane can directly replace any existing use of fossil gas because it is the same chemical compound (CH₄). However, due to the extra chemical conversion step (methanation) and the need for a source of carbon, synthetic methane is significantly more complex and expensive to produce than hydrogen. Given the many possible uses of renewable hydrogen (e.g., to replace hydrogen currently used by industry, as a transportation fuel, or for the seasonal management of renewable electricity), it may be preferable to use hydrogen directly rather than convert it to methane. Producing synthetic methane also creates the potential for leakage, which could undermine the climate benefits.” (“Renewable” Gas – A Pipe Dream or Climate Solution?, 2020, pg. 4)
- “The potential supply of biogas and synthetic gas is dwarfed by the United States’ current level of fossil gas use. According to a study sponsored by the American Gas Foundation (AGF) and conducted by ICF International, the United States could produce 1,660 to 3,820 TBtus of biogas and synthetic gas annually by 2040.¹⁵ On the basis of these numbers, NRDC applied its own screens to project that ecologically sound biogas and synthetic gas could replace roughly 3 to 7 percent of the country’s 2019 gas use, with biogas replacing 2 to 5 percent and synthetic methane replacing 1 to 2 percent.¹⁶ While those contributions would be significant, they do not justify reliance on biogas and synthetic gas as the sole or primary strategy to replace fossil gas use.

These estimates rely on projections about current knowledge and technology for an industry that is still very young.¹⁷ We anticipate significant learning over the next decade: It may turn out to be harder or more costly to produce biogas and synthetic gas, or new technologies and scale (especially for synthetic gas) could bring costs down and increase the potential supply.

If total gas demand declines over time, these percentages would increase. However, there may also be competing uses for these resources. For example, long-distance transportation may transition to biogas or hydrogen. And many of these

biomass resources could also be converted to liquid fuels to serve other sectors. New demand for this same resource would compete with existing demand for gas for heating and cooking in buildings, industrial processes, and electricity generation. ” (“Renewable” Gas – A Pipe Dream or Climate Solution?, 2020, pg. 6)

- “Biogas is often considered “zero carbon” because its fuel sources—organic material—have absorbed carbon from the atmosphere and would have released that carbon as part of a natural carbon cycle. However, evaluating the climate impacts of both biogas and synthetic gas must take into account the energy required to produce it, whether the source creates new methane where none or little would have existed otherwise, and how much methane leaks during production. All processes that generate methane should require an emissions management plan because without careful monitoring and oversight, these fuels could cause more harm than benefit to the climate.” (“Renewable” Gas – A Pipe Dream or Climate Solution?, 2020, pg. 6)
- “Gas utilities, eager to remain in business, assert that renewable natural gas (RNG) has a future in buildings. A new report out on Wednesday by Earthjustice and the Sierra Club criticizes the industry’s aggressive marketing of RNG for buildings, arguing that it’s too expensive, there’s not enough of it, and it does not solve the health and safety risks of pipelines carrying methane or burning gas indoors.” (Grist, 2020)
- “Sierra Club and Earthjustice don’t reject the idea that RNG could be useful to tackle climate change. They just reject the notion that it’s a feasible solution for buildings. First, it’s a lot more expensive than fossil natural gas, and most forecasts don’t see that changing much in the future. The report cites an analysis by the American Gas Foundation (AGF), an independent research arm of a gas industry group, which found that some sources of RNG could cost between \$7 and \$20 per million British thermal units by 2040, but others could be as high as \$45. Right now, the cost of natural gas is only \$2 to \$3 per million British thermal units, so a switch to RNG could mean steep rate hikes for customers... While the AGF study demonstrates that RNG could meet residential needs — U.S. residential consumption was 4,996 trillion British thermal units in 2018 — the environmental groups argue that the limited supply should be reserved for sectors where electrification is much harder, like aviation, shipping, and heavy industry.” (Grist, 2020)
- “E3, an energy economics consulting firm, analyzed various scenarios for achieving California’s emissions goals in a report published in April and found that electrifying building appliances is likely to be a more cost-effective, less risky long-term strategy than RNG, with additional benefits in terms of air quality and public health. In short, this is because whichever decarbonization strategy the state pursues, gas prices are likely to increase in the long term, either because more and more costly RNG will be put into the system or because some customers will switch to electric appliances, shrinking the pool of customers paying to maintain the gas system. Either way, as gas prices rise, customers will be incentivized to go electric. In other words, while going all in on RNG for buildings could save gas utilities from obsolescence, it could also decimate their customer base.” (Grist, 2020)
- “Even at the conclusion of the electrification transition, liquid biofuels play an important role in mitigating emissions in hard-to-electrify end-uses such as heavy industry and aviation. The United States already has a biofuels industry of significant size, but it

primarily produces corn-derived ethanol, a relatively high carbon form of biofuel over its lifecycle. As light-duty vehicle travel is electrified, the demand for liquid transportation fuels decreases, and this sector is reduced in importance. This analysis also finds that the focus of biofuels should be on displacement of liquid fossil fuels, rather than gaseous fuels.” (350 PPM Pathways, 2019, 42)

- “Renewable natural gas” (RNG) is an overlooked solution that can enable the low-carbon future by focusing on two of the most difficult sectors to decarbonize: heat and heavy-duty transportation. RNG is pipeline-compatible gaseous fuel derived from biomass or other renewable sources that has lower lifecycle CO_{2e} emissions than geological natural gas.” (Chahbazpourr, 2019, pg. 68)
- “RNG can also qualify for renewable energy credits (RECs) if used to produce electricity. However, RNG used for thermal purposes (e.g., heating or cooking) does not qualify for any environmental credits and is treated as traditional natural gas. The biggest hole in RNG policy today is a lack of a mechanism to properly value RNG when consumed for thermal purposes. Until there is such a mechanism, RNG will not be used to decarbonize heat. The good news is that policymakers have started to focus on decarbonizing heat and to recognize the need to generate incentives or credits when RNG is used for thermal purposes.” (Chahbazpourr, 2019, pg. 68)
- “There are also perennial crops that are able to produce ample quantities of feedstock for biofuels, such as switchgrass, that could take the place of the annual crops now grown for this purpose. 98 In part due to different fertilizer and water needs of switchgrass and corn, the life-cycle carbon intensity of switchgrass biofuel is less than that of gasoline, while that of corn ethanol is greater. 99 Other perennials can be a source of edible oils that are now largely produced by annual crops such as rape or soy. While there are now no perennial grains ready for commercial use, the Land Institute, a nonprofit research organization dedicated to developing perennial staple crops, has been making promising progress. 100 Returning to more pasture-based systems of raising livestock also effectively switches the feed from an annual to a perennial crop.” (Carbon-Neutral Agriculture, 2017, pg. 8)

Other Resources

Related Topics in this Document: Energy Intensive Industries, Landfill Methane Capture, Building Heating Systems

Sustainable Feedstock for Biofuel Production/Conversion

New York Actions

- “First, the CLCPA’s definition of “renewable energy systems” does not include biomass or biogas, which are currently eligible under the RES. Therefore, it is recommended that the Commission align future procurements conducted by NYSERDA with the eligible technologies defined under the CLCPA.” (CES White Paper, 2020, pg. 10)

Preservation and Management of Bioenergy Feedstocks

LPDD Recommendations

- *“States should adopt policies to keep forests from being converted to cropland, keep natural and biodiverse forests from being converted to biofuel forests, increase carbon sink potential of agricultural soils by forestalling conversion to more carbon-intensive uses, and protect watersheds and biodiversity from natural resource conversion related to residential, industrial, and commercial development.”*
- *“To maintain forest and agricultural lands, state legislatures may develop programs to prohibit development of lands in one area and allow the transfer of development rights to other areas.”*
- *“State legislatures could adjust commercial forest management programs to more directly integrate deep decarbonization objectives, particularly related to regeneration, regulation (or prevention) of conversion of feedstock forests to other, non-forested uses, and regulation of GHG-emitting technology utilized during the feedstock cultivation process.”*
- *“States that are more inclined to regulate land uses should work together on a regional basis to preserve natural carbon sinks and to alleviate concerns of pushing economic growth into other jurisdictions.”*

Related LPDD Database Pathways

- State Level Commercial Forest and Agricultural Resource Management: <https://lpdd.org/pathway/state-level-commercial-forest-and-agricultural-resource-management/>
- Preservation of Forests and Carbon Sinks: <https://lpdd.org/pathway/preservation-of-forests-and-carbon-sinks/>

Incentives and Mandates for Bioenergy

LPDD Recommendations

- *“States with an active RPS (the time horizon for some RPS has passed), and states that may adopt an RPS in the future, should include sustainability requirements based on life-cycle analysis in the definition of qualifying bio-mass.”*
- *“States could adopt programs to provide economic payments to bioenergy feedstock producers to reforest/replant cultivated acreage, to engage in management methods that sequester more carbon during the cultivation process, and to ensure that other “competing” land values are also protected.”*

Related LPDD Database Pathways

- Bioenergy in Renewable Energy Mandates: <https://lpdd.org/pathway/bioenergy-in-renewable-energy-mandates/>
- Bioenergy in Renewable Energy Standards: <https://lpdd.org/pathway/bioenergy-in-renewable-energy-standards/>
- Subsidies for Bioenergy Feedstock Development: <https://lpdd.org/pathway/subsidies-for-bioenergy-feedstock-development/>

Bioenergy Feedstock Certification

LPDD Recommendations

- “State governments could require that any bioenergy feedstock used in the state be certified by an independent certification organization (or allow agencies to adopt private certification standards for their own certification programs).”

Related LPDD Database Pathways

- Tracking and Certifying Sustainable Forests: <https://lpdd.org/pathway/tracking-and-certifying-sustainable-forests/>

Other Recommendations

- Strong Caution against using Animal Manure for Biogas Production (“Renewable” Gas – A Pipe Dream or Climate Solution?, 2020, pg. 3)
- Limited Support for Agricultural Residue for Biogas Production (“Renewable” Gas – A Pipe Dream or Climate Solution?, 2020, pg. 3)
- Strong Caution against using Forestry And Forest Product Residue for Biogas Production (“Renewable” Gas – A Pipe Dream or Climate Solution?, 2020, pg. 3)
- Strong Caution against using Energy Crops for Biogas Production (“Renewable” Gas – A Pipe Dream or Climate Solution?, 2020, pg. 3)
- “Shifting production from crops intended to feed animals with a high conversion rate (of pounds feed to pounds meat), feedstock for biofuels with high life-cycle carbon emissions, or processed foods to crops intended for human consumption as whole foods, would therefore improve the efficiency of crop use.” (Carbon-Neutral Agriculture, 2017, pg. 9)
- “A switch from the dominant biofuel—corn ethanol—to biofuels derived from perennial crops grown on lands that are less suitable to food crops would help to reduce competition for human food and relieve additional acreage from food production.” (Carbon-Neutral Agriculture, 2017, pg. 9)”
- “The primary implementation mechanism is the creation of a state-level Biomass Energy Program. The program would provide overall coordination to encourage regional consistency in sustainability criteria, track and maintain a biomass inventory employing appropriate sustainability indicators to monitor changes in the flow of biomass, provide for the coordination of research to ensure that the development of a sustainable bio-based economy proceeds in an orderly fashion, and facilitate the development and leveraging of public/private partnerships.” (CAC Report 2010, Chapter 9, page 12)
- “Increase the amount of agricultural and forest biomass available on a sustainable basis to support low-carbon energy development while accounting for the environmental, economic, and social impacts of expanded biomass feedstock production” (CAC Report 2010, Chapter 9, page 12)

Discussion and Analysis

- “ANIMAL MANURE can generate methane when digesters process it in anaerobic conditions.” Recommendation for Bio Gas: “Strong caution. There are very limited quantities of gas that can be sustainably produced from animal manure. Livestock operations can and should manage manure in ways that protect environmental and human health, but often large livestock operations cause significant human and environmental harm, and using manure to produce methane is economical only for

large-scale, concentrated livestock operations.¹² Large concentrated manure sources should be required to reduce their methane emissions and to work with local communities to avoid environmental harms. On-site use of gas should be considered instead of extending pipelines. Small operations with sustainable grazing practices and other sustainable manure management practices that prevent methane creation should be encouraged over large-scale operations.” (“Renewable” Gas – A Pipe Dream or Climate Solution?, 2020, pg. 3)

- “AGRICULTURAL RESIDUE—including crop residues from orchards and vineyards, field and seed crops, food processing, and vegetable crops—can be a source for thermal gasification.” Recommendation for Bio Gas: “Limited support. Agricultural residue is largely woody, and biogas would most commonly need to be produced through thermal gasification. Before considering gasification, those who manage agricultural residue should focus on food waste prevention and surplus food rescue; maintaining nutrient cycling in soils; and productively using these sources as animal feedstocks, animal bedding, or fertilizers. Vegetable crops are best used by incorporating them back into soil or using them as animal feed.” (“Renewable” Gas – A Pipe Dream or Climate Solution?, 2020, pg. 3)
- “FORESTRY AND FOREST PRODUCT RESIDUE, including tree branches, brush, sawmill wastes, and non-merchantable trees from logging and thinning, can be a source for thermal gasification.” Recommendation for Bio Gas: “Strong caution. These resources would be processed through gasification, and access often requires energy-intensive collection and transportation. In cases where the emissions from collection and processing are managed so there is a net decrease in climate and air pollution, only these sources are acceptable: n Trees removed for safety reasons from within 200 feet of homes, built infrastructure (such as power lines), and other man-made structures. Outside of removals from these areas to protect people and property, NRDC does not support the use of trees as an energy feedstock. Small-diameter logging slash (e.g., branches and leaves) if these would otherwise be burned on site. However, these sources are limited, logistically challenging, and expensive to collect. n Sawmill residues.” (“Renewable” Gas – A Pipe Dream or Climate Solution?, 2020, pg. 3)
- “ENERGY CROPS are grown specifically to produce energy.” Recommendation for Bio Gas: “Strong caution. Energy crops are often a poor use of land and should not be supported where they compete with food production or biologically diverse landscapes.” (“Renewable” Gas – A Pipe Dream or Climate Solution?, 2020, pg. 3)
- “Bioenergy is used in New York today largely in the form of ethanol blended into gasoline and wood combusted in buildings for heat, with smaller quantities of biodiesel being used for vehicles and space heating. The transition to carbon neutrality will require very strategic use of limited biomass and careful screening of sustainable feedstocks to ensure that bioenergy is carbon neutral when considering its net GHG impacts. As illustrated in Figure 23, the pathways modeled in our analysis can achieve deep decarbonization using available in-state biomass feedstocks that are assumed to be converted to advanced renewable natural gas and renewable petroleum products. We also assume that a small amount of wood consumption remains in 2050 to serve a variety of needs, including residential wood usage in the North County.⁸” (NY Pathways, 2020, pg. 42)

- “The circular carbon economy, or CCE, is a term for an energy economy that uses CO₂ embodied in biomass feedstocks or through direct air capture to produce electric fuels. Given existing energy service delivery mechanisms, both fuel delivery and fuel consumption infrastructure, large portions of energy demand in 2050 is still met as it is today, with liquid and gaseous fuels. These fuels can no longer be fossil-based and so require drop-in, non-fossil-based alternatives. These fuels begin as electrolyzed hydrogen before they are catalyzed with captured CO₂. Critical sources of carbon for utilization in this analysis are biorefineries and direct air capture facilities. Biorefineries that are located in areas with limited sequestration potential are specifically good candidates as they can run at high utilization factors and have extremely concentrated sources of CO₂ emissions for low-cost capture. DAC facilities with utilization are also employed to a lesser extent as seen in Figure 17. This is a critical strategy in the long-term, even before net-zero emissions economies have been achieved.” (350 PPM Pathways, 2019, 62)
- “Shifting production from crops intended to feed animals with a high conversion rate (of pounds feed to pounds meat), feedstock for biofuels with high life-cycle carbon emissions, or processed foods to crops intended for human consumption as whole foods, would therefore improve the efficiency of crop use. This efficiency could allow for the production of an adequate food supply on fewer acres than would be required otherwise. This in turn would reduce direct emissions associated with the cultivation of the excess acreage, as well as allow the restoration of grassland and forestland that can function as carbon sinks.
- A 2013 study estimated that 67% of the calories and 80% of the protein in crops produced in the United States are diverted to animal feed. 101 ... The study further found that up to an additional 6% of both calories and protein of U.S. crops were diverted to biofuel production. 106 Neither the calories nor the protein were available for human consumption. Notably, this estimate predated enactment of the Renewable Fuel Standard (RFS) that spurred demand for biofuels in the United States, and the percentage of potential food lost to biofuel production is almost certainly much higher today. 107 A switch from the dominant biofuel—corn ethanol—to biofuels derived from perennial crops grown on lands that are less suitable to food crops would help to reduce competition for human food and relieve additional acreage from food production.” (Carbon-Neutral Agriculture, 2017, pg. 9)
- “Objectives include the following: (1) Defining sustainability criteria that address the social, economic, and environmental dimensions of biomass-derived energy, including the ability for a production system or technology to survive without public subsidies, and the development of full life-cycle carbon analysis that can support objective comparisons with other renewable and non-renewable energy sources; and (2) Developing and encouraging the use of best management systems for the establishment and harvest of feedstocks. These systems should be designed to ameliorate local impacts of storage, pre-processing, and distribution of feedstocks at conversion facilities.” (CAC Report 2010, Chapter 9, page 12)
- “Special considerations: GHG reductions will be realized through the end use of biomass feedstock to displace higher carbon forms of energy and reductions will vary accordingly; The availability of in-state produced sustainable biomass feedstock must parallel, and

oftentimes precede, the development and growth of biomass conversion facilities if New York State is to maximize GHG reductions and economic benefits; Development of sustainability criteria related to the production and harvest of biomass should be pursued on a regional basis; Continued research focused on improving cradle-to-grave efficiencies (increasing yields, improving conversion technologies, understanding and improving sustainability criteria) will impact the rate at which biomass production occurs; This policy option provides significant rural revitalization potential. The Renewable Fuels Roadmap estimates feedstock supply jobs account for over 80 percent of the job growth potential associated with the increased production of sustainable feedstocks; State and federal policies related to renewable portfolio standard (RPS) and renewable fuel standard (RFS) will impact the rate at which biomass production occurs; The on-farm production of biomass feedstocks on idle and marginal land represents a crop diversification strategy for the purposes of adapting to climate change.” (CAC Report 2010, Chapter 9, page 13)

- “This policy option would advance the development and commercialization of low-carbon biomass conversion processes, which for some pathways can be an area with considerable technical and financial risk. The policy option acknowledges the need to support the biomass conversion industry along the development and commercialization continuum. A long-term commitment of public (primarily federal) sector funding will be necessary to partner with industrial funding to support the development of new biomass conversion technologies and the realization of the lessons learned from market experience. Research will be needed in both academic and private laboratories. Publicly funded programs should be implemented in a manner that promotes the commercial use of new intellectual property.” (CAC Report 2010, Chapter 9, page 14)
- “When the technology is ready to be developed at a commercial scale, public support could be in the form of low-cost financing or other innovative mechanisms to reduce the technical uncertainty of the new technology to the private investment community. Innovative risk-sharing programs can be implemented to share the technical and market uncertainty and promote private investment. Beyond the point of commercial-scale manufacturing, public support is critical to ensure that all actors along the supply chain are positioned to move the product to the consumer. Public incentives, either grants or tax incentives, can be critical at this stage. While federal incentives can be important, at this stage of market transformation state initiatives could be significant in helping to develop the industry base in New York State.” (CAC Report 2010, Chapter 9, page 15)
- “There will be competition among the liquid, bioheat, and gaseous fuels markets for the limited sustainable feedstock resource. It is likely that the feedstocks will move where the highest profit can be realized. Realizing the carbon reduction benefits from the conversion to fuels will require a consistent and major commitment to developing the sustainable resource base (AFW-1). Sustainable feedstocks can also serve as the building block for more than biofuels. Conversion processes already on the verge of being commercially viable and technologies that will be developed in the future will allow for the development of bio-based products that may also have an impact on carbon reduction. These products may serve as substitutes or alternatives to products that are inherently carbon-intensive. Federal policies (e.g., the RFS) will drive the majority of market activity in this sector. The ability of New York to capitalize on advanced

conversion technologies will be, in large part, determined by regional policies and programs. New York markets do not operate in a vacuum.” (CAC Report 2010, Chapter 9, page 15)

Other Resources

Related Topics in this Document: Solid Waste Management

Development of Bioenergy and Methods to Accurately Measure Net Emissions

Discussion and Analysis

- “Biorefining with CCS (BECCS) and direct air capture technologies can provide additional negative emissions to offset remaining emissions in the energy and non-combustion sectors. CO₂ is a waste product of biofuel production and can be captured and sequestered to produce negative emissions. Direct air capture (DAC) of CO₂ may prove to be an important “backstop” technology if other measures do not perform as expected. However, DAC is unproven at scale, and its cost outlook is highly uncertain.” (NY Pathways, 2020, pg. 47)

Other Resources

Related Topics in this Document: Carbon Capture and Sequestration

Hydrogen Cell Technology

Other Recommendations

- “Literature review of research papers shows that approximately 10% hydrogen could be blended into the existing gas system without impacting gas quality or requiring alterations to existing natural gas appliances.” (Chahbazpourr, 2019, pg. 69)

Discussion and Analysis

- “The relative share of hydrogen fuel cell relative to battery electric vehicles over time may be affected by a number of factors, including the cost outlook for hydrogen production from zero-emission generation resources over time and the potential for regional or national initiatives to convert the long-haul fleet and develop hydrogen fueling infrastructure.” (NY Pathways, 2020, pg. 22)
- “Hydrogen emits no carbon when combusted and can be readily produced from water through electrolysis, using zero-carbon electricity sources. However, more research is needed on industrial, as well as transportation, applications to unlock this potential. R&D funds should be directed to reducing the cost of producing hydrogen via electrolysis, which uses electricity to split water into hydrogen, so that electrolysis can replace natural gas as the dominant source of hydrogen production.” (Federal Policies for Net Zero, 2020, 8)

- “There are currently no hydrogen blending demonstration projects in the United States; however, there are research efforts underway to assess more precisely how much hydrogen can safely be blended into the system. This research is looking not only at the impact on end-use appliances, but also at the potential impact on infrastructure (e.g., cast-iron pipes versus plastic pipes). Similar efforts are underway in Europe. For instance, a collaborative of energy organizations in the United Kingdom is developing a roadmap for how to convert Leeds, England’s third-largest city, to a hydrogen gas network. This project, called Leeds H21, is one of several in the UK looking at hydrogen’s potential to serve thermal needs.” (Chahbazpourr, 2019, pg. 69)
- “There may be many opportunities for improved overall efficiency and performance of industrial applications using low carbon heat options. For example, hydrogen supplied to chemical plants can serve both for heating and as a feedstock and for steel mills as both a heating fuel and chemical reductant. Similarly, indirect electrical resistive heating may be integrated with waste heat recovery systems to gain overall plant efficiency. Optimizing these systems remains largely hypothetical, with questions remaining around the potential scale of opportunity, potential cost, and potential methodologies.” (Low Carbon Heat, 2019, 61-62)

Other Resources

Related Topics in this Document: Research and Development

Just Transition

Workforce Development and Training

New York Actions

- “NYSERDA is also offering \$10 million in funding through Green Jobs - Green New York to support a Loan Loss Reserve Program prioritizing lending to support green jobs and lending for energy efficiency and renewable energy in communities across New York. This pilot program will have a direct benefit to underserved borrowers by reducing the risk for community-based financial institutions that loan money for energy efficiency improvements and renewable energy systems installed in residential and multi-family buildings as well as in buildings used by small businesses and not-for-profits. The program will catalyze and expand clean energy financing and expand the availability of, and improve the terms for, financing products by requiring that a minimum of 35 percent of any residential loan portfolio be made available to consumers with lower credit scores or consumers with lower household income, and a minimum of 35 percent of any multifamily building loan portfolio be for affordable multifamily buildings.” (LMI Clean Energy Investments, 2020)
- “Workforce development for building electrification and energy efficiency — Increase pool of skilled labor and industry partnerships to rapidly scale the nascent heat pump industry, providing economic opportunity for New Yorkers, including by making use of

\$40 million in workforce development funding announced in 2020 State of the State.” (Clean Energy, 2020, Electrification of Buildings, 36)

- “Department of City Planning - Under NY Works, DCP is also working with fellow agencies to promote job creation at transit-accessible centers, such as Downtown Brooklyn and Long Island City, to bring jobs closer to residents, extend the capacity of the existing transit system to serve commuters, and reduce overall GHG emission from transportation. DCP’s borough planning offices are in constant conversation with community boards, neighborhood leaders, and the public to identify opportunities for projects or community partnerships that advance sustainability goals” (NYC 1.5C, 2017, Agency Highlights, 34)

LPDD Recommendations

- *“State legislatures could allow utilities to charge ratepayers for the cost of industrywide hiring halls and for retraining that bridges the gap between workers’ old skills and new occupations. State legislatures could require within future renewable energy portfolio standards or energy-efficiency mandates hiring preferences for workers dislocated from coal-fired power plants. State legislatures should also promote the creation of more clean energy jobs in coal country; local governments should also promote the creation of more clean energy jobs in coal country. State legislatures should re-envision the severance taxes that create natural resource trust funds as tools for phasing down extraction of fossil fuels and raising more near-term resources for social policies that support just transitions. To reduce or eliminate the wage gap between carbon and non-carbon jobs, state legislatures could establish within RPS and energy-efficiency laws occupational wage standards in non-carbon energy industry occupations.”*

Related LPDD Database Pathways

- Social Policies to Facilitate a Just Carbon Transition: <https://lpdd.org/pathway/social-policies-to-facilitate-a-just-carbon-transition/>

Other Recommendations

- “By focusing on city-sited and in-state energy generation, NYC would not only lay the groundwork for energy self-sufficiency but also catalyze the local clean energy economy. Concentrating on in-state, large-scale renewable energy generation such as community-scale solar projects, offshore wind projects, and larger upstate solar projects, New York will also decrease our dependence on imported energy. The City has the opportunity to send a positive signal to invest in New York’s antiquated energy infrastructure while creating tens of thousands of long term, living-wage careers.” (NYC EJA, 2020, 12)
- “Job retraining programmes, focused on industrial sectors impacted by decarbonisation. This is a preventative option that aims to stop people from falling into poverty due to the significant shifts in the economy that are needed to achieve carbon neutrality. Programmes should be set up early and preemptively to reskill and upskill workers, while reflecting the impacts on the local labour market conditions. Programme administrators should work with industry to identify labour shortages and reskill workers to fill gaps in these sectors, and leverage the job creating potential from the

energy transition and digitalisation. Funding can be via carbon revenues or general tax revenue.” (EQuality, 2020, 2)

- “Job retraining programmes are measures that can be implemented pre-emptively to counter redundancies resulting from the energy transition. Job retraining programmes address wage losses of workers, which could occur due to sectoral shifts in the economy, which in turn could be precipitated by decarbonisation policies. Programmes aim to reskill and upskill workers, enabling them to find employment in growth sectors. Job retraining programmes should consider the local labour market and be tailored at the regional level to specific groups or sectors.” (EQuality, 2020, 59)
- “In 2016, the Transition Training Fund (TTF) was set up in Scotland to support unemployed workers in the oil and gas sector.⁷⁶ The programme was developed in response to the shutting down of oil and gas operations in the North Sea that began in 2014. The Scottish Government allocated £12million of its general budget to the TTF, with the aim of redeploying 1,000 workers per year over the course of three years. No legislation was required to implement the policy, and the TTF was administered by an existing national skills agency—Skills Development Scotland. The fund made grants of up to £4,000 per person available for oil and gas workers who were either unemployed or at risk of redundancy, to assist them in accessing skills retraining. ⁷⁷ Training was provided via two pathways: an individual route for an applicant’s preferred training, or a procured route that provided training in target sectors. Skills Development Scotland engaged with industry to identify sectors in need of workers to ensure that those who selected the procured route had a high likelihood of finding a job once their training was complete. As shown in Figure 27, the TTF provided training for 4,272 people and 89% of trainees found employment post-training.” (EQuality, 2020, 60)
- “Actionable steps that can be taken by jurisdictions to implement similar job retraining programmes: 1. Identify need in sectors that are (or are likely to) experience significant unemployment. 2. Allocate funds to be administered by existing national skills agency (if one exists). 3. Identify sectors that need workers, e.g. those experiencing labour shortages or growth. 4. Design flexible retraining programmes, matching workers with sectors in need. 5. Market retraining programmes so that workers are aware of them and roll out applications. 6. Deliver retraining. 7. Monitor and report on spending and benefits delivered.” (EQuality, 2020, 61)
- “To further support a transition to a regenerative economy, the City should facilitate the expansion of jobs that increase our diversion and local processing of recyclable and compostable materials. Within the Commercial Waste Zones Law, microhaulers are enabled to scale up their tonnage allowances as subcontractors with primary haulers, but space to process organic material within the city is limited. Microhauling is an industry that employs high proportions of women and young people of color, standing in stark contrast to the male-dominated private sanitation industry. In addition to limited organics processing space within the city – which stifles productivity and incomes – microhaulers are additionally burdened by laws that categorize compost as a fertilizer, and therefore as an explosive, making these small businesses pay exorbitant overhead costs to insure their workers.” (NYC EJA, 2020, 41)
- “Rezoning such as these that propose turning industrial areas into luxury commercial and retail space are misguided. These rezonings have the potential to lead to

gentrification and displacement, underestimate climate risks, and undervalue manufacturing land that should remain to support a Just Transition. Industrial retention is a long-standing priority for environmental justice communities. Manufacturing jobs can support working and middle-class families, paying an average of \$62,000 annually compared to retail and other service sector jobs that pay an average of \$44,020 and \$36,350 annually, respectively.⁶⁷ Industrial land will be critical to supporting the economic transition to a renewable energy economy. The CLCPA, which legislated commitments to reduce greenhouse gas emissions by 85% in NYS by 2050, is expected to create over 150,000 new green jobs in the ensuing decades. These new climate jobs, including solar and wind manufacturing, green infrastructure, and coastal resilience, need industrial land and infrastructure to ensure local benefits and sustainable economic development.” (NYC EJA, 2020, 44)

- “NYSERDA’s role: Unlock new job growth, such as offshore wind port infrastructure investments and competitions for deep commercial building retrofits. Provide workforce development programs to develop the human resources needed to build the clean energy economy, support a just transition for historically disadvantaged populations and industries affected by the transition away from fossil fuels, and support host communities with a site reuse toolkit and consulting assistance.” (Clean Energy, 2020, Clean Energy Economy, 22)
- “Ensure that individuals working in conventional energy industries are provided with training and opportunities in the growing clean energy economy. Ensure training curricula and programmatic support respond to industry needs. Provide targeted support to offset risks that might prevent clean energy firms from hiring or training. Deploy additional \$40m announced in 2020 State of the State to train 40,000 workers over the next five years. Support launch of \$20m Offshore Wind Training Institute and establishment of SUNY partnerships to meet industry ramp-up.” (Clean Energy, 2020, Clean Energy Economy, 22)
- “Improve community-level outreach and engagement to increase access to clean energy solutions and improve energy literacy. Provide opportunities for under- or unemployed individuals to access clean energy job opportunities.” (Clean Energy, 2020, Energy Affordability and Equity, 31)
- “As one feature of the job guarantee program for these displaced workers, we propose that the workers receive 100 percent compensation insurance over a five-year period. This means that any gap between what these workers were earning in their fossil fuel industry jobs—including wages and benefits—and what they are paid in their new clean energy jobs would be covered in full through the insurance guarantee.” (The Economics of a Just Transition, 2018, 13)
- “A Just Transition program must include a provision for retraining for the displaced fossil fuel industry workers. The government program will also need to serve as a job placement clearinghouse for all displaced workers...under the job guarantee feature of the just transition program, there will not be any pressure to place workers into jobs. Rather, the sole aim will be to get workers adequately trained into the new jobs that they will have been guaranteed.” (The Economics of a Just Transition, 2018, 14)
- “But some displaced workers will need to relocate and, therefore, need to receive relocation support. As a generous rough estimate, we allow for an average of \$10,000 per

displaced worker for relocation expenses. That would put the full cost of relocation allowances at \$27 million per year.” (The Economics of a Just Transition, 2018, 15)

- “Our rough estimate of the overall annual costs of providing an effective job guarantee program for displaced fossil fuel industry–dependent workers will include the following: (1) \$200 million per year for compensation insurance, (2) \$65 million per year for retraining support, and (3) \$27 million for relocation allowances. This totals to \$292 million. For the sake of simplicity and to err on the side of overstating our estimate, we round this up to \$300 million.” (The Economics of a Just Transition, 2018, 15)
- “Collaborate with City agencies, universities, unions, and trade organizations to ensure that the NYC workforce is prepared to deliver on climate objectives” (NYC 1.5C, 2017, 2020 Climate Actions, 24)
- “The Technical Work Group has established a policy scenario to further encourage a stronger workforce responsive to needs of the clean energy economy: (1) quantify the training needs in terms of the number of individuals to be trained and dollars to be spent on workforce development activities; (2) establish a process for early identification of these new needs, defining the training and education needs, developing training curriculum and certifications, and delivery of the same; (3) define the characteristics of the future workforce based on demographics, expectations for displaced and underemployed workers as well as others who have faced barriers to equal employment opportunities due to shrinking job sectors, and expectations regarding communities in need, and define the training needs to move that workforce into the green energy career pathway; (4) better define the career ladders and training needed to advance the clean energy economy; (5) identify the education and training needs for green professionals; (6) ensure the educational system supports the development of green career training; (7) make workforce training and development investments to address skill shortages in the energy efficiency labor market that will significantly contribute toward achieving the 80 by 50 goals and maximize the use of public resources; and (8) commit to train building professionals involved in the clean energy field to reach 35 percent of these participants by 2020, and 70 percent by 2030.” (CAC Report 2010, 6, 27)
- “They should include strong Minority and Women-owned Business Enterprise contracting and hiring standards. Whenever possible and feasible, they should incorporate 1) a community-based delivery system that establishes and funds local groups as hubs for the program to generate homeowner interest and develop training-to-jobs networks, and 2) local environmental and community-development goals whenever feasible.” (CAC Report 2010, 6, 27)
- “First, at its most basic level, a statewide green jobs policy should synergize workforce development and environmental sustainability by promoting a new "green economy" that values nature and people. Second, this policy should seek to stimulate the overall local, regional and state economy by creating high quality, environmentally-friendly jobs that provide living wages and benefits and offer a progressive career ladder. Third, this policy should principally target and enhance educational and vocational training focused primarily on energy conservation and renewable sources of energy. Fourth, and most important, any green jobs policy or law should create environmentally sustainable pathways out of poverty for low-income and under-served communities which focus on recruitment, job training and job placement. As will be discussed throughout this article,

the transition to a green economy must, as a matter of moral, economic and environmental necessity, put the needs of environmental justice communities at the center of the dialogue. Economic enfranchisement and workforce redeployment are the clarion calls of the green jobs movement, and focusing workforce development towards a green, inclusive economy is a pragmatic and appropriate way to put New York's--and the nation's--communities back to work.” (Green Jobs, Part 1, 2009, 2)

Discussion and Analysis

- “Just Transition framework for U.S. workers and the communities in which they live. Our rough high-end estimate for such a program is a relatively modest \$600 million per year. This equals 1.2 percent of the roughly \$50 billion per year in new public investment that will be needed to advance a successful overall U.S. climate stabilization program. As we show, this level of funding would pay for (1) income, retraining, and relocation support for workers facing retrenchments; (2) guaranteeing the pensions for workers in the affected industries; and (3) mounting effective transition programs for what are now fossil fuel–dependent communities... One reason that the costs for this program can be kept relatively modest is precisely because the fossil fuel industry cutbacks will be occurring in conjunction with the growth of the clean energy industry—that is, large-scale investments in energy efficiency and clean renewable energy production. This is critical because, among other factors, within the U.S. economy, the number of jobs generated by clean energy investments will be much larger than the jobs that will be lost through fossil fuel industry retrenchments.” (The Economics of a Just Transition, 2018, 2)
- “With respect to the fossil fuel–based electric utility industry, government statistics include twenty occupational categories. Most of these occupational categories will be unaffected by whether electricity is generated from fossil fuel or renewable energy sources. Similar to the mining support activities, these occupations include management, finance, computer programming, marketing, and consumer service. The only occupations within this category that are likely to be heavily affected by a transition from fossil fuel to renewable-based electricity generation are those within the category of “installation, maintenance and repair.” These jobs account for about 30 percent of all employment in the fossil fuel–based electric power industry. For our calculations, we, therefore, assume that 26 percent of all fossil fuel–based utility employment will be affected by a transition to renewable energy electricity sources.” (The Economics of a Just Transition, 2018, 6)
- “Studies have found that programmes are perceived as more successful when they are led by local stakeholders and are bottom-up, rather than state or national initiatives... Studies highlight the importance of open dialogue with the affected population in building solutions and facilitating inclusion in decision-making processes.” (The Economics of a Just Transition, 2018, 6)
- “Despite its recent reauthorization, TAA has long been criticized by a wide range of observers as not nearly adequate to provide significant support to workers who have experienced job losses or sharp wage cuts through reemployment... Similar federal programs in recent decades have been no more effective than the TAA in relocating displaced workers into good new jobs...such support programs will only be needed to

play a supplementary role in a comprehensive jobs program for fossil fuel workers. This is because we estimate that about 85 percent of the necessary job retrenchments can be managed through attritions by retirement when current employed fossil fuel workers reach age sixty-five. For the other 15 percent of job losses throughout the fossil fuel and ancillary industries, a straightforward proposal will be to guarantee new employment opportunities within the rapidly expanding clean energy sectors.” (The Economics of a Just Transition, 2018, 7-8)

- “There will be three types of major costs associated with providing job guarantees for displaced fossil fuel workers in the clean energy sector, such that this guarantee will entail minimum hardships for the displaced workers as they move into their clean energy industry jobs. These costs include (1) compensation insurance, (2) job retraining, and (3) moving expenses.” (The Economics of a Just Transition, 2018, 12)
- “Opportunities to prepare and expand upon current workforce training, continuing education, credentialing, licensing, on-the-job training, recruitment and job placement efforts are identified. Initiatives will focus on the following: Mid-stream decision makers and building professionals in the residential, multifamily, and commercial building sectors; Industrial and power systems engineers and skilled technicians; Manufacturing engineers and technicians; Biorefinery, upstream, or feedstock production training related to biomass energy as well as downstream training for conversion facility personnel; Integrated farm management processes and systems; Forest management focusing on upstream workers; Waste reduction, recycling, and composting.” (CAC Report 2010, 12, 7)
- “The higher education system must continuously evolve to reflect the needs of the changing economy through new curricula and through the establishment of low-carbon economy-centered certifications and degree programs. Incumbent workers must have access to workforce development programs to help them continuously upgrade their skills to meet the needs of their employers. Finally, new energy service jobs, combined with proper training, would create opportunities for professionals to remain and work in New York and create pathways out of poverty, an equally important social objective.” (CAC Report 2010, 12, 8)
- The first program, entitled the State Labor Market Research, Information and Labor Exchange Research Program, empowers the Secretary of Labor to award competitive grants to states, enabling them to administer labor market and labor exchange information. In particular, this program provides funding to state agencies that administer the Wagner-Peyser Act--an Act establishing a network of employment service centers--and state unemployment compensation programs to identify job openings in the renewable energy and energy efficiency sectors, administer skill and aptitude testing for workers, and counsel and refer qualified workers to openings and training programs. The second program, entitled the State Energy Training Partnership Program, empowers the Secretary to award grants to states to administer renewable energy and energy efficiency workforce development programs. States, in turn, are allowed to use the money to award competitive grants to eligible partnerships, which include the partnerships mentioned above. These partnerships are required to have experience in implementing worker skills training and education programs as well as the ability to identify the target populations that would benefit from activities related to

energy efficiency and renewable energy industries. Priority will be given to states that demonstrate that activities under the grant will meet national and state energy policies associated with energy efficiency, renewable energy and the reduction of greenhouse gases and are able to leverage public and private resources to fund training programs.” (Green Jobs, Part 1, 2009, 4)

- “Washington was the first state to pass a green jobs law. The Climate Action and Green Jobs Act,⁹ which was signed into law in March 2008 and took effect this past June, combines green collar job training initiatives and greenhouse gas (GHG) reduction strategies. With respect to green jobs, Section 9 of Act creates a green collar job training program to train and transition workers to clean energy jobs with the goal of increasing the number of such jobs in the state to 25,000 by 2020. The Act requires that state agencies work together to conduct labor market research and analyze projected growth in the green economy, recruitment and skill requirements of green employers, wage and benefit ranges within green businesses, and education and training requirements for jobs within these industries.” (Green Jobs, Part 1, 2009, 5)
- “The law provides that the Technology Center shall, among other things: (1) stimulate the creation and development of new clean energy ventures that will form the foundation of a strong clean energy industry sector or cluster in the state; (2) provide support to existing clean energy companies to expand their operations within the state; (3) attract new capital and research facilities from institutions outside the state; (4) foster collaboration between industry, state government, research universities and the financial sector to advance clean energy technology commercialization and venture development; (5) conduct market research to identify barriers to creating and expanding a clean technology industry, including job training needs; (6) support demonstration projects that are evaluated by independent, third-party peer research institutions; (7) serve as the clearinghouse for information related to the clean energy industry in the state; (8) promote programs and investments that lead to pathways toward economic self sufficiency for low and moderate-income individuals and communities in the clean energy industry; and (9) perform any other actions necessary to effectuate the state's public interests.” (Green Jobs, Part 1, 2009, pg. 5: Workforce Development (Model after Massachusetts))
- “Based on the University of Washington's findings, the Employment Security Department, in consultation with the Department of Ecology (DOE), the state's environmental protection agency, shall propose which industries will be considered "high demand green industries" and which jobs will be considered "high-wage occupations" based on current and projected job creation and their strategic importance to the state's green economy. These designations will inform DOE's planning and strategic development as well as the planning of the State Workforce Training and Education Coordinating Board and higher education boards. DOE will develop criteria for existing investments and make recommendations for new or expanded financial incentives and strategies, to recruit, retain, and expand green economy industries and small businesses and make recommendations for new or expanded financial incentives and strategies to stimulate research and development of green technology and innovation, including designating innovation partnership zones linked to the green economy. The Act also directs the State Workforce Training and Education Coordinating

Board to create and pilot "green industry skill panels," which will consist of business representatives from clean energy industries, labor unions representing workers in these industries, state and local veterans agencies, employer associations, educational institutions, and local workforce development councils and other stakeholders within the region that the panels propose to operate. The panels are required to conduct labor market and industry analyses, plan strategies to meet the recruitment and training needs of the industry and small businesses" (Green Jobs, Part 1, 2009, pg. 5: Workforce Development (Model after Washington State)

- "Urgent action on green jobs legislation can set the stage for an economic resurgence. With the prospect of increasing unemployment and a predicted budget shortfall of at least \$1.5 billion in 2009, there is a tremendous need for initiatives that stimulate the economy. Fortunately, state policy makers understand the inter-relationship between workforce development, clean technology and a green economy. According to New York's Renewable Energy Task Force, a qualified and skilled workforce will be a key factor in attracting clean tech companies to the state and building viable markets for renewable energy and energy efficiency technologies.¹² A newly trained workforce will be especially important in economically depressed regions of the state, like upstate New York, which once was a bustling manufacturing center. While these manufacturing jobs have largely left New York, many workers with relevant skills remain. Green jobs legislation would assist these workers in developing new skills by harnessing the skills they already have, and by training newer workers in acquiring skills, thus empowering a new generation of workers to become the backbone of New York's economy. These skilled workers will attract clean energy companies to build factories in the state, creating jobs. For example, in neighboring Pennsylvania, the state's skilled workforce attracted German and Taiwanese companies that manufacture solar equipment and a Spanish company that manufactures wind turbines.¹³ Numerous studies have confirmed that jobs in the "green economy" are qualitatively superior to "gray economy" jobs in terms of pay, benefits and a more progressive career ladder." (Green Jobs, Part 2, 2009, 4-5)
- "California Green Jobs Act (2008): First, it will assist in identifying and linking green collar job opportunities with workforce development training opportunities and encourage regional collaboration in local workforce investment areas to meet regional economic demands. Second, it will create and develop public, private, philanthropic, and nongovernmental partnerships to build and expand California's workforce development programs, network, and infrastructure. Third, it will provide policy guidance for job training programs in the green technology sectors to assist and prepare specific populations, such as at-risk youth, displaced workers, veterans, formerly incarcerated individuals, and others facing barriers to employment. Fourth, it will develop, collect, interpret, and distribute statewide and regional labor market data on California's new and emerging green industries workforce needs, trends, and job growth. Fifth, it will identify funding resources and make recommendations on how to expand and leverage funds. Finally, the Council will foster regional collaboration in the green economic sector." (Green Jobs, Part 1, 2009, 7)
- "One of the crucial underpinnings of our legislative proposal is to ensure that job training and education programs include people who need them most and create "pathways out of poverty" for New York State residents. Thus, the legislative proposal

defines certain fundamental criteria such as giving priority and an entry point to low-income communities, at-risk youth, formerly incarcerated individuals, workers affected by declining industries and industries in transition into the green economy and other under-served sectors of the workforce. Another important feature of these job training and education programs is to involve the private sector in determining relevant skills, ensuring that appropriate curriculum is developed and that certificates and credentials are recognized by potential employers. Although this legislative proposal provides for basic criteria, it does not impose uniform statewide programs to various regions and communities of the state. To implement this statewide strategy, the subcommittee would work with regional and local entities to create local Green Jobs Corps. These local Corps would comprise a multi-stakeholder task force, with representatives from the community, government, education, labor and business groups. With intimate knowledge of their communities, local Corps would be well positioned to decide what programs can best fit their needs.” (Green Jobs, Part 2, 2009, 7)

- “Most green jobs will be reformulated and retooled blue-collar jobs. Many of these jobs are in the energy, transportation, and building sectors. As the country transitions toward a clean energy economy, there will be a growing demand for new skill sets. Labor unions stand to gain from a redeployment of their membership to new applications of currently outdated skills. For example, steel workers and pipe-fitters, who are currently seeing their union membership decline and employment opportunities dry up, will be vital in the new clean energy economy for wind turbine technology and solar energy. Plumbers, electricians and other building trades will need to be re-trained in the latest energy efficiency and renewable energy technologies to meet growing demand for energy efficient buildings and other structures.” (Green Jobs, Part 1, 2009, 2)
- “The question that the green jobs movement addresses is how to ensure that the people who need the most help are included in the emerging green economy. The answer is relatively straightforward, at least in concept: these people need to receive sufficient education and job training concerning these new jobs and technologies and, most important, they must benefit from the new employment opportunities. Another important environmental justice aspect of green jobs is that they require a local workforce. Green-collar jobs will not be outsourced. Under- and unemployed workers in communities need to be identified and must receive training so that they can take advantage of these local jobs. Thus, any green jobs initiatives that the state undertakes should focus on the revitalization of urban and rural communities. This means that money should be injected into our vocational and community colleges to start training a green workforce. Job training can include such areas as solar panel installation, building retrofits, sustainable agriculture, material reuse, green roof installation, and planting trees in urban neighborhoods, to name a few. The challenge is to ensure that there is equal access to these opportunities, particularly for entry-level opportunities that do not require a bachelor's degree, where career advancement is possible and that offer family-sustaining wages and benefits.” (Green Jobs, Part 1, 2009, 3)

Other Resources

Related Topics in this Document: Impacts Of Closing Electric Generating Facilities And Opportunities Presented By Reuse Of These Sites

Impacts of Closing Electric Generating Facilities and Issues and Opportunities Presented by Reuse of these Sites

Discussion and Analysis

- “For the purposes of designing effective Just Transition policies, we have to especially account for the prospect that, at various points, large production sites, like one big coal mine, could shut down all at once. This could produce layoffs in the hundreds or more as one-time events. In such situations, it will not be possible to cover something like 85 percent of the job losses through attrition by retirement when workers turn sixty-five. Rather, the job losses in such situations are likely to hit workers of all ages to a roughly equivalent extent. That in turn means that more workers will need to be placed into new jobs and provided with wage and benefit insurance as well as retraining and relocation support. The resources needed to manage such larger transition programs will, therefore, need to be in place.” (The Economics of a Just Transition, 2018, 15-16)
- “At present, there are dramatic differences in the conditions of the pension funds in the coal industry as opposed to oil and gas and the ancillary industries. These differences reflect the broader conditions in these respective industries over the past several years... Through the Pension Benefit Guaranty Corporation (PBGC), the federal government does have substantial authority to require companies to fulfill their pension fund obligations, as opposed to avoiding them through Peabody-type strategies. We discuss this further below. But when companies are truly in crisis—that is, that they have no funds available to support their pension funds, even when such support is set as a first priority—then the federal government will need to intervene to protect the workers’ pensions.” (The Economics of a Just Transition, 2018, 18-19)
- “Given that, over the next twenty years, the oil and gas industry will need to contract by between 30 and 40 percent as part of the clean energy transition, the evidence to date makes clear that the companies are hardly likely to replenish their pension funds as a matter of course. The federal government will, therefore, have to mandate full funding. One way to enforce this would be for the PBGC to utilize its powers under the 2006 Pension Protection Act to prohibit the oil companies from paying dividends or financing share buybacks until their pension funds have been brought to full funding and then maintained at that level. As needed, the PBGC can also exercise its authority under the 2006 Act to place liens on company assets when pension funds are underfunded.” (The Economics of a Just Transition, 2018, 22)
- “Given these financial conditions for the utilities and support industry firms, protecting the pensions of workers in the industry should follow the same approach that we have already sketched for the oil and gas industry. That is, these firms should be required to fully fund their pensions and to maintain full funding before they are permitted to pay dividends or engage in stock buybacks. Such regulations should be sufficient to guarantee pensions in most circumstances over the transition in which fossil fuel production and consumption decline steadily. If firms do face genuine crisis conditions comparable with those currently faced in the coal industry, policy interventions comparable to the Obama Power Plus program for coal will need to be implemented more broadly. But none of the large utilities or support industry firms are presently even

approaching the level of distress that would require a federal bailout to guarantee the workers' pensions. Precisely because conditions in the industry are favorable, this is an opportune period to set down strong and workable pension fund protection standards." (The Economics of a Just Transition, 2018, 25)

- "In seeking to develop such a program, it is first necessary to recognize the extent to which fossil fuel production in the United States is concentrated geographically. Five states—Kentucky, Montana, Pennsylvania, West Virginia, and Wyoming—account for nearly 70 percent of all U.S. coal production. But even within these five states, coal industry jobs represent a low percentage of overall statewide employment. As we see in Table 9, West Virginia has the highest share of coal employment, with the 20,281 coal industry workers representing 2.9 percent of the overall statewide workforce. In Wyoming, the 6,673 coal industry workers represented 2.4 percent of the state's over-all workforce. As the table shows, these are the only two states in which coal industry jobs exceeds 1 percent of overall statewide employment. In fact, coal production is further concentrated by county within these heavily producing states. Three counties produce 45 percent of Kentucky's coal output, a single county produces 60 percent of Montana's output, two counties produce two-thirds of Pennsylvania's output, six counties produce half of West Virginia's output, and Campbell County alone in Wyoming itself produces 88 percent of that state's output...The level of geographic concentration for U.S. oil and gas production is roughly equivalent to that for coal. The top three states in oil production—Texas, North Dakota, and California, along with offshore federal waters—account for 71 percent of all U.S. production, with Texas by itself accounting for 35 percent. With natural gas, the top four producing states—Texas, Pennsylvania, Louisiana, and Oklahoma—account for 60 percent of total production, with Texas alone producing 28 percent." (The Economics of a Just Transition, 2018, 25-26)
- "Large cities tied to the fossil fuel industry, such as Houston and Dallas, will unavoidably face big adjustments, similar to those experienced by major manufacturing cities such as Detroit and Pittsburgh over the past three decades. But smaller communities that are less diversified will experience still greater losses...The situation is, again, still worse for coal-dependent communities. For example, in Boone County, West Virginia, 47 percent of all jobs in recent years were with the region's coal industry. However, just between 2011 and 2014, coal mining employment in the area fell from 4,600 to 1,400, a 70 percent decline.³⁶ The County's budget also fell 45 percent between 2012 and 2015.³⁷ In 2016, three elementary schools were consolidated, and at least seventy teachers were laid off.³⁸ Again, in the absence of a well-functioning transition program, this pattern will persist in Boone County and similarly coal-dependent communities." (The Economics of a Just Transition, 2018, 27)
- "Within this broader clean energy investment program, policies can be designed so that regions and communities that are heavily dependent on fossil fuel industries will receive generous support to advance regionally appropriate clean energy projects...Reclamation of abandoned coal mines as well as oil and gas production sites is one major category of community reinvestment that should be pursued as the fossil fuel industry contracts. Moreover, the federal government already has extensive experience financing and managing reclamation projects, beginning with the passage of the Abandoned Mine Land (AML) program in 1977, as one part of the broader Surface Mine Control and

Reclamation Act. The program has been funded through fees charged to U.S. mining companies, with the fees having been set as a percentage of market prices for coal.” (The Economics of a Just Transition, 2018, 28)

- “The conditions faced by the nuclear power–dependent communities and the aims of the repurposing program for them have useful parallels with the challenges that will be faced by many fossil fuel–dependent communities... Operating with such constraints, the Worker and Community Transition program (1994-2004) provided grants as and other forms of assistance in order to promote diversification for these thirteen nuclear energy–dependent communities and to maintain jobs or create new employment opportunities. It encouraged voluntary separations, assisted workers in securing new employment, and provided basic benefits for a reasonable transition period. The program also provided local impact assistance and worked with local economic development planners to identify public and private funding and assist in creating new economic activities and replacement employment.” (The Economics of a Just Transition, 2018, 29)
- “The experience in Piketon, Ohio provides a good case study of how this program has operated in one community. Piketon had been the home of a plant-producing weapons-grade uranium that closed in 2001. The workers in the plant were represented by the Oil Chemical and Atomic Workers union (OCAW—which merged in 1999 with the United Steel Workers (USW)). The union leadership was active in planning the plant’s repurposing project. The closure could have been economically devastating for the region, but the federal government provided funding to clean up the three-thousand-acre complex. The clean-up operation began in 2002, and is scheduled to take forty years to complete.⁴⁰ Currently 1,900 workers are employed decontaminating the site at a cost of \$300 to \$400 million a year. The contractor hired to clean up the site employs union workers, and the president of the USW local union is enthusiastic about the long-term prospects for the project and the site.” (The Economics of a Just Transition, 2018, 30)
- “The most serious problem facing the energy-impacted communities . . . was the lack of a basic regional economic development and industrial diversification capacity for most of the regions affected by the cutbacks . . . To address this problem directly, community assistance initiatives could encourage the formation of new clean energy businesses in the affected areas.” (The Economics of a Just Transition, 2018, 30)
- “It is important to keep in mind that the extent of the overall community displacement that will result through the clean energy transition will be no greater than what the United States experienced after the end of the Cold War. Between 1987 and 1996, 1.4 million jobs were lost overall in the defense and aerospace industries, a 40 percent decline... The federal government did advance substantial transition programs during this period, in particular through the Defense Reinvestment and Conversion Initiative. The total funding for the program amounted to more than \$16.5 billion over the years 1993 to 1997, that is, about \$4 billion per year.” (The Economics of a Just Transition, 2018, 31)
- “Former coal industry employees may be able to find replacement jobs, where they are offered, but often with a sacrifice: either with a lower salary that introduce skills and wage gaps, or with a requirement to commute long distances to find employment opportunities since coal jobs and replacement renewable energy jobs or other, non-energy jobs may not align geographically. While there is ample evidence that clean

energy industries provide more job opportunities than fossil fuel industries, a decline of coal and other fossil fuel jobs nonetheless significantly affects those that held the jobs, as well as the economies in which they reside. Meanwhile, pension funds through the coal industry are severely underfunded due to the economic decline of the industry.” (Carley & Konsky, 2020, 3)

Other Resources

Related Topics in this Document: Workforce Development, Facility Siting Issues

Reduce Carbon Leakage Risk and Anti-Competitiveness Impacts

LPDD Recommendations

- “State PUCs could change existing cost recovery frameworks where they discourage repair by, for example, impos-ing the risk of increased leakage entirely on customers.”

Other Recommendations

- “The first-best solution to emissions leakage is to make carbon pricing complete; every source of CO₂ emissions should be responsible for its costs to society. When this solution is not feasible, for political-economy or jurisdictional reasons, programs targeted at the substitution or trade between electricity generators subject to, and exempt from, carbon pricing can be designed to directly mitigate emissions leakage. Because the organized wholesale electricity market is the platform where electricity production and consumption are coordinated across different electricity generators and regions, it is an excellent venue to address emissions leakage.” (Carbon Pricing in Wholesale Electricity Markets, 2020, 18)
- “Design of the cap-and-invest program will need to address leakage of emissions. Among the mechanisms to be used would be implementation of complementary measures to reduce electricity demand and deploy renewable energy (including the RPS and LCPS), allocating a portion of the allowances for free to sources in energy-intensive, competitive industries, and including imported energy within the scope of the program. Regulating the carbon intensity of electricity imported into the state would have to be implemented in a manner that complies with the constitutional principles governing state regulation of interstate commerce.” (CAC Report 2010, Chapter 8, page 20)

Discussion and Analysis

- “Producing synthetic methane also creates the potential for leakage, which could undermine the climate benefits.” (“Renewable” Gas – A Pipe Dream or Climate Solution?, 2020, pg. 4)
- “Even if the RTOs and FERC decide not to advance affirmative carbon-pricing rules, RTOs may still have a role to play in developing responsive market rules that assist with the implementation of carbon-pricing programs adopted by the states. Responsive RTO action may be particularly important for states to implement carbon-pricing programs that minimize leakage by applying the price to imported electricity or by crediting

electricity exports. As the descriptions of different approaches above make clear, the economic and legal features of an RTO's affirmative carbon-pricing rule are closely bound up with one another. Consequently, the approach an RTO plans to take for the adoption of a program cannot be determined independently from key elements of that program's design, such as its geographic scope, the availability of an opt-out, its leakage mitigation features across jurisdictional borders, and the price level. Rather, these elements must all be considered in relation to one another from the outset." (Carbon Pricing in Wholesale Electricity Markets, 2020, 62)

- "An interstate accord to apply a carbon tax to a group of states would accomplish a number of objectives with respect to leakage. Most obviously, a regional approach would mitigate or eliminate competitive disadvantages certain businesses within a taxing state would suffer when faced with out-of-state competitors who would not otherwise be subject to a carbon tax. And a regional approach would subject a greater quantity of GHG emissions to the tax and its reduction pressures, thereby increasing the overall effectiveness of the tax as a climate policy tool." (Ratzkin, 2017, 209)

Other Resources

Related Topics in this Document: Carbon Tax

Stranded Assets

LPDD Recommendations

- *"The federal government, states, or the private sector could require companies to consider the possibility that their fossil fuel-related assets would be stranded, before making investment decisions."*
- *"State PUCs should consider the possibility of stranded assets when assessing proposals for fossil fuel infrastructure that will be paid for by ratepayers, such as electric transmission lines and (in states where electric utilities are still vertically integrated) generating facilities."*
- *"If existing climate change disclosure litigation is resolved in a manner favorable to the New York attorney general, the New York attorney general should require securities disclosures to also include discussion of possible asset stranding related to climate regulation."*

Related LPDD Database Pathways

- Stranded Assets and Climate Disclosures: <https://lpdd.org/pathway/stranded-assets/>

Other Recommendations

- Look at 'Geothermal Networking' as a way to address natural gas stranded assets (Gellerman, 2020)

Discussion and Analysis

- “Most gas distribution infrastructure assets in New York, will ultimately be in actual use for a period that is significantly shorter than its physical useful life. The transition mandated by the CLCPA will lead to some portion of those assets’ value being “stranded”—that is, unrecoverable in the way that was initially planned—because of reductions in both the level and duration of the asset’s usage.” (Gundlach & Stein, 2020, 20)
- “The business proposition associated with as-of-right line extensions to residential customers will have been significantly changed by the passage of the CLCPA. In other words, the current rules may obligate gas utilities to waste ratepayer money—either knowingly or disregarding available facts. Necessarily, the CLCPA’s mandates have implications for the future of mass market consumption of fossil fuels in New York, including for the services provided by gas corporations and the likely useful lives applicable to new investments in infrastructure to be used to provide such services. And yet, however clear those implications might be from a business standpoint, they do not effectuate revisions to longstanding practice and enforceable legal rights, including gas utilities’ expectation that they can recover from ratepayers the cost of line extensions to new customers. Barring further changes to existing law, gas corporations (which hold a monopoly only for the distribution of gas) and combination utilities (which hold monopolies for the distribution of gas as well as electricity), will continue to operate on the expectation that when they invest in gas assets to serve the needs of gas customers, they can recover from gas customers in aggregate the costs associated with such investments (amortized over the useful life of such assets), together with a reasonable rate of return.” (Gundlach & Stein, 2020, 21)
- “By the 2020s, consumption of every fossil fuel declines in a pathway to 350 ppm. Thus, new infrastructure to transport fossil fuels run a high risk of either becoming stranded or locking in a higher emission pathway. Some infrastructure built for a 20th century energy system is still useful in the 21st century such as natural gas storage and transmission pipelines and should be maintained.” (350 PPM Pathways, 2019, 66)
- “Geothermal ‘Networking’: “The idea is that a gas utility takes out its leaky gas pipe and, instead of putting in new gas pipe, we put in a hot water loop... Eversource conducted its own study of networked geothermal heat pump systems, leading it to propose three different pilot projects to Massachusetts regulators in order to prove that the networked systems are feasible...“Under a networked system, homes and businesses would own the geothermal heat pumps, while Eversource would own and manage the system of pipes, sensors and pressure regulators, Conner said. That would convert the gas utility into a networked, thermal management company.” (Gellerman, 2020)

Other Resources

Related Topics in this Document: Facility Siting Issues, Impacts of Closing Electric Grid Generating Facilities and Opportunities Presented by Reuse of These Sites, Geothermal

Environmental Justice

Criteria and List of Disadvantaged Communities

New York Actions

- “The CLCPA defines “disadvantaged communities” as “communities that bear burdens of negative public health effects, environmental pollution, impacts of climate change, and possess certain socioeconomic criteria, or comprise high-concentrations of low and moderate- income households, as identified pursuant to section 75-0111 of this article.” Section 75-0111 in turn creates a process through which the Climate Justice Working Group will establish criteria for identifying disadvantaged communities.” (CES White Paper, 2020, 12)
- “The CLCPA also includes a mechanism for tracking progress toward ensuring that LMI and disadvantaged communities share the benefits of the clean energy transition. The CLCPA requires the Commission to direct NYSERDA and IOUs to “develop and report metrics for energy savings and clean energy market penetration in the low and moderate income market and in disadvantaged communities . . . and post such information on the authority’s website.”³¹ NYSERDA will work with DPS over the course of 2020 to develop a framework for tracking market penetration and energy savings associated with the allocation of ratepayer funds in the LMI market, building on the data that is currently available in the Clean Energy Dashboard. Upon the establishment of criteria for disadvantaged communities by the Climate Justice Working Group, NYSERDA will incorporate disadvantaged communities into the metrics tracking and reporting framework.” (CES White Paper, 2020, 17)
- “DEC defines potential EJ areas as U.S. Census block groups of 250 to 500 households that meet or exceed at least one of the following statistical thresholds: 1. At least 51.1% of the population in an urban area reported themselves to be members of minority groups; 2. At least 33.8% of the population in a rural area reported themselves to be members of minority groups; or 3. At least 23.59% of the population in an urban or rural area had household income below the federal poverty level.” (Securing Our Future, 2020, 24)

Discussion and Analysis

- “EJ communities are low-income communities and communities of color who face disproportionate exposure to environmental hazards due to both intentional design and structural racism. In New York City, EJ communities tend to live close to sources of noise, air and water pollution, including power plants, waste transfer stations, wastewater treatment plants, highways, and industrial sites. They also tend to have less access to environmental amenities such as safe parks and green, open space. These disparities are often associated with higher rates of asthma, heart disease, and cancer, and increased vulnerability to heat-related disease and death in EJ communities.” (Just Nature NYC, 2020, pg. 2)
- “California Environmental Protection Agency (CalEPA) undertook the task of identifying disadvantaged communities through public consultation and the California Communities Environmental Health Screening Tool 3.0 (CalEnviroScreen).⁹⁰

CalEnviroScreen is a tool that scores each census tract in California for pollution burden and population characteristics to identify areas disproportionately burdened by and vulnerable to multiple sources of pollution.⁹¹ The output of the tool is a score for each locality and a map to be used for the purpose of allocating California Climate Investments according to the statute.” (EQuality, 2020, pg. 63)

- “The California Office of Environmental Health Hazard Assessment (OEHHA), on behalf of the California Environmental Protection Agency (CalEPA), has developed a quantitative methodology which assigns numerical scores to local geographies based upon their aggregate burden of and vulnerability to various sources of environmental pollutants. This effort is known as the CalEnviroScreen program and is currently on its third iteration. CalEnviroScreen 3.0 (CES) scores are issued at the census tract level for the entire state. Census tracts whose combined CES scores place them above the 75th percentile statewide are technically classified by the California Energy Commission (CEC) as environmentally disadvantaged communities (DACs). This designation qualifies these communities for priority consideration under various state level funding programs and initiatives.

The CES program’s use of census tract boundaries as a reference geography presents a challenge for this analysis as zipcode geographies are the most common geographic unit for the spatially disaggregated reporting for energy system transformation metrics. In order to reconcile the incongruence between census tract and zipcode geographies we developed a methodology to assign each zipcode with the average scores of all of the census tracts that it spatially intersects. According to this methodology, zipcodes whose mean CES composite scores are still above the 75th percentile DAC threshold were assigned the label majority-DAC zipcodes. A more detailed discussion of this spatial aggregation as well as a map visualization of the spatial correspondence between DAC census tracts and majority-DAC zipcodes are provided in the supplementary material.” (Growing Inequities in the Residential Energy Sector, 2020)

Other Resources

Related Topics in this Document:

Climate Justice Working Group recently appointed (CAC Meeting, 6/24) - members linked here: https://greenbank.ny.gov/CLCPA_new/Climate-Justice-Working-Group

Low-Income Assistance: Electricity

New York Actions

- “This statewide framework will invest nearly \$1 billion through 2025 to advance energy efficiency in the LMI market segment, including:
 - Over \$300 million to reduce energy burdens by increasing access to energy efficiency for LMI homeowners and renters;
 - More than \$500 million to improve energy efficiency in affordable multifamily buildings;

- \$45 million for community-level engagement and capacity building with community-based organizations; and
- \$30 million for developing clean heating and cooling solutions for LMI homes and buildings through research and analysis of institutional barriers, and funding of pilots and demonstrations. This investment builds on New York's nation-leading push on building electrification with the recently approved New York State Clean Heat Implementation Plan that will invest nearly \$700 million in building electrification solutions, including a variety of heat pump technologies.” (LMI Clean Energy Investments, 2020)
- “One of the most important elements of the New Efficiency: New York program is that it allocates at least 20% of incremental funding—representing \$253 million for 2021-2025—to LMI efficiency programs. Furthermore, the PSC directed that 40% of the LMI budget be spent on multifamily buildings (on a statewide basis, recognizing that there are more multifamily buildings in some utility territories than others). EEFA NY strongly supports the PSC’s focus on providing targeted financial support for ramped-up efficiency in the affordable multifamily sector, and this is a critical start on that path.” (Valova, 2020)
- “In a petition recently addressed by the Commission, NYSERDA proposed an expansion of the NY-Sun program intended to fulfill this requirement and to “dramatically advanc[e] access to solar energy for LMI customers, environmental justice communities and disadvantaged communities.”²⁵ In its May 14, 2020 Order Extending and Expanding Distributed Solar Incentives, the Commission approved NYSERDA’s proposal to allocate \$135 million for additional incentives for projects benefitting LMI customers, affordable housing, and environmental justice and disadvantaged communities as well as at least \$65 million of MW Block and Community Adder incentives supporting the projects that receive those additional incentives.” (CES White Paper, 2020, 15)
- “In its January 16, 2020 Order Authorizing Utility Energy Efficiency and Building Electrification Portfolios through 2025,²⁸ the Commission authorized substantial new utility investments in energy efficiency, incorporating the requirement that no less than 20% of incremental funding go to dedicated LMI programs, and authorizing NYSERDA to allocate \$30 million to LMI heat pump programs.²⁹ Further, the State’s IOUs and NYSERDA were directed to develop a statewide LMI portfolio, to include the incremental energy efficiency funding and investments in energy affordability and access through the Clean Energy Fund. The IOUs and NYSERDA will soon file with the Commission an LMI Portfolio Implementation Plan that provides a comprehensive view of the LMI program goals and implementation strategies.” (CES White Paper, 2020, 16)
- “National Grid's Fruit Belt Community Solar Demonstration Project: National Grid aims to help low-to moderate-income customers access clean energy while reducing arrears through a neighborhood solar project in an economically distressed area, and test how solar can be paired with communications technologies to deliver benefits to the overall electricity system” (REV - Demonstration Projects 2020)
- “Provide consumer incentives through New Efficiency New York to increase the affordability of electrification solutions for residents and businesses in New York while delivering 4.6 Trillion Btu of energy savings.” (Clean Energy, 2020, Electrification of Buildings, pg. 35)

- Federal Department of Energy’s Weatherization Assistance Program, which provides funding to low-income households to buy more energy efficient appliances (Weatherization, 2020)
- “NYSERDA’s RetrofitNY program will change the way buildings in the multifamily sector are renovated. RetrofitNY will bring a large number of affordable multifamily housing units to or near net zero energy use by 2025” (NY to Zero, 2019, Affording Multifamily Net Zero Energy, pg. 19)

Other Recommendations

- “Targeted funding must be accompanied by robust customer identification, education, outreach, referral, and enrollment programs, not just for individual customers, but for affordable multifamily property owners and managers as well. LMI programs must also explicitly include efficiency support for in-unit and common areas in multifamily buildings. In addition, the PSC correctly notes that the utilities’ “current portfolios do not sufficiently target building envelope improvements” (Efficiency and Electrification Order at p. 45). Multifamily efficiency programs must include whole-building measures.” (Valova, 2020)
- “We recommend that NYSERDA direct funds to innovative financing for clean energy and carbon abatement, working with grassroots advocates such as the Brooklyn Movement Center, El Puente, and Chhaya CDC, as well as utility companies, to develop a business model that would be fully inclusive of LMI customers in environmental justice communities. This commitment could help stimulate entrepreneurship, employment, and growth in the local clean energy market.” (Bautista et al, 2019, 6)
- “Actionable steps that can be taken by jurisdictions to implement similar subsidy scheme [to make Low-Income Energy Efficiency Programs]:
 1. Pass legislation set up of a subsidy scheme for energy efficiency measures either specifically for low-income households or as part of a broader/ existing scheme.
 2. Set up or identify a body for oversight and management of the scheme.
 3. Define and set up a suitable application, implementation and evaluation procedure. Identification of low-income households can be done through leveraging other public programmes or databases.
 4. Publicise the scheme broadly, e.g. online and in local communities.
 5. Provide a measurable benefit for participants.” (EQuality, 2020, pg. 59)
- “Develop a robust portfolio of programs for low-income consumers and disadvantaged communities, in coordination with utilities.” (Clean Energy, 2020, Energy Efficiency, pg. 18)
- “Identify scalable models for adoption of heat pump solutions/ beneficial electrification in the LMI market segment.” (Clean Energy, 2020, pg. 31)
- “Implement a statewide LMI portfolio with the investor-owned utilities that increases the impact of ratepayer-funded LMI initiatives.” (Clean Energy, 2020, pg. 31)
- “Invest in development of replicable models for achieving a healthier built environment and carbon neutrality in LMI and otherwise disadvantaged communities.” (Clean Energy, 2020, pg. 31)
- “Expand access to solar for LMI households, communities, and affordable housing.” (Clean Energy, 2020, pg. 31)

- “Align State resources and strategy to increase public investment in energy affordability and access.” (Clean Energy, 2020, pg. 31)
- “Expand reach of energy efficiency and weatherization programs.” (Clean Energy, 2020, pg. 31)
- “Leverage regulatory, policy, and financing mechanisms to increase adoption of clean energy solutions in affordable housing.” (Clean Energy, 2020, pg. 31)
- “Quantify and maximize health and other non-energy benefits associated with clean energy improvements in LMI communities.” (Clean Energy, 2020, pg. 31)
- “Re-align low-income weatherization and efficiency programs to focus on GHG emissions, utility bill reduction, health, comfort and rapid deployment of measures through a comprehensive program of outreach, technical assistance, bulk purchasing, and subsidized installation based on performance and contractor training.” (CA Building Roadmap, 2019, 10)
- “We suggest that the redistributive investment of public funds for the purpose of accelerating DAC participation in energy system transformations constitutes a socially optimal investment strategy – one which reflects the dramatically higher marginal utility of units of energy consumed at levels of sufficiency rather than excess.” (Growing Inequities in the Residential Energy Sector, 2020)
- Instead of “continuing to finance EE programs whose measures are most easily implemented during the processes of new construction or major renovations and thus, are disproportionately used by affluent, single family homeowners,” we suggest “creating new EE programs whose measures can be readily implemented in densely occupied, aging, or multi-family structures and which address the renter-owner split incentive barrier” (Growing Inequities in the Residential Energy Sector, 2020)
- Instead of “Continuing to subsidize net-metering tariffs which pay the owners of affluent single family homes above market rates to install large PV systems capable of offsetting up to 100% of their total annual consumption,” we suggest “creating new virtual net-metering tariffs which allow for the output of community scale PV systems to be virtually allocated to several multi-family households, partially offsetting a fraction of their annual consumption” (Growing Inequities in the Residential Energy Sector, 2020)
- Instead of “Continuing to provide tax rebates for the members of affluent households to purchase multiple, potentially redundant, EV/PHEVs for limited use in satisfying their personal transportation needs,” we suggest “restricting the availability of these rebates to low-income, single vehicle households and ride share fleet operators whose services can, potentially, satisfy the transportation needs of numerous households” (Growing Inequities in the Residential Energy Sector, 2020)
- “Increased investment in weatherization through federal programs, utility ratepayer-funded programs, and other sources can help revitalize our economy in recession by creating jobs, improving community resilience and public health, and reducing the wealth gap and energy insecurity.” (Weatherization, 2020)

Discussion and Analysis

- “Targeted energy efficiency measures. Leveraging the policy and institutional infrastructures that exist throughout EU countries in the form of energy efficiency obligation schemes and subsidies that direct more funds to low-income households and

ensure future energy savings. The programmes should include upfront subsidies to help overcome the initial investment costs which are often barriers to implementing energy efficiency measures for the most vulnerable households. The financing could leverage recycled revenue raised from decarbonisation policies and/or could be co-funded through government funding. The amount of funding required is 1–3 billion EUR per annum for the EU as a whole.” (EQuality, 2020, pg. 2)

- “Energy efficiency measures in industry reduce costs which feed through into consumer prices. As shown in Figure 15, since lower income households spend a higher share of their income such price reductions have a larger impact on these households. In addition, energy efficiency improvements in homes also proportionally benefit lower income households when these lead to savings in the energy bill. Finally, the overall energy efficiency improvements are large enough to shift fossil fuel prices leading to a substantial reduction in energy use across the whole EU which leads to a small reduction in energy prices from which lower income households benefit further.

It is important to highlight that the impact of the benefit of energy efficiency improvements across households depends on how the costs of the energy efficiency are distributed. In this scenario, the additional expenditure on energy efficiency measures for households is attributed as a percentage increase on spending on household maintenance. This spending is broadly even across household deciles, but in absolute terms, higher income households pay a larger share of the investment costs.” (EQuality, 2020, pg. 35)

- “Studies document another form of personal hardship related to the energy transition: enhanced energy insecurity. It is possible that the energy transition will result in a higher cost of energy, at least in the short- and medium-term, due to the need to cover new infrastructure and technology costs, for example, for smart meters, power lines and battery storage technologies. If the costs of energy rise, it will disproportionately harm those that already pay a large share of their income on energy and do not have extra income to absorb higher bills.” (Carley & Konsky, 2020, 3)
- “Researchers have also identified many cases in which access to low-carbon and efficient technologies that accompany the energy transition is not universal and, in most cases, is exclusively seized by higher income households. Scholars have drawn such conclusions about low-emissions and electric vehicles, residential solar photovoltaic panels, community solar, smart meters, efficient appliances and LED lightbulbs. This lack of technological availability or access across all demographics is typically attributed to the high upfront costs of these technologies, incentives for purchase of the technologies that reduce eligibility of those that do not have strong credit or do not pay taxes, for example, and a misalignment between required installation and use of the technology with living conditions (for example, rental properties).” (Carley & Konsky, 2020, 4)
- “Studies find that low-income households and households of colour are more likely to live in energy inefficient dwelling units, have inefficient appliances, or poorer structural building conditions, all of which requires more energy to heat or cool to adequate living conditions. These conditions both exacerbate energy insecurity and, where the costs of energy rise as a result of the energy transition, these populations may be further disproportionately burdened, and potentially face more severe circumstances such as utility financial burden and the threat of utility disconnection. In addition, as climate

change continues to alter weather patterns, and affect residential thermal conditions, vulnerability toward energy insecurity may continue to grow.” (Carley & Konsky, 2020, 4)

- “The decreasing cost and increasing availability of new technologies capable of improving household energy efficiency, generating and storing renewable energy, and decarbonizing major end use appliances have begun to significantly transform many residential communities across the U.S. Despite these positive developments however, the degree to which disadvantaged communities (DACs) have been able to participate in and benefit from these transformations remains far from equal” (Growing Inequities in the Residential Energy Sector, 2020)
- “It is likely that residents of low-income DACs will be inherently more limited in terms of their ability to either reduce or shift the timing of their consumption. Consequently, these communities may be more adversely impacted by these new energy pricing schemes. Wealth is a prominent driver of demand for residential energy. Worldwide, wealthier groups lead more materially and energetically intensive lives than the less affluent, consuming in excess of what they require to meet their essential needs (Meyers et al., 2003; Creutzig et al., 2015; Fournier et al., 2019). In the state of California, this relationship between income and the demand for residential energy services has been previously studied – with higher-income groups being found to consume more electricity and gas than lower-income groups (California Energy Commission, 2018). These lower levels of consumption, in many cases, are also paired with a lower standard of energy services due to the inferior thermal performance among the older, lower-quality housing stock, and less efficient household appliances which are common in DACs (Barbose et al., 2018).” (Growing Inequities in the Residential Energy Sector, 2020)
- “Faced with need to reduce the greenhouse gas emissions (GHGs) of their energy consumption, many states, including California, have embarked on courses of market-based ecological modernization (Mol et al., 2009). In the past 20 years, market-based electrification and energy efficiency (EE) initiatives, primarily subsidies and tax credits, have become preferred tools for encouraging adoption of domestic renewable energy systems, electric vehicles, and newer, more efficient appliances (Reames and Stacey, 2019). Rather than curtailing the demand for energy, states have instead sought to reduce the GHG intensity of energy services by increasing the efficiency of residential housing stock and electrifying end-uses currently powered by fossil fuels. Increases in residential efficiency and distributed generation, it is hoped, will decrease demand for energy, with gradual fuel-switching for heating and transportation enabling further decarbonization (Reames and Stacey, 2019).” (Growing Inequities in the Residential Energy Sector, 2020)
- “In 2016 at least \$2.5 billion dollars [were spent] on residential EE initiatives, based upon data available from twenty-nine states (Reames and Stacey, 2019). While their ease of implementation and politically inoffensive nature are attractive to policymakers, many of these programs have been found to disproportionately benefit wealthier individuals (Galli-Robertson et al., 2019). Incentive programs, even those that offer more generous payments to applicants that meet low-income requirements, are consistently underutilized by lower-income and minority cohorts due to financial barriers, limited awareness of such programs, and lower rates of property ownership (Bird and

Hernández, 2012; Scavo et al., 2016; Parsons et al., 2018).” (Growing Inequities in the Residential Energy Sector, 2020)

- “By design, market-based approaches to residential EE, electrification, and renewable generation capacity expansion programs tend to prioritize volume – measured in units of either of estimated energy savings, sales, or installed capacity – over the equitable distribution of program benefits. The tendency of these programs to be over-utilized by the rich and under-utilized by the poor is well-documented. However, this tendency is not always perceived as problematic or even especially undesirable. If the primary objective of market-based incentive programs is GHG abatement, what does it matter if wealthy citizens are the ones who are participating, so long as demand for grid-supplied energy diminishes? This simplistic approach ignores the fact that the marginal benefits enjoyed from the consumption of each additional kilowatt-hour or therm vary between individuals as well as at different levels of consumption. These marginal benefits decline substantially as the volume of consumption increases beyond the sufficiency range. Thus, the cumulative benefits generated from the expenditure of public funds are maximized when programs target households whose levels of consumption are within the sufficiency range.” (Growing Inequities in the Residential Energy Sector, 2020)
- “If the renewable energy transition is to both significantly reduce emissions of locally impactful criteria pollutants and globally impactful GHGs as well as alleviate energy insecurity without enabling excessive consumption, current residential energy policies are inadequate. In order for these policies to maximize the social benefits of domestic renewable energy systems, electric vehicles, and energy efficiency programs, they must account for the higher marginal utility of units of energy consumed at or below the level of sufficiency.

DAC residents who currently experience energy poverty stand to benefit immensely from such redesign of energy efficiency and residential renewable energy incentives. Inequities in the energy transition are of concern not because DAC members should have EVs, PV systems, and efficient appliances as a matter of fairness in material allocations. Rather, they are of concern because adoption of these goods ensures that individuals and households are not deprived of the full suite of energy services in a renewable future and are not subjected to economic hardship or other indecencies as a result of the energy transition.” (Growing Inequities in the Residential Energy Sector, 2020)

- “Public policies designed to reduce GHG emissions in California have resulted in a skewed distribution of benefits toward those who utilize the most energy. This is because these affluent consumers have a greater ability to access existing programs and incentives. This inequality of participation amounts to the implicit subsidization of excess consumption, which is being financed by the general energy utility rate payer. Program participation requires extra effort, knowledge and access. The underlying design assumption behind the majority of these policy programs – that equality of availability will necessarily produce equality of participation – is fundamentally flawed.” (Growing Inequities in the Residential Energy Sector, 2020)
- “Current policies do not address the absolute levels of energy consumption, per se, but rather tend to focus on increasing energy efficiency. However, increases in efficiency have largely only been realized at the highest levels of consumption. Low income DAC

residents continue to live in less comfortable housing and pay a larger proportion of their income for that discomfort. This problem with efficiency has been known for over a century, and was first described by William Stanley Jevons when observing the introduction of coal in England (Alcott, 2005). He noted that though the efficiency of engines was improving, more and more coal was needed as there was an expansion of its use. It is critical today to understand that efficiency improvements alone are not likely to lead to absolute reductions in energy use” (Growing Inequities in the Residential Energy Sector, 2020)

- “It is likely that the imposition of hard limits on total energy use will ultimately be necessary to mitigate all of the impacts incurred across the breadth of this life cycle. The inequities in the system as it exists today place a larger burden of cost on the least affluent, and, perversely, reward the high consumers with access to incentives. Policy aims need to get beyond efficiency to address absolute levels of consumption and to reflect reasonable need rather than excessive use. If not, efficiencies will continue to chase increased demand with limited effect, and DAC communities will be prevented from improving their well-being, though they use the least energy of all.” (Growing Inequities in the Residential Energy Sector, 2020)
- “Black households have higher residential energy expenditures than white households in the US. This residential energy expenditure gap persists after controlling for income, household size, homeowner status, and city of residence. It decreased but did not disappear between 2010 and 2017, and it is fairly stable in levels across the income distribution, except at the top. Controlling for home type or vintage does not eliminate the gap, but survey evidence on housing characteristics and available appliances is consistent with the gap being driven at least in part by differences in housing stock and related energy efficiency investments.” (Lyubich, 2020, pg. 1)
- “Black Americans bear a disproportionate burden of the current energy system, both through disproportionate pollution exposure, and as I highlight, through disproportionate costs, likely at least in part as a result of persistent disparities in wealth and housing.” (Lyubich, 2020, pg. 2)
- “Black respondents are about 13 percentage points more likely to report that their home was at least somewhat drafty. Out of a set of several appliances and home features⁹, Black respondents have a 7 percentage point lower share that were Energy Star rated, and they are 3 percentage points less likely to report having received a rebate or tax credit for upgrading an appliance. If anything, Black respondents are slightly more likely to have gotten an energy audit, suggesting that this isn’t a matter of differential information, though this result is not statistically different from 0. Moreover, Black respondents were about 50% more likely to report having reduced or forgone basic necessities at least one month in the last year in order to afford their energy bill, were about 40% more likely to report having kept the home at an unhealthy temperature at least one month in the last year in order to afford their energy bill, and were about twice as likely to have received a disconnect notice due to inability to pay a bill at least one month in the last year. These estimates suggest that energy costs are highly salient, and are evidence of a striking disparity in energy burden” (Lyubich, 2020, pg. 5)
- “Black households face a higher energy burden than white households at almost every position in the income distribution. Understanding the differential energy burden is

critical when designing policies that will affect energy prices, such as much-needed policy to reduce greenhouse gas emissions. This is especially true given that this gap may be another of many outcomes that has been affected by the persistent effects of systemic racism in the United States, mediated in particular by differences in housing stock and wealth.” (Lyubich, 2020, pg. 5)

- “Home weatherization provides a long-term, much-needed solution for energy affordability for many low-income families who live in older buildings with less-efficient appliances and equipment. It also improves comfort and health at a time when more people are staying home during the COVID-19 pandemic and creates jobs, which are badly needed now. Even though weatherization reduces energy bills and provides health benefits, such as reduced asthma risk, funding from the Department of Energy (DOE) for WAP doesn’t currently meet the demand and needs of low-income households... only about 2% of low-income households in the United States receive much-needed weatherization services each year.” (Weatherization, 2020)
- “NASCSP’s funding survey also shows that WAP’s funding has increased in recent years, but not enough to meet the overwhelming need. In addition, the weatherization program has wisely shifted in recent years to focus on deeper, more comprehensive retrofits and stronger quality work plan and inspection requirements, all of which can save more energy and reduce costs further. Because of this greater investment per home, the number of homes weatherized annually has actually decreased.
- Weatherization funding can and should be increased. Just last week, the U.S. House of Representatives passed an infrastructure bill that called for a significant increase in program funding, up to \$1 billion in 2025. Congress is also working to set weatherization funding levels for the upcoming fiscal year.” (Weatherization, 2020)
- “The City and State should work with utilities to create programs that benefit New Yorkers who have thus far been excluded from the clean energy economy. Such programs should target low-income communities, communities of color, and renters who have historically faced both the disproportionate health impacts of fossil fuel-based infrastructure, and stand to benefit most from strategic investment in energy efficiency and clean energy... This commitment could help stimulate entrepreneurship, employment, and growth in the local clean energy market.” (Bautista et al, 2019, 6)
- “One strong model for equitable energy efficiency financing is called Pay As You Save (PAYS). PAYS allows customers to purchase and install cost-effective upgrades through a voluntary on-bill tariff. Due to the energy efficiency improvements, the customer’s overall energy bill is lowered, even when the tariff is added to their monthly bill. This model is more inclusive than debt-based programs because PAYS programs are open to customers regardless of income, credit score, or renter status. PAYS has been highlighted by the NAACP as a mechanism to alleviate energy burden for low-income communities of color.”(Bautista et al, 2019, 7)
- “If new offshore wind at this incremental cost of \$40.93/Mwh is used to meet the goal of 55,600,000 Mwh of renewable energy in 2030, then New Yorkers will spend an extra \$2.3 billion per year for electricity. This incremental cost would be an increase of between 8 percent and 12 percent on statewide electric bills, which could be a significant increase in monthly living expenses for some low-income and working class New Yorkers.” (Getting Greener, 2019, The Cost of New Offshore Wind Generation, pg. 29)

- “A cap-and-trade system can be particularly suited to the multi-family housing stock when it includes public housing. As an example, a portion of public housing is in desperate need of energy efficiency upgrades, from new windows and insulation to new boilers, but many public housing systems lack the capital to make these improvements. A cap-and-trade system would enable public housing to finance improvements through the sale of emissions credits created by improved energy efficiency” (Getting Greener, 2019, 4.1.1 Cap-and-Trade System, pg. 43)
- “Beneficial Electrification for Low-and-Moderate Income (LMI) Consumers — Support development of electrification solutions that can benefit LMI consumers, addressing both affordability and technical issues associated with the low-income building stock.” (Clean Energy, 2020, Electrification of Buildings, pg. 35)
- “Community solar projects, if supported and executed with an eye towards equity and justice, have the potential to achieve a range of important objectives, including spurring local community-based economic development through utility bill alleviation and the establishment of long-term community economic assets; addressing entrenched race- and class-based inequities imposed by historical environmental and economic burdens in the energy sector; and shifting energy generation towards cleaner, more efficient sources in the interests of both energy conservation and mitigation of the environmental and public health impacts of traditional energy sources.” (Prakash, 2018, 201)
- “Community solar projects often explicitly seek to lift the burden of high and unpredictable utility bills on lower-income households through project participation. Lower-income households throughout New York State tend to be significantly more energy burdened than middle- and higher-income households.²⁸ Developing a subscriber base focused on lower-income households can pose some challenges both from a financing and organizing standpoint. On the financing side, given that the revenue stream for a community solar project is through its subscription fees and depends on subscribers’ ability to pay those fees consistently over time, traditional financiers of community solar development often require certain minimum credit scores for all participating subscribers. Lower-income households and people of color in particular may have difficulty demonstrating compliance with such a threshold for a range of reasons including historic and persistent barriers to credit and the lasting impacts from predatory lending practices.²⁹ Early findings in studies of bill payment performance suggest that an individual’s FICO credit score is not necessarily a strong indicator of whether they will pay a bill associated with their utilities.³⁰ Therefore, this barrier to developing a low-income subscriber base and alleviating significant energy burden and insecurity is likely unwarranted in many cases.” (Prakash, 2018, 206)
- “Low-income households have also been the targets of predatory practices in the energy space since the deregulation of the energy markets and the entry of numerous energy service companies (ESCOs) in the 1990s.³¹ Aggressive door-to-door sales, vague and unenforceable commitments to reduce energy cost, and unanticipated and in many cases egregious increases in utility costs for already energy-burdened customers resulted in the Commission putting a moratorium on sales of ESCO services to low-income utility customers.³² This history casts a pall over current efforts to engage lower-income utility customers in a community solar project, an initiative that can feel suspect to many who dealt with escalating utility costs after entering into contracts with ESCOs... Potential

subscribers are more likely to feel comfortable participating in community solar project stewarded by an organization with a track record of deep community involvement and trust-building over decades.” (Prakash, 2018, 206)

- “Currently, low-income customers enrolled in the California Alternate Rates for Energy (CARE) Program or the Family Electric Rate Assistance (FERA) Program are also eligible to receive a rebate under the California Climate Credit, or a credit on residential and small business electricity bills resulting from the sale of allowances received by investor-owned utilities as part of the Cap-and-Trade Program.” (CA Scoping Plan, 2017, 37)

Other Resources

Related Topics in this Document: Cap-and-Trade, Energy Efficiency, Community Solar

Low-Income Assistance: Natural Gas

New York Actions

- “The New Efficiency: New York program has as its primary goal the achievement of annual efficiency savings of 3% for electricity and 1.3% for gas – goals that match or exceed the targets set by the majority of states in the U.S. The PSC has allocated a total of \$1.99 billion in ratepayer funds from 2019-2025 toward electric and gas efficiency programs and electrified heating investments (in addition to previously authorized programs totaling another \$1 billion). Under the Efficiency and Electrification Order, \$892 million will go toward electric efficiency investments, \$552 million toward gas efficiency, and \$454 million toward heat pumps... One of the most important elements of the New Efficiency: New York program is that it allocates at least 20% of incremental funding—representing \$253 million for 2021-2025—to LMI efficiency programs. Furthermore, the PSC directed that 40% of the LMI budget be spent on multifamily buildings (on a statewide basis, recognizing that there are more multifamily buildings in some utility territories than others). EEFA NY strongly supports the PSC’s focus on providing targeted financial support for ramped-up efficiency in the affordable multifamily sector, and this is a critical start on that path.” (Valova, 2020)
- “PSC approved several important funding and programmatic provisions as part of Con Edison’s 2019 rate case, including: granting Con Edison full flexibility to allocate funds between its electric and gas LMI efficiency programs; making its gas efficiency programs available to interruptible customers—an important measure that can increase efficiency access to a subset of customers who haven’t previously been able to take advantage of energy efficiency programs; and a commitment by Con Edison to help owners/developers of LMI projects obtain financing by funding studies of efficiency project potential and by providing the customer with a commitment letter for the utility incentives for which they are eligible.” (Valova, 2020)

Other Recommendations

- “EEFA NY also appreciates the PSC’s instruction to the utilities to design their gas efficiency incentive programs to maximize gas efficiency. Increasing gas efficiency for

existing gas customers is critical to promoting greater affordability and environmental benefits. At the same time, in regard to new customers seeking energy services for cooking, heating, or hot water, the utilities must prioritize renewable alternatives to the greatest extent possible.” (Valova, 2020)

Discussion and Analysis

- “Affirming that customers have a right to energy and heat, at just and reasonable rates, while eliminating provisions that ensure the indefinite continuation and expansion of gas service; Maintaining the financial and functional capacity of gas corporations to operate through the transition, recognizing that they are unique repositories of know-how, data, and customer relationships; and Ensuring that customers who continue to rely on gas to serve their heating loads do not face spiraling bills as the number of customers contributing to gas company revenue shrinks while gas company expenses and liabilities skyrocket.” (Gundlach & Stein, 2020, 32)
- “Energy insecurity is significantly higher than most policymakers might assume, and a coordinated energy and housing assistance effort is necessary to target such energy insecurity... Successful funding programs stress the importance of leveraging multiple funding streams, building partnerships including those with the local community, designing predictable policies, seeking low-hanging and highly cost-effective interventions, and prioritizing quality control and training.” (Carley & Konsky, 2020, 6)

Other Resources

Related Topics in this Document: Building Heating Systems

Low-Income Assistance: Heating Oil

New York Actions

- “The Home Energy Assistance Program (HEAP) helps low-income people pay the cost of heating their homes.” There are emergency and regular benefits, depending on the severity of the situation. (HEAP 2020)
- “The NYC Retrofit Accelerator continues the mission of NYC Clean Heat, a successful program that provided guidance to help building owners convert off of No. 6 and No. 4 heavy heating oil to cleaner fuels.

In April 2011, the New York City Department of Environmental Protection issued regulations requiring buildings with certain sized boilers, typically found in buildings 40,000 square feet or larger, to convert from No. 6 and No. 4 heavy heating oils to cleaner fuels. The deadline for converting off of No. 6 heating oil was June 30, 2015. The City achieved 100 percent compliance with the regulation, due largely to the direct assistance provided through NYC Clean Heat.

Buildings still burning No. 4 oil must switch to a cleaner fuel by 2030 or during boiler or burner replacement, whichever is sooner. Buildings have four alternative fuels to choose from: ultra-low sulfur (ULS) No. 2 oil, biodiesel, natural gas, or steam.” (Retrofit Accelerator, 2020)

Discussion and Analysis

- “When fossil fuel support is phased out, this frees up government expenditure which can be used to reduce taxation rates. Figure 14 shows that under the standard revenue balancing assumptions, the reduction in taxes makes the policy scenario more regressive. The distributional impact increases up to 2030, by which point most of the fossil fuel support is assumed to be phased out. Beyond 2030, the size of the fossil fuel support saved falls relative to growth in economic activity and income. When variations in the revenue balancing options are considered (direct income taxes vs VAT), this shows that an increase in income tax has a relatively strong impact on the regressivity of the scenario. As the direct income tax is reduced proportionally, this benefits the higher income households more than lower income households. If revenues are balanced through VAT reductions, then this can offset the regressivity of the policy leading to a very marginal net progressive effect.” (EQuality, 2020, pg. 33)

Other Resources

Related Topics in this Document: Building Heating Systems

Public Participation and Education

New York Actions

- “EEFA NY strongly supports the PSC’s recognition that in developing programs and implementation plans, the utilities and NYSERDA must work with all relevant stakeholders, including customers and market participants, as part of the Performance Management and Improvement Process mandated in the Order. That process – and all additional stakeholder participation – should include benchmarks for incorporating stakeholder feedback into program design and implementation in a way that has a direct and meaningful impact on program design.” (Valova, 2020)

Other Recommendations

- “Finally, timely access to information and transparency were advanced as critical issues that cut across all the policy areas. The central importance to EJ communities of processes that required formal public notice and participation procedures such as federal and State permitting was repeatedly stressed by stakeholders.” (CAC Report 2010, Chapter 10, pg. 5)

Discussion and Analysis

- “These policy options could increase the longevity of climate policies by achieving greater public acceptance. Policies that increase income equality are more likely to maintain public support and options such as the direct lump-sum rebate approach can make a very visible point about the potential for decarbonisation policies to reduce inequality. Furthermore, the policy options identified by the study do not face significant legislative barriers in their implementation, as many are within the powers of the EU member states and/or align with EU directives such as the Energy Efficiency Directive (EED). As these policy options are administratively straightforward to implement, the

infrastructure and institutional capacity required are often already in place. What is needed now is the political will and ambition to act and make the changes needed to address the distributional impacts of the critical decarbonisation policies the EU needs to combat climate change. The decarbonisation transition can and should be an equal one for all citizens of Europe.” (EQuality, 2020, pg. 2)

- “The term “cumulative risks and impacts” refers to a combination of factors that result in certain communities or sub-populations being more susceptible to environmental stressors of varying kinds, including being more exposed to environmental toxins, or having compromised ability to cope with and/or recover from such exposure. Because of the breadth and nature of the policies proposed for the Climate Action Plan, stakeholders highlighted the potential for implementation to either increase cumulative impacts or decrease them depending on the specific design of individual policies and the interactions among several of them in a given community. The importance of adequately analyzing the public health implications of the proposed policies was also emphasized.” (CAC Report 2010, Chapter 10, pg. 4)
- “Community and EJ stakeholders engaged in the Climate Action Plan process repeatedly stressed the need to incorporate adequate public awareness-raising and community engagement measures into the Climate Action Plan. They stressed that without sustained local dialogues to educate community members and build support for the various policies, the desired paradigm shift to a low-carbon economy would be much more difficult... because of past difficulties, misunderstandings, and procedural missteps, many EJ leaders are wary of official decision-making and planning processes that they feel have served them poorly in the past. Explicitly acknowledging and addressing such problems and shortcomings was identified as a critical component of developing and implementing the Climate Action Plan.” (CAC Report 2010, Chapter 12, pg. 3)
- “Community and EJ stakeholders discussed the reality that awareness-raising and public education activities around climate change often have been piecemeal and sporadic, and have lacked the kind of targeted, New York-specific context to make them as effective as possible.” (CAC Report 2010, Chapter 12, pg. 3)

Other Resources

Related Topics in this Document: Facility Siting Issues

Facility Siting Issues

New York Actions

- Due to Accelerated Renewable Energy Growth and Community Benefit Act (AREGCBA), “NYSERDA will prioritize sites that are located on dormant electric generating sites, former industrial sites, existing or abandoned commercial sites, brownfields and landfills, are 65 acres or larger and have flat or gently sloped terrain. Proposed sites will be evaluated based on environmental site conditions, the ability to interconnect to the electrical grid, and whether the site is physically suited to host a large-scale renewable energy project.” (Cuomo Solicitations, 2020)
- “New York Energy Highway, an infrastructure project to update the grid and add up to 3,200 MW of electricity generation and transmission capacity through \$5.7 billion public and private-sector investments.” (New York Energy Highway 2020)
- “The Erie County Industrial Development Agency intends to work with 148 acres of the 994-acre Bethlehem Steel Redevelopment Area, the largest brownfield in Buffalo, New York. The first planned building in the NZE district is designed to be a large, NZE, light industrial building to serve as a “lighthouse project” to attract more NZE development. The project, funded by NYSERDA with \$1.75 million, will advance sustainable building design and construction and will ultimately tell the story of resiliency, urban and industrial regeneration, and innovation. The building will feature more than 80,000 square feet of mixed-use manufacturing and commercial office space and will be powered by solar, geothermal, and wind energy to produce as much energy as it consumes on an annual basis. As the first certified NZE manufacturing facility of its size in New York, the project will result in a state-of-the-art, dynamic facility to showcase new advances in renewable energy construction. The facility will also serve as a valuable hub for construction education and performance testing, energy management, and workforce training for the remaining district build-out and the greater region.” (NY to Zero, 2019, Leading with Districts, 11)
- “Department of City Planning - DCP is working closely with communities in the coastal floodplain to plan for lasting, sustainable infrastructure that prepares neighborhoods to withstand the effects of climate change. DCP is also working with communities in developing neighborhood planning initiatives that promote mixed-income housing for the city’s growing population.” (NYC 1.5C, 2017, Agency Highlights, pg. 34)

Other Recommendations

- “The Coronavirus has proven how air quality issues that disproportionately impact low-income communities can have devastating impacts.” (A State Approach to a Just Transition Webinar 2020)
- “Must focus on solar ownership for people in low-income communities. Energy from environmental justice areas is being sold to larger solar developers for profit. We need to focus on local ownership of renewable energy assets to reduce energy burden.” (A State Approach to a Just Transition Webinar 2020)
- Site a renewable facility on Rikers Island, as proposed by City Councilmember Costa Constantinides in the Renewable Rikers Act (NYC EJA, 2020, pg. 13)

- “Requiring gas corporations and other utilities to consider the long-term outlook associated with new gas infrastructure investments and to the extent feasible to plan near-term gas infrastructure investments with this long-term outlook in mind, including implications for service lives; Authorizing gas corporations to invest in programs and assets that facilitate fossil-free thermal service, in a manner that gives them an opportunity to earn a rate of return; Requiring gas corporations and other utilities to develop a safe gas decommissioning protocol that balances the need for the physical safety of workers, customers, and anyone proximate to distribution infrastructure that undergoes significant operational changes, with the need for urgency; and Establishing a mechanism to fund gas infrastructure decommissioning.” (Gundlach & Stein, 2020, 30)
- “Both the City and State should adopt model rules for protecting rent-regulated tenants from rent increases and evictions, preventing the deregulation of apartments, and restricting property resale in connection with investments in residential and commercial energy efficiency.” (Bautista et al, 2019, 6)
- Dedicate sufficient resources to Article 10 statutory agencies with primary review responsibilities (DPS, DEC, and DAM) to enable project reviews to proceed more quickly. (Kelly & Piasecki, 2019)
- Impose firm time deadlines, for all stages of the Article 10 process, on reviewing agencies to improve processing times.(Kelly & Piasecki, 2019)
- Impose limits on the ability of reviewing agencies to raise issues not raised in response to the Preliminary Scoping Statement. This change would be similar to DEC’s recent revision to the SEQRA regulations limiting lead agencies’ ability to raise new issues beyond those originally scoped. (Kelly & Piasecki, 2019)
- For projects proposed to be sited on lands currently in agricultural use, establish a presumption that the site will return to agricultural use post-decommissioning, meaning that the project proponent shall not be required to conduct natural resources studies that would not be required of an active agricultural operation. (Kelly & Piasecki, 2019)
- Direct DEC to rely exclusively on the inventory of freshwater wetlands mapped pursuant to Article 24 of the Environmental Conservation Law in determining requirements for development of specific renewable energy sites. National Wetlands Inventory (NWI) maps may be used to supplement State-mapped wetlands, but only insofar as NWI wetlands maps may implicate non-duplicative federal requirements. (Kelly & Piasecki, 2019)
- Direct DEC to develop a general permit for freshwater wetlands that will establish standard practices for all renewable energy projects, regardless of size, on sites that contain mapped wetlands. (Kelly & Piasecki, 2019)
- Direct the commissioners of Article 10 statutory agencies to identify and implement opportunities to expedite project reviews. (Kelly & Piasecki, 2019)
- Identify and implement standards for all agreed-upon (or non-controversial) environmental issues in order to limit the adjudicatory proceeding to necessary issues. (Kelly & Piasecki, 2019)
- When necessary, be prepared to overrule local laws to allow for siting and construction of renewable projects. (Kelly & Piasecki, 2019)
- “Building codes and siting guidelines should include adaptation considerations, such as placing buildings and other facilities away from projected flood zones and favoring

designs and materials appropriate for future climate conditions, to help make New York's communities resilient to climate change." (CAC Report 2010, 16)

Discussion and Analysis

- "New York City (Zone J) consumed 52,003 GWh in 2019, roughly a third of the statewide total of 155,832 GWh.⁶¹ At the same time, nearly all of the roughly 22,500 GWh of electricity generated within New York City was from fossil fuel-fired generation. Without displacing a substantial portion of the fossil fuel-fired generation currently operating within Zone J, the statewide 70 by 30 Target will be difficult to achieve. The location of fossil-fueled generation of this magnitude in the most densely populated area of the State only accentuates the need for change." (CES White Paper, 2020, 44)
- "The value of local manufacturing becomes even more apparent during national emergencies. COVID-19 has demonstrated that New York City is unable to fill the demand for medical supplies such as ventilators and N95 respirator masks that are critical for protecting public health. NYS and NYC have been calling on manufacturers to help source and manufacture these needed medical supplies.^{69,70} Manufacturers in the Brooklyn Navy Yard – an SMIA – have been filling the gap in shortages of these needed medical supplies during the pandemic.^{71,72} Since climate change has the potential to create more frequent public health emergencies, the City must recognize that rezoning of industrial space to commercial and residential uses undermines NYC's ability to respond to manufacturing and other needs that arise during a crisis." (NYC EJA, 2020, pg. 45)
- "One vision of NYC-EJA and allies is of a renewable Rikers Island, aimed at transforming the 413 acres of publicly-owned land from a notorious jail into a hub for renewable energy and energy storage technology, as well as other sustainable uses. In NYC, Rikers Island represents the inequities rampant in the criminal justice system, where people of color have for too long faced disproportionate arrests and incarceration. In 2019, the New York City Council voted to officially close down Rikers Island by 2026.⁷ Council member and chair of the Environmental Protection Committee, Costa Constantinides, in partnership with criminal justice and environmental justice advocates, put forth the Renewable Rikers Act. The Act is a package of legislation aimed at transferring ownership away from the NYC Department of Corrections and studying potential sustainable uses, including renewable energy, energy storage, stormwater management, and solid waste management.⁸ With land at premium in the five boroughs, a publicly-owned clean renewable energy project on Rikers Island would mark a major milestone in achieving NYC's climate and equity goals." (NYC EJA, 2020, pg. 13)
- There is a lot of opportunity for renewable energy projects in places like Lewis County, which already has the most renewable energy projects in New York. However, any renewable energy projects must be built with transmission in mind. Similarly, we must keep forest conservation in mind and make sure to develop the grid across the community without excessive concentrations in one area. The majority of new high power transmission lines will be upgrades to existing ones but not all. (ACE Town Hall 2020)
- "Incentives for clean energy manufacturers and developers to invest in communities that have historically hosted fossil fuel infrastructure can help those frontline communities during this transition. New investment can help create jobs and reinvigorate local

economies affected by the transition. A recent analysis suggests that for three-quarters of the remaining U.S. coal fleet, building new wind or solar power plants within 35 miles of those coal power plants could replace the energy at a lower cost than continuing to run those old coal power plants.” (Federal Policies for Net Zero, 2020, 16)

- “Low-income New Yorkers should be able to access the benefits of clean and renewable energy without the threat of gentrification and displacement. Although improved energy efficiency can potentially reduce the energy burden and increase affordability for low-income tenants, property owners of rent-stabilized units can use major renovations and investments, i.e., Individual Apartment Improvements (IAIs) and Major Capital Improvements (MCIs), to justify increasing rents and displacing long-time tenants. Inclusive financing and other incentives may help provide widespread energy retrofits in larger, multifamily buildings without incurring costs to building owners, thus precluding rent increases due to energy efficiency upgrades. Still, tenants require further protections. Both the City and State should adopt model rules for protecting rent-regulated tenants from rent increases and evictions, preventing the deregulation of apartments, and restricting property resale in connection with investments in residential and commercial energy efficiency.” (Bautista et al, 2019, 6)
- “Article 10: Instead of a seamless path towards development, applicants seeking to construct solar and wind projects have experienced what the Alliance for Clean Energy New York (ACE NY) has described as an “unnecessarily complicated and time-consuming” process that is slowing construction of renewable projects “at a time it desperately needs to accelerate.” The calls for improvements to the Article 10 process are not limited to those of developers. In an April 2019 letter sent to PSC Chair John Rhodes, 2020, a coalition of major environmental organizations likewise called for changes to the Article 10 siting process, urging adoption of a set of measures focused on speeding up the lagging project review process.” (Kelly & Piasecki, 2019, 169)
- “Standing in stark contrast to the public’s general support for renewable energy, however, is the fact that renewable energy projects, regardless of proposed location, seem never to fail to engender opposition from local residents. Everyone wants to support the development of renewable energy, as long as it is sited somewhere else, which frustrates and hampers renewable energy developers who are willing to put capital at risk in order to construct and operate these projects that are the keystone to the transition from fossil fuels.” (Kelly & Piasecki, 2019, 171)
- “Unlike the Article 10 process, a SEQRA review can generally result in an expeditious outcome, with the entire process being measured in months, rather than years. Further, a SEQRA review can be much more streamlined than the Article 10 process, which requires a lengthy pre-application process typically lasting at least nine months and submission of a detailed application, followed by what may include a prolonged process of stipulations and an adversarial hearing (and possibly rehearing) before hearing examiners from both DEC and DPS. By contrast, the applicant in a SEQRA process deals directly with the lead agency in a less formal way, conforming the project to address the lead agency’s issues, ideally leading to final approval. However, SEQRA is not without its challenges, however. Critics have long complained that the process is subject to abuse by hostile lead agencies and can be lacking in transparency.” (Kelly & Piasecki, 2019, 173)

- “Given the location of fossil generation in downstate New York, a carbon price will reduce emissions in downstate environmental justice areas. Further, given the location of fossil generation in downstate New York, a carbon price will reduce local air pollution there.” (NYISO, 2019, 58)
- “Industrial facilities are clustered in regions because of the historical resource base (e.g., refining along the US Gulf Coast or steelmaking along the Great Lakes) and may be far from either critical infrastructure or low-carbon fuel supplies. Many of the options considered in this report lack infrastructure for delivery of decarbonized fuels—including hydrogen pipelines, CO₂ storage pipelines, biogas hookups—and enabling of high-voltage transmission lines. Some regions have such infrastructure (e.g., Gulf Coast), but they are not adequately sized or organized for deep decarbonization.

Providing critical infrastructure of this kind would likely provide opportunities to serve domestic industries and limit project costs through geographic colocation.¹²¹ Build-out of such infrastructure could lower the hurdle to adoption significantly, especially in industrial hubs and clusters.¹²² Infrastructure would be supported through omnibus legislation, direct government procurement, block grants or matching grants, regulatory fast tracking, facilitation of access to rights-of-way, and special tax treatment for key infrastructure projects (e.g., economic activity zones, private activity bonds, or master limited partnership status).” (Low Carbon Heat, 2019, Implications for Policy, pg. 54-55)

- “Building location efficiency into state housing program eligibility and policies to mitigate any negative aspects of gentrification and increased housing prices resulting from revitalization and redevelopment” (CAC Report 2010, Chapter 7, page 29)
- “The current siting process for power plant facilities is left to a patchwork of local and State regulatory processes. An opportunity exists to re-create a more streamlined process for the siting of power plants. Components to consider: A siting process that combines and coordinates numerous regulatory authorizations and procedures into a single fuel- and technology-neutral approval process; time-certain framework for rendering a decision on an application; A provision for the override of the application of local substantive legal requirements that are unreasonably restrictive in view of factors specified in the statute; An analysis of alternative sites similar to that required by State Environmental Quality Review Act; A finding and determination that the authorized generating facility minimizes and mitigates predictable, significant, and adverse disproportionate environmental impacts, considering the cumulative effect of emissions from other major facilities and the goal of reducing net emissions or, at a minimum, avoiding increased pollution in communities that bear a disproportionate burden of emissions; Opportunities for extensive public involvement, including improved notice provisions, so as to address environmental justice and other public concerns associated with the construction and operation of the proposed electric generating facility; Availability of intervenor funding, starting at the pre-application phase, for technical and legal services.” (CAC Report 2010, Chapter 8, page 21)
- “It will be challenging to balance the need for efficient and predictable permitting with expanded opportunities for extensive public involvement, including improved notice provisions, to address environmental justice and other public concerns associated with the construction and operation of proposed electric generating facilities. This policy

proposes a revised process that serves both goals because unless progress is made in both areas it is doubtful that sufficient support can be mustered to accomplish either.” (CAC Report 2010, Chapter 8, page 21)

- “A coordinated project review under the power plant siting law could result in greater efficiency and lower costs for state agencies and municipalities from not having to conduct individual and possibly duplicative review processes. Also, permitting costs should be reduced with the use of a shorter and more certain regulatory process. This should result in lower costs to the developer. In addition, a more predictable permitting process might encourage a larger number of projects to be proposed, affording the state a wider range of future generation options.” (CAC Report 2010, Chapter 8 page 21)
- “Community and EJ stakeholders raised concerns about the implications of some of the proposed policy approaches for hard-won procedural safeguards designed to ensure adequate access to official decision making in areas such as permitting, the siting of facilities and infrastructure, and conducting environmental impact assessments. Specifically they cited language regarding the need to “overcome barriers” as troubling. They contended that “EJ communities have long been victimized by proposals that evade zoning and siting law review” and that carving out exceptions in order to advance climate change-related goals would be strongly opposed. As an example, they pointed to a specific controversy that occurred in New York City in 2000, when the New York Power Authority (NYPA) met with determined resistance to a plan to site natural gas-fired turbines exclusively in EJ communities. A lawsuit and citywide protests ensued, resulting in a court order directing NYPA to prepare an environmental impact statement.” (CAC Report 2010, Chapter 10, page 4)
- “Stakeholders cited the need to apply the precautionary principle to forestall unforeseen long-term health impacts in cases where relatively new and untested technologies were deployed in overburdened communities.” (CAC Report 2010, Chapter 10, page 4)

Other Resources

Related Topics in this Document: Transmission, Industrial Heat Emissions

Air Conditioning for Public Housing and Low-Income Households

New York Actions

- “This statewide framework will invest nearly \$1 billion through 2025 to advance energy efficiency in the LMI market segment, including:
 - Over \$300 million to reduce energy burdens by increasing access to energy efficiency for LMI homeowners and renters;
 - More than \$500 million to improve energy efficiency in affordable multifamily buildings;
 - \$45 million for community-level engagement and capacity building with community-based organizations; and
 - \$30 million for developing clean heating and cooling solutions for LMI homes and buildings through research and analysis of institutional barriers, and funding

of pilots and demonstrations. This investment builds on New York's nation-leading push on building electrification with the recently approved New York State Clean Heat Implementation Plan that will invest nearly \$700 million in building electrification solutions, including a variety of heat pump technologies.” (LMI Clean Energy Investments, 2020)

- “The Low Income Home Energy Assistance Program (LIHEAP) is a federally-funded grant program administered by the State and the City to assist with costs associated with heating and cooling. However, availability of cooling assistance is currently limited, and can only be used to purchase an air conditioning unit or fan for a unit where an individual meets certain income qualifications, and has a documented medical condition that is exacerbated by heat, among other requirements. Further, this assistance is not available to subsidize any utility costs associated with an air conditioning unit or a fan. To make cooling more accessible to the most heat-vulnerable New Yorkers, the State should: (i) supplement LIHEAP funding; and (ii) make a greater percentage of LIHEAP funding available for cooling, including for assistance with utility costs associated with cooling. Furthermore, the City could provide funds to supplement the LIHEAP allocation so that vulnerable residents have access to cooling. This could include people with serious health conditions, people with disabilities, seniors, and New York City Housing Authority (NYCHA) residents, who are among the City’s most heat-vulnerable. The Human Resources Administration (HRA) administers the funds allocated by the federal LIHEAP program, and the agency’s existing infrastructure could be used to administer any additional funds.” (Securing Our Future, 2020, 50)
- “The Cooling Assistance benefit helps eligible households buy and install an air conditioner or fan up to a cost of \$800.” This is an NYC program. (Cooling Assistance Benefit 2020)
- “The Cool Neighborhoods NYC program addresses the effects of heat waves, rising summer temperatures, and the urban heat island effect targeting the most at-risk communities across the city. Cool Neighborhoods NYC is a \$106 million program designed to help keep New Yorkers safe during hot weather and uses an equity and public health approach to climate change mitigation and adaptation planning.” (NYC 1.5C, 2017, Implementing 2020 Climate Actions, pg. 28)

Other Recommendations

- “New York City needs a large scale, City-funded energy efficiency program to help improve and preserve affordable and public housing.” (NYC EJA, 2020, pg. 62)
- “State legislatures should expand the warranty of habitability to require landlords to provide tenants with protection against heat as well as cold.” (Heat Waves, 2018, 543)
- “Low-income energy assistance programs should be fully funded and should cover both the purchase of air conditioners and the electricity to run them (as they now help pay for heating oil and gas). As is now the case with military family housing, public housing in all but the coolest areas should have air conditioning. Because this action could make the housing less affordable, the government will need to step up its funding to fill the need.” (Heat Waves, 2018, 543)
- “Building codes should encourage ventilation, awnings, shades, and other traditional methods to lower the heat.” (Heat Waves, 2018, 543)

- “Governments at all levels should buy only the most efficient air conditioners to help drive the market.” (Heat Waves, 2018, 543)

Discussion and Analysis

- “New York City needs a large scale, City-funded energy efficiency program to help improve and preserve affordable and public housing. Energy efficiency not only draws down building carbon emissions, but also results in ancillary benefits such as reduced operating and maintenance costs that can be invested for other property improvements, healthier residential environments, lower utility bills, and quality job creation.

Energy efficiency is also key to increasing community resiliency. Tenants in rent-stabilized, affordable and public housing tend to be low-income people of color, residing in areas of high heat vulnerability, made worse due to lack of access to green space. Tenants in inefficient rent-regulated buildings face a disproportionate energy burden, paying a much higher proportion of income on energy costs.¹²³ On hot days, when everyone is running their A/C, the most heat vulnerable communities are susceptible to blackouts and brownouts – meaning losing power when it’s needed most. These same residents are often excluded from energy efficiency and clean energy financing programs” (NYC EJA, 2020, pg. 62)

- “New York City’s 12 most heat-vulnerable neighborhoods are predominantly high-poverty areas where residents are majority people of color. This assessment is based on the NYC Heat Vulnerability Index (HVI), which summarizes factors associated with adverse health effects and identifies neighborhoods with a higher risk for heat-related deaths and consists of environmental metrics, poverty rates, and race demographics proven to be strong indicators of heat risk.” (Bautista et al, 2019, 2)
- “Furthermore, tenants of public and affordable housing face unique challenges related to heat vulnerability. Residents of the New York City Housing Authority (NYCHA) are particularly vulnerable to the risks of heat. Based on NYC-EJA’s analysis, more than half of NYCHA residents live in the City’s most heat vulnerable neighborhoods (see Figure 1, below).¹⁰ Elderly residents are particularly at risk from the negative health effects of extreme heat, and 61,500 of NYCHA’s approximately 400,000 residents are over the age of 65.¹¹ Furthermore, in highrise buildings, which are characteristic of many NYCHA developments, indoor temperatures can be much higher than outdoor temperatures. Although air-conditioning can alleviate hot indoor temperatures, NYCHA residents face significant barriers to installing air-conditioning, including approval from NYCHA, paying an annual fee per air-conditioning unit, and paying the costs for professional installation, as well as the additional cost to remove bars from windows.¹² These challenges will necessitate community preparedness and extreme heat strategies specifically targeted to NYCHA tenants.” (Bautista et al, 2019, 3)
- “Cost is a major factor keeping people from acquiring or using air conditioning units, even in the United States. Affluent households are more likely to have units than poor ones, and owners are more likely to have them than renters.¹¹¹ Many poor people who do have units cannot afford the electricity to run them.¹¹² The power for home air conditioning costs \$265/year on average (\$525 in the hot and humid Southeast).¹¹³ The federal Low Income Home Energy Assistance Program mostly provides limited money to help low-income families heat their homes in the winter; very little goes for cooling, and

in most states even that assistance is limited to buying air conditioners, not to operating them.¹¹⁴ Several states do have rules prohibiting utilities from cutting off residential electric or gas service due to nonpayment of bills during times of extreme heat.” (Heat Waves, 2018, 529)

- “In almost every state, residential leases are legally deemed to include an “implied warranty of habitability,” meaning that the apartment or house is livable, safe, and clean.¹⁸⁶ This means that heat must always be provided when it is cold.¹⁸⁷ It rarely means that there has to be air conditioning when it’s hot, but if the landlord has provided an air conditioner, it should be in working order.¹⁸⁸ An exception is Phoenix, where the city code requires rental housing to have cooling that keeps the temperature no greater than 86°F.¹⁸⁹ Air conditioning is generally not required in public housing. Sometimes the government will pay for the machines but rarely for the electricity.¹⁹⁰ In New York City, almost 90% of all households have air conditioning, but less than half of those in public housing.¹⁹¹” (Heat Waves, 2018, 538-9)

Other Resources

Related Topics in this Document: Low-Income Assistance: Electricity

Carbon Taxation and Pricing

Carbon Tax

New York Actions

- Assembly Bill A2718 (In Committee as of July 2020), Relates to establishing a carbon farming tax credit for farmers, Establishes a tax credit for farmers who maximize carbon sequestration potential through a "carbon farming" land management strategy; directs DEC to develop regulations related to certifying the amount of carbon sequestered or emissions reduced.
- “Current carbon tax bill: addresses some but not all of the concerns raised in this article. Some of the key features discussed that are lacking include a rebate or dividend mechanism that would capture nonfilers or those whose income tax liability is too small to offset their carbon burden; an offset geared toward manufacturers or farmers whose products may be subject to close price competition; a mechanism to tax imported electricity; an exemption for imported fuels or electricity already taxed; a feature to extend the tax to regional neighboring states; and a coefficient to capture fugitive methane emissions released during the life cycle of natural gas production. These features all can be addressed in negotiations as the bill advances.” (Ratzkin, 2017, 210)

LPDD Recommendations

- “State governments should impose a GHG price through a carbon tax or fee, or through a cap-and-trade program, that allows agricultural producers to earn revenue by storing soil carbon or reducing methane or nitrous oxide emissions.”

- “State legislatures should adopt a price for carbon either through a carbon tax or through cap-and-trade systems that include new buildings.”
- “New York should continue to support RGGI’s treatment of private forest carbon capture as an emission offset, and RGGI’s exemption of emissions from sustainably produced biomass. New York should pursue means to impose a tax burden on those who deforest their land through conversion.”

Related LPDD Database Pathways

- Reports on carbon price mechanism design: <https://lpdd.org/pathway/reports-on-carbon-price-mechanism-design/>
- Existing carbon price schemes: <https://lpdd.org/pathway/existing-carbon-pricing-schemes-world/>
- Proposed carbon pricing schemes (US): <https://lpdd.org/pathway/proposed-carbon-pricing-schemes-us/>

Other Recommendations

- “Fund low-carbon technology subsidies via general taxation or carbon revenue. Low Carbon subsidies are a progressive decarbonisation policy, if not funded through a surcharge on electricity users.⁵ This study finds that the costs for low-carbon technology subsidies could be balanced more equitably by funding subsidies for low-carbon technologies, such as renewable energy support schemes, through rising income tax rates for high incomes or carbon revenue earmarking, rather than through a surcharge on electricity consumption.” (EQuality, 2020, 2)
- “One approach would involve a proposal submitted to FERC pursuant to FPA section 205 that affects only an individual RTO’s service territory. But it is also possible for FERC to act pursuant to FPA section 206 so that a carbon-pricing rule would be included in several or all RTO wholesale market rules.” (Carbon Pricing in Wholesale Electricity Markets, 2020, 62)
- “Establish an economy-wide carbon pricing system to deliver effective price signals to energy consumers. Two options for such a system are: (1) a carbon fee and (2) a cap-and-trade system. To be most effective, these policies should be implemented on at least a regional, if not national, scale, so that dollars are directed most effectively toward the dirtiest energy sources and states. CLCPA tasks the New York State Department of Environmental Conservation with estimating a “social cost of carbon,” that is, a monetary figure capturing the costs of an incremental increase in carbon emissions, an important step for implementing a pricing scheme.” (Getting Greener, 2019, Executive Summary, 3)
- “One goal is to get renewables built. As discussed above, Carbon Pricing will integrate the value of clean energy into the market and will dramatically reduce the cost of the separate REC-contracting program that NYSERDA implements² to get new renewable projects built. In this way, the cost of the NYSERDA program will decrease, and will be a better reflection of the cost premium required by renewable energy in NYS. In theory, when the energy market revenues increase enough, New York could see development of wind and solar power without REC contracts.³ If this happens, the resulting clean energy that emerges organically from the marketplace would save consumers the cost of funding

the State programs that would otherwise be needed. We believe it will be more likely that because the grid is rapidly decarbonizing, the carbon increment to the energy market revenue will remain modest, and renewable development will continue to be supported by NYSERDA's Clean Energy Standard procurement, but at a lower cost." (The Case for Carbon Pricing at the NYISO, 2019, 3-4)

- "To be effective, the carbon price must be set high enough to achieve significant emissions reductions. The tax should steadily rise in accordance with a pre-existing schedule to send a clear long-term signal to the marketplace, thereby allowing economic actors sufficient time to make and implement investment decisions to lower their carbon emissions." (Ratzkin, 2017, 202)
- "The scope of the carbon tax should include other important GHGs, especially methane, which has 25 times the global warming potential of carbon dioxide over a 100-year period. In the case of natural gas, the principal methane emissions are associated not with combustion but with fugitive emissions during the extraction and distribution processes. A tax on natural gas can account for these emissions by applying the tax not just to the carbon dioxide emissions from natural gas combustion, but to an imputed "methane coefficient" derived to represent the full life-cycle emissions in the natural gas production process. Without reflecting the impact and cost of methane emissions, a carbon tax would unduly favor natural gas usage." (Ratzkin, 2017, 203)
- "Broad consensus exists among carbon tax advocates that a carbon tax should not increase economic burdens on the poor and lower middle class. Like all broad consumption taxes, such as the sales tax, a carbon tax would have this result absent other interventions. Therefore, a carbon tax should be wedded to offsetting measures to protect the least well off against the regressivity that a naked carbon tax would entail. Such measures might include dividend payments or refundable income tax credits focused on the lowest quintiles of the population, or an offsetting reduction in existing regressive taxes, such as sales or payroll taxes. Advocates of a universal approach prefer distributing dividends evenly per capita or per household, pointing out that such a plan would also be progressive and redistributive because the collection of the tax will fall on higher income brackets in greater dollar amounts due to their greater absolute carbon footprint." (Ratzkin, 2017, 202)
- "With the NYISO Report on the table, careful consideration should be given to determining how a carbon tax would interact with a potential NYISO charge. Were NYISO to move ahead with a carbon charge proposal, an economy-wide carbon tax would need either to exempt electricity from its scope, or credit back the NYISO price (as well as the RGGI price) to avoid double taxation. Alternatively, the NYISO charge could be eliminated in the event that a state economy-wide tax, with the electric sector within its scope, is enacted." (Ratzkin, 2017, 203)
- "Must include an exemption or offset for imported carbon already taxed to encourage adoption of carbon taxes by other states." (Ratzkin, 2017, 211)
- "This policy option recommends that the State undertake a comprehensive review of the current tax structure and financing programs and their impact on current and future carbon reduction activities. As part of its review, the State would also identify gaps in the current tax structure and financing programs and identify policy options for future shifts to support carbon reduction activities... As the State evaluates the viability of the

financing policy options, it will need to take into account the limitations on State entities' ability to provide financing, including their statutory authorization, their covenants with bondholders, the overall capacity of their balance sheet to provide large capital investments, and their ability to collaborate with other agencies." (CAC Report 2010, 6, 33-34)

- "Need for state-level carbon tax given constraints of federal government." (Ratzkin, 2017, 200)

Discussion and Analysis

- "Lump-sum transfers or equivalent tax relief measures. Direct financial rebates to citizens have already been applied by jurisdictions such as Switzerland and Canada as an effective way to recycle the revenues raised from revenue-generating decarbonisation policies (such as carbon pricing) and reduce inequality. In an EU4 context, the study identified that a lump-sum direct rebate option recycling the revenues from key decarbonisation policies—including carbon pricing and fossil fuel taxes—would see an average sum of €260 going to households across the EU every year. This amount represents a 4.2% increase in household disposable income for the households and an 0.8% increase for the highest-income households. For jurisdictions where a direct rebate would not be politically feasible, the recycling of carbon revenue to offset reductions in taxes such as value added tax (VAT) or electricity taxes would also be a viable alternative resulting in similar financial benefits to lower-income households." (EQuality, 2020, 2)
- "The study finds that the addition of the Covid-19 shock does not have a substantial impact on the distributional effects of the decarbonisation policies or the effectiveness of the identified policy options to counter regressive effects. There is a small reduction in the progressive impact throughout the period from now to 2050 as the scale of the change in real income under the Covid-19 shock is slightly reduced. The main driver of the smaller progressive impact is the reduction in climate policy revenues that are allocated to the lump-sum transfer, which are lower with the Covid-19 shock in 2021." (EQuality, 2020, 9)
- "A steadily increasing carbon price reaching €350/ tonne CO₂ is imposed in line with the European commission's long term strategy. The coverage of the carbon price reflects a coverage that is broader than the current EU ETS by also including energy use from construction and transport sectors other than road transport which is covered separately through the scenario related to taxation on energy vectors. The carbon price is modelled as a carbon tax on the sectors targeted and is assumed to be paid by the relevant industry. This policy is not assumed to have any cost directly imposed on consumers, which are instead indirectly affected through industry and energy prices. Overall, as can be seen in Figure 5 the impact of Carbon pricing is regressive as lower income households are worse off than higher income households resulting in an increase in the Gini coefficient. This regressive impact increases over time as the carbon price increases in real terms over time" (EQuality, 2020, pg. 21-22)
- "Although a carbon price is not imposed directly on households, it still leads to a regressive impact indirectly through two main channels:
 - Carbon pricing targets a wide range of industries which feeds into consumer expenditure on a wide range of goods and services. As the impact is spread across

goods and services, the impact of prices on households is well distributed. However, the overall increase in consumer prices will impact lower income households more as they have a higher aggregate propensity to consume from income, whereas higher income households save more of their income.

- Despite carbon pricing incentivising some decarbonisation in the power sector, while not achieving full decarbonisation by itself, the high carbon price leads to higher electricity prices across the EU. The impact of this price rise is assumed to be passed through fully to the consumer prices and as lower income households spend a higher portion of their income on electricity than higher income households this impact will have a proportional greater impact on these households.” (EQuality, 2020, 22)
- “The most regressive policies are those that impose costs on household energy use either directly (Taxation on energy vectors and Phase out of fossil fuel subsidies) or indirectly (Carbon pricing) as the lowest income households spend a higher proportion of their income on household energy use. The most progressive policies are those that lead to reductions in household energy expenditure (Energy efficiency measures or emissions performance standards) or energy prices (Subsidies for low-carbon technologies).” (EQuality, 2020, 43)
- “However, how the revenues and costs generated from climate policies are balanced by government matter considerably for the overall distributional impact of the policies. If modelled with standard revenue balancing assumptions, the distributional impacts of each policy are amplified by the adjustment in taxation: Revenue generating policies (carbon price, taxation on energy vectors and phase out of fossil fuel subsidies) become more regressive when balanced by reduction in income taxation. When balanced by a reduction in VAT, the impacts become less regressive and in some cases offset the regressive impacts. Cost incurring policies become more progressive (Subsidies for low-carbon technologies) when the spending is balanced by an increase in general taxation. However, if balanced through an increase in VAT, the impacts become less progressive. The results from the modelling thus highlight that policymakers have an important role to play in managing the distributional impacts of climate policies.” (EQuality, 2020, 44)
- “Rebates in the form of lump-sum cash transfers can be used to target the regressive effects of certain climate policies, such as taxation on energy vectors and carbon pricing. The modelling in this study reveals that both policies can have a higher impact on low-income households, as they impose a higher cost of energy on individual households, as well as the overall economy. This finding is substantiated in the literature. To counteract the regressive effects of carbon pricing, jurisdictions in North America and Europe offer rebates to households and firms. In addition to countering regressive effects of climate policies, the return of funds can help to improve public perception, and therefore the political feasibility of these policies. The Canadian Climate Action Incentive (CAI) is a prime example of a lump-sum transfer policy that has been used to counter regressive effects of carbon pricing.” (EQuality, 2020, 47-8)
- “Low-income households receive a larger share of their income from labour and social transfers than high-income households, which might also receive income from capital, e.g. rental payments if they own property. This means that an income tax is a tax on the primary source of income for many low-income households. They also spend a larger

share of their income on VAT and electricity taxes, as these are indirect taxes that are uniformly applied across households. Recycling carbon taxes through lower income taxes compensates households directly and has the additional benefit of increasing their available income the incentive of pursuing a formal work.⁴⁹ Lower VAT increases the purchasing power of the after tax-income. Lower electricity taxes make electricity cheaper and while alleviating the financial burden on low-income households it might increase the electricity consumption.” (EQuality, 2020, 52)

- “Reductions in income tax, or VAT or electricity tax, offer an administratively cheap way to ensure that low-income households are not adversely financially affected by a rising carbon tax. While the initial tax reform might be offsetting for some governments, a reduced income, VAT or electricity tax has no ongoing administrative costs, as many subsidy schemes do and thus does not require the setup of an implementing agency. Depending on the height of the tax cut, the policy can be quite costly in terms of foregone budget. However, tax cuts are popular with voters, which can make a compelling case in national politics. Taxes offer the administratively cheapest way to reach all households levels but are over time less visible than a lump-sum transfer.” (EQuality, 2020, 54)
- “Constitutional requirements:
 - Any state involvement in the application of a carbon price must not result in the state establishing a wholesale electricity rate.
 - State carbon-pricing actions may not create an undue burden on interstate commerce or be protectionist.
 - State carbon-pricing policies may not regulate extraterritorially.” (Carbon Pricing in Wholesale Electricity Markets, 2020, 23)
- “FERC may approve an RTO carbon-pricing rule only if it is a wholesale rate for the transmission or sale of electricity or directly affects wholesale rates... Requirements:
 - An RTO carbon-pricing rule must result in rates that are just and reasonable
 - An RTO carbon-pricing rule must not result in undue preference or discrimination
 - Factual findings underlying FERC’s decision regarding inclusion of a carbon price in an RTO’s market rules must be supported by substantial record evidence” (Carbon Pricing in Wholesale Electricity Markets, 2020, 22)
- “Economic efficiency has, over time, become the policy and legal touchstone for FERC in its determinations of whether organized wholesale electricity market rules ensure that rates in those markets are just and reasonable and not unduly discriminatory or preferential.¹¹⁵ Thus, under this framework, FERC may approve, accept, or require carbon-pricing rules in the RTOs because doing so would enhance the economic efficiency of the organized wholesale electricity markets.” (Carbon Pricing in Wholesale Electricity Markets, 2020, 33)
- “Several of these approaches can be supported on the grounds that their adoption, by addressing a significant market failure, would improve the efficiency of organized wholesale electricity markets and thereby make wholesale rates just, reasonable, and not unduly preferential or discriminatory. The alternative approach being considered by NYISO would rest on another theory that an affirmative carbon-pricing rule would yield just and reasonable rates by harmonizing organized wholesale electricity market

operations with state policies and thereby protect the integrity of organized wholesale markets.” (Carbon Pricing in Wholesale Electricity Markets, 2020, 62)

- “Determining the social cost of carbon will be important for evaluating the tradeoffs between the costs of different energy proposals and projects and the benefits of incremental GHG emission reductions. The social cost of carbon will be incorporated into the benefit-cost scoring of futures projects and projects with higher costs but lower carbon impacts could be selected over other competitive projects.” (Getting Greener, 2019, Analyzing Options for Carbon Reduction: The Social Cost of Carbon, 41)
- “Price signals change purchase and sale behavior in the short-run and unleash innovation in the long run. In the realm of carbon reduction, there are two approaches to pricing: (1) cap-and-trade systems and (2) carbon fees. Either approach will build the cost of carbon into the delivered price of energy and so energy costs will increase. Whichever system is adopted, it should be economy-wide, including the transportation sector, which represents 33 percent of New York’s GHG emissions, as well as heating and cooling usage in the commercial, industrial, and residential sectors, which account for over 30 percent of statewide GHG emissions. To be most effective, the pricing system should apply to as broad a market as possible covering all sectors and as many participants as possible. Both systems will be most effective if they are at least regional in scale and preferably done on a national basis.” (Getting Greener, 2019, 4.1 Establish an Economy-Wide Carbon Pricing System, 41)
- “A carbon fee puts an explicit price on the carbon in a fuel. In order for it to be most effective, the fee is applied to all fuels so that it impacts all industries and at a rate high enough to impact behavior. Several countries and one Canadian province already have put carbon fees in place or are in the process of implementing them, including Argentina, Finland, Portugal, Mexico, Norway, Sweden and British Columbia in Canada. The experience of British Columbia, however, shows that an economy-wide fee with few exemptions can be effective. As noted by researchers from Duke University and the University of Ottawa, “[e]mpirical and simulation models suggest that the tax has reduced emissions in the province by between 5% and 15% since being implemented. At the same time, models show that the tax has had negligible effects on the aggregate economy, despite some evidence that certain emissions intensive sectors face challenges.” (Getting Greener, 2019, 4.1.2 Carbon Fee, 44-45)
- “At this time, no states in the US have implemented a carbon fee. In November 2018, voters in the State of Washington rejected a ballot initiative for a carbon tax. At the federal level, carbon tax legislation has been proposed, but has not gotten beyond the discussion stage. Though imposing any new tax or fee is politically challenging, a carbon fee has the benefits of fairness and clarity and the ability to easily work on an economy-wide basis. In the fall of 2016, the PSC and NYISO began examining the impact of a carbon fee within wholesale electricity markets and created the Integrating Public Policy Task Force (IPPTF), which has issued a series of reports and straw proposals on the topic. The IPPTF proposal would levy a carbon fee on electricity entering the wholesale distribution market based on relative carbon emissions, offset by any already applicable RGGI taxes. The proposed fee would only apply to electricity consumption.” (Getting Greener, 2019, 4.1.2 Carbon Fee, 44-45)

- “Carbon pricing in organized wholesale electricity markets has the advantage of considering only the ability of resources to supply electric energy at the lowest marginal social cost, independent of the type of underlying technology, product, or service. This technology-neutral approach ensures every resource can prove itself in the market because the only measure by which resources are compared is their joint cost of operations and carbon intensity.” (Carbon Pricing in Wholesale Electricity Markets, 2020, 18)
- “New York State also has an energy storage goal. Carbon Pricing can support this goal by producing better and more lucrative price signals for investors in energy storage. For example, because the polluting generators are charged for their emissions, the carbon increment to energy prices will be larger when more polluting generators are contributing electricity to the grid. This will send a price signal to storage facilities to charge when the price is low (and the power is cleaner) and discharge with the price is higher (and less clean). The improved market economics for storage will yield savings to consumers in the form of reduced payments by State programs to stimulate storage, in pursuit of New York’s aggressive 3,000 MW storage goal.” (The Case for Carbon Pricing at the NYISO, 2019, 4)
- “Carbon Pricing will also help support pre-2015 renewables and reinvestment in these existing hydropower and wind power projects. Because our goals are so ambitious, New York should be acting to support and maintain the existing generators we have, and Carbon Pricing is one way to do that. New York’s significant number of small hydropower generators are aging and face decisions about repairs, reinvestment, and life extension. With Carbon Pricing, the market provides these clean generators the boosted revenues they need to stay in operation. The same effect occurs for existing wind facilities as their REC contracts with NYSERDA end. These facilities face a decision – should they sell their RECs in New England, because New York has no program to procure them? Should they reinvest in increasing clean electricity production by replacing turbines or making other improvements? Right now, New York has no program in place to maximize the production from these existing resources or encourage these resources to keep their RECs in New York State. This is a serious gap in the Clean Energy Standard program.” (The Case for Carbon Pricing at the NYISO, 2019, 4)
- “Carbon tax (6%): A tax on industry for every unit of GHGs via a well-designed carbon tax (or an equivalent cap-and-trade system) financially incentivizes firms to find innovative ways to reduce emissions, without specifying particular technologies that must be used. Industry is more sensitive to carbon pricing than other sectors, such as buildings (where split incentives and other market and information barriers can prevent price signals from reaching decision makers).” (U.S. Net Zero Emissions By 2050: Decarbonizing Industry, 2019)
- “In British Columbia, the best example of an existing subnational carbon tax, the Ministry of Finance reports Canada-leading reductions in GHG emissions of 5.5% between 2007 and 2014 even though the tax topped out at the relatively modest value of C\$30 per ton in 2012.” (Ratzkin, 2017, 201)
- “Reduction of GHG emissions, and the fossil fuel combustion that creates them, can also be expected to yield important “cobenefits” by reducing emissions of other pollutants

that also are byproducts of combustion (more localized emissions/impact).” (Ratzkin, 2017, 201)

- “There is a double policy win available to enacting states: reduced emissions (GHGs and co-pollutants) and improved local economies. Moreover, carbon tax proposals often include mildly redistributive rebates to low- and moderate-income households intended to reverse the regressivity.” (Ratzkin, 2017, 202)
- “Environmental justice advocates frequently support the allocation of carbon tax revenue toward spending on climate adaptation and related infrastructure projects. Such proposals generally focus on protecting those most vulnerable to climate change, typically based on geographic location. It should be noted for consideration in this debate that, even in revenue-neutral formulations, a carbon tax can readily be structured to avoid regressivity and even be redistributive.” (Ratzkin, 2017, 207)
- “A current limitation is the ability to measure greenhouse gas reductions from altered practices, so it would be beneficial for organizers of offset systems such as state governments to explore different payment schemes; for example, instead of paying for offsets per ton (as is generally the case), payments could be based on practices implemented per acre, with a price set by calculations of average benefits, or based on measurements of surrogate indicators. Finally, offset markets should prioritize year-to-year reductions such as in methane from rice production or animal production or permanent (or long-term) changes in land use. Short-term soil carbon sequestration practices, which can be quickly reversed and are poorly understood, are a less reliable strategy for offsetting fossil fuel emissions at this time.” (Carbon-Neutral Agriculture, 2017, 29)
- “Carbon pricing for all greenhouse gases from agriculture would be a highly effective policy lever. 348 While economic uncertainties make it difficult to predict precise impacts, a carbon price creates a broad signal affecting the decisions of most or all actors and can spur innovation toward lower greenhouse gas technologies and practices. A system that allowed agricultural producers to earn revenue by storing soil carbon or reducing methane or nitrous oxide emissions, especially if such payment were in lieu of current federal farm subsidies, could be an effective way to quickly cut emissions while increasing the carbon sink. A carbon pricing mechanism would need to cap all greenhouse gases, otherwise it could shift practices to those with a greater climate impact. Given the difficulty of precisely measuring emissions of nitrous oxide and methane from agricultural operations, however, it would be difficult to have a precise fee applied to such emissions. Whether as an offset or within a cap or tax regime, it would be necessary to create methodologies that can model emissions based on practices, at least until precise measurement tools become available.” (Carbon-Neutral Agriculture, 2017, 28-29)

Other Resources

Related Topics in this Document: Financing

Regional Greenhouse Gas Initiative

New York Actions

- “New York is already a member of the Regional Greenhouse Gas Initiative (RGGI), an effective 9-state cap-and-trade system covering the electrical generation power sector. To be most effective RGGI should be expanded to other sectors of the economy, including transportation.” (Getting Greener, 2019, Executive Summary, 3)
- “The Regional Greenhouse Gas Initiative (RGGI) is an excellent example of an effective cap-and-trade system for cutting carbon emissions... The program establishes annual caps to the amount of carbon that may be emitted by the electric power sector within the RGGI region. Participation by states is voluntary and if a state withdraws or enters, then the total cap is adjusted proportionately. Each state sets limits on carbon emissions in the electric power sector and issues carbon allowances and a system for participation in regional auctions of carbon allowances.” (Getting Greener, 2019, 4.1.1 Cap-and-Trade System, 42)

Related LPDD Database Pathways

- Reports on carbon price mechanism design: <https://lpdd.org/pathway/reports-on-carbon-price-mechanism-design/>
- Existing carbon price schemes: <https://lpdd.org/pathway/existing-carbon-pricing-schemes-world/>
- Proposed carbon pricing schemes (US): <https://lpdd.org/pathway/proposed-carbon-pricing-schemes-us/>

Other Recommendations

- “Members of the Regional Greenhouse Gas Initiative (RGGI) in the US use part of the RGGI proceeds to provide a direct energy bill assistance to households, with some states specifically targeting low-income households.⁹⁷ However, one of the advantages of the California system is that funding allocations are adaptable to deliver benefits to fit the specific needs of communities ... Actionable steps that can be taken by jurisdictions to implement similar compensation funds: 1. Pass legislation requiring a minimum investment of compensation funds in low-income or disadvantaged communities. 2. Set up a body for oversight and management of funds. 3. Identify and define recipients using census data and other national statistics. 4. Identify a need within that community. 5. Provide a measurable benefit. 6. Monitor and report on spending and benefits delivered.” (EQality, 2020, 65)
- “Regional Greenhouse Gas Initiative (RGGI) - Derived from sale of carbon emission allowances as set forth in 6 NYCRR Part 242 and 21 NYCRR Part 507. The amount of revenues available is dependent on the variable auction prices for the allowances. Per requirements in 21 NYCRR 507, RGGI funds are used to advance energy efficiency, renewable energy, and carbon abatement projects in New York State.” (Clean Energy, 2020, Funding Commitments, 39)
- “New York should also work with other states to establish national carbon fee or cap-and-trade programs. Reversing the trend of increased emissions in Texas and Florida may provide greater benefits to New Yorkers than a small incremental decrease to New York’s own emissions and might be achieved at lower overall cost. New York should explore the possibility of working in a buyers’ consortium with other states to purchase

large-scale low and zero-GHG energy resources. At present, New York, New Jersey, Connecticut, Rhode Island and Massachusetts are all in the process of issuing solicitations and announcing winners for offshore wind energy projects. Rather than compete against each other, these states should identify opportunities to work together to bring the most cost-effective resources to the market.” (Getting Greener, 2019, 4.2 Look Beyond the Borders of New York, 45)

Discussion and Analysis

- “Redistribution of electricity levies to general taxation: The current level of renewable energy sources (RES) support financed by end users¹⁹ is projected forward, factoring in both the level of renewables to be deployed in the baseline scenario and an assumption that the RES support will be phased out by 2035. The RES support is taken off end user energy prices and then reallocated to an increase in general rates of taxation. ... Redistribution of existing RES support to general taxation is modestly progressive; it reduces electricity prices for end users which benefits low-income deciles more than other higher income deciles. This explains why the regressivity peaks in 2035 when the levy is assumed to have been phased out. The redistribution of RES support to general taxation can be considered as a proxy of the effect that, more generally, the elimination of policy costs from electricity bills would have.” (EQuality, 2020, 24)
- “Working toward carbon neutrality rather than 100% emissions reductions could allow New York City to procrastinate on its emissions reductions goals. Carbon offsets could allow polluters to continue consuming fossil fuels at untenable rates while benefiting from loopholes in a carbon offset market that would lead to a net increase in greenhouse gas pollution. Regardless of the number of trees we plant, we cannot continue to burn fossil fuels at our current rate without dire consequences for the planet – and for environmental justice communities at the frontlines of fossil fuel infrastructure.” (NYC EJA, 2020, 11)
- “Loopholes: A carbon-neutral economy may create loopholes that set back NYC’s efforts to address climate change, including carbon offsets that may not actually result in a net decrease in air pollution. We are already seeing the pitfalls of offsets in California’s carbon trading system. A 2016 study from Cushing et al. shows that the program leans heavily on carbon offset credits, and as a result, California may have overstated their emissions reductions by 80 million tons of carbon dioxide – a third of the total cuts that the state’s cap-and-trade program was expected to achieve in the next decade.” (NYC EJA, 2020, 11)
- “No Relief from EJ Burdens: Relying on carbon offsets to achieve our emissions reductions can perpetuate the disproportionate pollution impacts on communities of color in New York City. A polluter could invest in reforestation hundreds of miles, or even continents away, to “offset” the carbon they release into the atmosphere while doing nothing to alleviate the root cause of asthma attacks, lung disease, and other harms facing New York’s environmental justice communities.” (NYC EJA, 2020, 11)
- “While the objective of these programs is to increase the cost of carbon intensive fuels and discourage their use, a side effect of cap-and-trade systems and carbon fees is the creation of additional revenue. Any program that creates a carbon pricing system must also include clear mechanisms to return those funds to taxpayers in a manner consistent

with the payments made. Put simply, the funds collected by state government in the administration of these programs should not go into the State's General Fund. The experience with RGGI points to a way to use the funds to help consumers lower overall electric costs by using the proceeds to support energy efficiency programs available to all customers and to provide direct bill assistance. Each state that adopts a carbon fee or cap-and-trade program should aim to be revenue neutral and these funds should be returned to consumers through widely available energy programs, lower electric bills, or lower taxes." (Getting Greener, 2019, 4.1.3 Return of Tax Revenue to Consumers, 45)

Other Resources

Related Topics in this Document: Financing

New York Independent System Operator Pricing

New York Actions

- "Carbon And Other Externalities Accounting - A carbon price captures the external costs of GHG emissions by placing a price on the emission of a ton of CO₂e into the atmosphere. The City will continue to integrate the social cost of carbon to determine cost-effectiveness of energy investments. Accounting for environmental externalities to the city strengthens the business case for aggressively reducing GHG emissions and will support the acceleration of GHG reductions. The City will actively participate in the New York Independent System Operator's (NYISO, 2019) exploration of carbon pricing in the wholesale energy market and continue to advocate for aggressive federal regulation of GHG emissions. The City will also continue to advocate for New York State's efforts to develop a comprehensive valuation of distributed energy resources to monetize external benefits from clean distributed energy deployment. These external benefits include avoided GHG emissions and local air pollutants, enhanced resiliency, and clean energy investments in environmental justice communities. The City will also advocate that State and federal decision-making incorporates impacts to local air pollution, resiliency, and other aspects of a sustainable future. Benefits include transforming markets across buildings, energy, and transportation sectors, and improving air quality and health by reducing fossil fuel combustion." (NYC 1.5C, 2017, Key Actions to Provide Climate Change Leadership, 14)

Related LPDD Database Pathways

- Proposed carbon pricing schemes (US): <https://lpdd.org/pathway/proposed-carbon-pricing-schemes-us/>
- NYISO Carbon Pricing Proposal: <https://lpdd.org/resources/nyiso-carbon-pricing-proposal/>

Other Recommendations

- “Actively participate in the New York Independent System Operator's (NYISO, 2019) exploration of carbon pricing in electricity markets and continue to advocate for aggressive federal regulation of carbon” (NYC 1.5C, 2017, 2020 Climate Actions, 24)
- “The NYISO would incorporate the social cost of carbon emissions into the NYISO-administered wholesale energy markets using a carbon price in dollars per ton of carbon dioxide emissions. The NYISO would apply the carbon price by debiting each energy supplier a charge for its carbon emissions at the specified price as part of its settlement. Suppliers would embed these additional carbon charges in their energy offers (referred to as the supplier’s carbon adder or adjustment in \$/MWh) and thus incorporate the carbon price into the unit commitment, dispatch, and price formation through the NYISO’s existing processes. In addition to charging internal emitting generators, the NYISO would charge imports and credit exports the LBMP [location-based marginal price] carbon impact to prevent the carbon charges on internal generation from causing emissions leakage and costly distortions. Because the carbon charges on suppliers would increase the variable costs of carbon-emitting generation dispatched by the NYISO, a carbon charge would raise the energy market clearing prices whenever carbon emitting resources are on the margin (referred to as the carbon pricing effect on LBMPs, or LBMPc). All suppliers, including clean energy resources, would receive the higher energy price, net of any carbon charges due on their emissions. A carbon charge would also provide incentives for innovative low carbon technologies that may not yet be developed. Low carbon dioxide emitting New York resources, including efficient carbon emitting units, renewables, hydropower, and nuclear generators, would benefit from higher net revenues. Load Serving Entities (LSEs) would continue to be charged the LBMP for wholesale energy purchases, which would account for the carbon adder of the marginal units. The NYISO would return the carbon charge residuals (Carbon Residuals), collected from carbon dioxide-emitting suppliers and net imports, to LSEs....The New York Public Service Commission (PSC) would set the Gross Social Cost of Carbon (SCC) pursuant to the appropriate regulatory process.” (NYISO, 2019, 12)
- “A carbon price may be imposed partially or fully through one or more mechanisms in the power sector, including through direct or indirect means such as:
 - adoption of technology-specific standards (e.g., New York’s ZEC standard applicable to nuclear plants, or through RECs for renewable resources without emissions of CO₂)
 - a cap-and-trade program (such as RGGI)
 - policies (e.g., tax incentives, research and development (R&D), financial support for entry of early stage technologies that have the potential to produce electricity with zero-carbon resources) that help with innovation and commercialization of carbon-free energy systems (such as are supported by NYSERDA R&D grants)
 - a sector-specific or economy-wide carbon tax
 - an externality value (e.g., a shadow price associated with a technology’s carbon emissions),
 - sometimes used in integrated resource planning contexts and in establishing the benefits and costs of energy efficiency programs
 - a carbon adder introduced into the dispatch algorithm of a wholesale energy market (such as has been under consideration by NYISO).” (NYISO, 2019, 25)

- “A carbon pricing mechanism tied to the actual cost of climate-related impacts (i.e., the social cost of carbon) would be an efficient signaling mechanism to indicate the value that New York State places on renewable energy and zero-carbon attributes of various projects, and would help support early entry through the wholesale market design. It would provide incentives for efficient investment in transmission, energy efficiency, and existing clean energy facilities (to keep them operating safely and economically as long as possible, and, in so doing, avoid the costs of replacing their output with other zero-carbon supply). It would harness the market to drive innovation. It would provide insurance against FERC action to mitigate New York’s market and avoid consumer cost impacts of such mitigation policies. These are all part of the value proposition afforded by a carbon price in the NYISO energy market.” (The Case for Carbon Pricing at the NYISO, 2019, pg. 6)
- “New York’s success in reaching its renewable goals is seriously jeopardized by the slow pace at which needed transmission additions are getting acknowledged, planned and implemented.⁷ Here too, Carbon Pricing can help. Quantitative analyses of potential transmission expansions tend to ignore the benefit of the reduced emissions and other environmental benefits that a transmission expansion can create. By putting the cost to society of CO₂ emissions right into the wholesale market price, this shortcoming in transmission cost/benefit analysis will be reduced. It is the wholesale prices that are used by the NYISO in quantifying the benefit of transmission additions. For example, a transmission addition that can move an additional 1 million MWh from Upstate (assuming a wholesale price of \$30/MWh) to Downstate (assuming a wholesale price is \$40/MWh) is calculated to have a benefit of \$10 million. Now, consider that with Carbon Pricing, the Upstate wholesale price becomes \$40/MWh and the Downstate price becomes \$55/MWh. Now, the benefit calculation shows that moving the same 1 million MWh from Upstate to Downstate has a benefit of \$15 million. In this way, more transmission proposals will be deemed economic, increasing the likelihood that they will get built, and built in the most cost-effective locations. As is stated in the October 3 report of the Analysis Group, “A carbon price will send price signals to investors, entrepreneurs, and project developers to invest in additional transmission capacity to open up Downstate New Yorkers’ access to plentiful and relatively cheap zero carbon/renewable resources in Upstate New York.” (NYISO, 2019, 54)

Discussion and Analysis

- “If one were to assume that no carbon price was implemented in the NYISO markets, then there would likely be “above-market” costs for many renewable and storage projects because wholesale market prices would not reflect the attribute value of such resources... Although such costs would need to be absorbed in New York’s economy as part of what it will take to develop, finance, and operate sufficient renewable resources to meet state statutory requirements, these costs would also show up as above-market costs in a NYISO market without a carbon price. If New York’s electric system did not value the renewable or zero-carbon attributes of certain power resources, then the system would likely not see the same pace and degree of new capital investment, because the NYISO system is currently relatively sufficient with supply resources.” (NYISO, 2019, 34)

- “A carbon price will send price signals to investors, entrepreneurs, and project developers to:
 - create innovative solutions and projects;
 - locate renewable projects closer to New York’s population centers;
 - offer inventive and attractive services to help consumers reduce their demand and switch their
 - vehicles and heating and cooling systems to electricity;
 - provide price signals to spur the development and expansion of electric-vehicle charging
 - infrastructure across the state;
 - reduce emissions from fossil-fuel power plants that affect vulnerable communities; and
 - invest in additional transmission capacity to open up downstate New Yorkers’ access to plentiful and relatively cheap zero-carbon/renewable resources in upstate New York.” (NYISO, 2019, 2)
- “A carbon price will help retain existing generating units with zero or low carbon emissions in operation as long as safely possible. It will provide owners of many such plants—including units that will come to the end of their contracts for renewable energy credits (RECs) or zero-emissions credits (ZEC) over the next decade—with visibility into future wholesale-market revenues at levels that (for some generating resources) will support the ongoing investments needed to maintain those units in operation. This has material financial value to consumers, as New York transitions its electric system: For every 1,000 MW of nuclear capacity retained in any year, for example, New Yorkers will avoid the cost of replacing that zero carbon energy with significantly larger and more costly amounts of capacity and investment in new zero carbon-emitting power-supply projects.” (NYISO, 2019, 3)
- “A carbon pricing mechanism can accelerate the electric-system transition at lower cost and less financial risk to consumers than otherwise... In this context, a carbon price can spur faster access to sufficient revenue certainty, with local pricing incentives to site such projects in downstate locations, and with potential savings deriving from market efficiencies... A carbon price will help support efficient electric-system reliability by sending investment signals to site new resources in areas where they will provide local reliability services at lower cost and with lower air pollution.” (NYISO, 2019, 3)
- “Without knowing—or even speculating about—what NYPA would do with such additional revenues, it is still logical to assume that this revenue can be viewed as a public benefit to New York’s economy. NYPA’s mission is to “power the economic growth and competitiveness of New York State by providing customers with low-cost, clean, reliable power and the innovative energy infrastructure and services they value.”¹⁴³ Few investor-owned power plant owners have that same public service mission. It is not hard to imagine that NYPA would put those revenues to use for public purposes. NYPA provides a number of services, including sales of electricity, customer-energy services, R&D, investment in economic development, and provision of low-cost financing to eligible entities (e.g., public entities in New York State, not-for-profit colleges and universities, recipients of NYPA’s economic-development rates) for energy efficiency and other energy projects.” (NYISO, 2019, 56)

- “Even if onshore wind projects could enter the market competitively through price signals in NYISO’s energy and capacity markets, it is not likely that offshore wind, storage at scale, or abundant solar projects can do so, at least for many years. This means that without aligning the wholesale market design with the renewable and zero-carbon attributes these resources provide, the Act’s anticipated build-out will require compensation in the form of RECs or some other way to value those attributes. And it is not likely that upstate nuclear units would seek to extend their operating licenses without a forward-looking expectation of further compensation for their zero-carbon-emissions attributes, either through additional ZEC contracts or some other means.” (NYISO, 2019, 35)
- “A carbon pricing mechanism—relying on a relatively stable and durable social cost of carbon to reflect the value of the generation that provides electricity supply without emitting carbon—can provide the type of forward wholesale-market revenue visibility and level of compensation needed to create incentives for investing in clean energy resources in the absence of, or even in tandem with, a long-term contract. Moreover, a stable carbon pricing mechanism can provide a steady hand on the rudder of change in New York State—one that can guide the transition toward the most efficient and lowest-cost path to decarbonization in full coordination with other state-driven policies.” (NYISO, 2019, 37)
- “In seven of the ten years, Carbon Pricing lowers retail prices. In three of the ten years, Carbon Pricing raises retail prices. The average effect over the 10-year period is to lower retail prices. All of the numbers, whether positive or negative, are small. This result is obtained despite failing to consider any of the benefits that were very difficult to quantify and were therefore left in an unquantified state. The unquantified benefits can be thought of as a cushion that reinforces the result that consumers will likely benefit. The most important factor in achieving this negligible impact on consumer prices is that the NYISO’s Carbon Pricing proposal uses 100% of the funds collected from emitting generators to lower consumer prices. As described above, the pollution fees that the NYISO collects will be provided to NY’s wholesale electricity buyers to offset/reduce what they would otherwise pay the NYISO for buying electricity for their customers. This is a design choice in the proposal. The initiative could, for example, use the collected funds for other purposes, such as environmental programs or revenue for general government services.” (The Case for Carbon Pricing at the NYISO, 2019, 7)

Other Resources

Related Topics in this Document: Carbon Tax

Transportation and Climate Initiative

New York Actions

- “New York is also participating in the regional Transportation and Climate Initiative, which is “a regional collaboration of 12 Northeast and Mid-Atlantic states and the District of Columbia that seeks to improve transportation, develop the clean energy economy and reduce carbon emissions from the transportation sector.” The TCI focuses

a great deal of its effort on clean vehicles and fuels and ways, freight efficiency and exploring regional policy issues. Public transportation is included in that, but is not a core focus.” (Getting Greener, 2019, 47)

- “TCI jurisdictions recognized that a cap-and-invest approach that requires progressively deeper reductions in pollution and results in proceeds that can be invested in safe, clean and affordable transportation options could be well suited to accomplishing these goals.” (TCI Fact Sheet, 2019)
- “In December 2018, nine TCI states and the district of Columbia announced their joint commitment to design, within one year, a regional low-carbon transportation policy proposal that would cap and reduce carbon emissions from the combustion of transportation fuels through a cap-and-invest program or other pricing mechanism, and would allow each TCI jurisdiction to invest proceeds from the program into cleaner and more resilient transportation infrastructure. After the policy development process has been completed, each jurisdiction will decide whether to adopt and implement the proposed policy.” (TCI Fact Sheet, 2019)
- “This announcement emphasized the states’ shared commitment to work with stakeholders and communities at every step of the policy design process. TCI states continue to provide opportunities for public input and engagement, through regional stakeholder workshops, online webinars, and a public input form accessible on the TCI website. Individual TCI jurisdictions are also providing state-specific opportunities for stakeholders to participate in the policy design process.” (TCI Fact Sheet, 2019)

Related LPDD Database Pathways

- Transportation and Climate Initiative: <https://lpdd.org/resources/transportation-and-climate-initiative/>

Other Recommendations

- “As TCI participant-states develop a Final MOU, we encourage them to consider the following points:
 - “Affected Fuel[s]” should include all transportation fuels that generate greenhouse gas emissions.
 - The “Regional Emissions Cap” in conjunction with the “Stability Mechanisms” should be set so the allowance price can reflect the external damages from carbon dioxide (CO₂) emissions.
 - Banking of allowances should be encouraged, however banking of allowances “without limitation” should be implemented with caution.
 - “Offsets” must be verified as real, permanent, and additional.” (IPI MOU Comment, 2020)
- “For one, a price of \$0.46/gallon reflects only the carbon dioxide damages from gasoline and ignores other market failures that are correlated with gasoline use, which include local air pollution, upstream methane emissions, traffic congestion, and motor vehicle accidents. Given the empirical evidence that the external damages of these market failures are large, the cap should be stricter than whatever achieves \$0.46/gallon. Second, the best available estimate for the damages from carbon dioxide emissions

ignores many important costs traceable to those emissions, such as extreme temperatures and changes in precipitation patterns. Put another way, although there is broad consensus that the Social Cost of Carbon is a valid and useful metric, it is rightly understood as a lower bound on the damages of carbon dioxide.” (ICP MOU Comment, 2020)

- “In the Final MOU, explicitly state both the monetized damages of carbon dioxide generally based on the Social Cost of Carbon and also the damages per allowance. For example, “WHEREAS, transportation is a significant source of greenhouse gas emissions, the best available estimates imply each additional gallon of gasoline contributes at least forty-six cents to future climate change damages, and these damages are expected to increase overtime.” Monetizing damages in this way would provide helpful context to stakeholders.” (ICP MOU Comment, 2020)
- “Set the program’s emissions cap so that an allowance price near \$0.46/gallon of gasoline is achievable. A strict initial cap of this sort would address the problem of allowance over-allocation and foster a robust market for allowances.” (ICP MOU Comment, 2020)
- “Design the Emission Containment Reserve to trigger if the allowance price is sufficiently low and the Cost Containment Reserve to trigger if the allowance price is sufficiently high, as the allowance price is the best measure of TCI’s compliance costs. Ideally, the allowance prices that trigger the containment reserves—i.e., the price “floor” and “ceiling”—should be set symmetrically around a price at least as large as \$0.46/gallon. Assuming the Social Cost of Carbon Adequately captures the costs to society of additional carbon dioxide emissions, this places equal weight on both risks: overestimating and underestimating the cost of compliance with TCI.” (ICP MOU Comment, 2020)
- “Because the Social Cost of Carbon is a lower-bound on the damages from gasoline combustion, the allowance price that triggers the Cost Containment Reserve should be greater than \$0.46/gallon.” (ICP MOU Comment, 2020)
- “Consider how unlimited banking will affect the allowance price and compliance costs when setting the cap, and set the initial cap at an appropriately strict level. This cap should be well below BAU emissions, which will encourage a well-functioning secondary market for allowances.” (ICP MOU Comment, 2020)
- “Establish a mechanism capable of reducing a potential glut of allowances, as RGGI’s Interim Adjustments for Banked Allowances did. And, if the quantity of banked allowances grows too large or the allowance price falls too low, use that mechanism to reduce the number of emission allowances available to regulated entities. In principle, this could be accomplished by an Emission Containment Reserve that is triggered by low allowance prices, or many banked allowances.” (ICP MOU Comment, 2020)
- “Some cap-and-trade programs have established direct limits on the amount of offsets that can be used for compliance: RGGI permits regulated entities to meet 3.3% of their compliance obligations by purchasing qualifying offsets; 53 California’s Cap-and-Trade Program permits 8% of compliance obligations to be made up of offsets.⁵⁴ Instead of a hard, direct, limit on the use of offsets, we recommend strict guidelines on what qualifies as an offset, ensuring qualifying offsets are real, permanent, and additional. Naturally, strict guidelines on what is qualified as an offset will reduce the number of offsets

available to regulated entities, and in this way, limit the use of offsets by regulated entities.” (ICP MOU Comment, 2020)

- “Several market design options reduce allowance price and revenue variability in emission markets and generally help constrain allowance prices. One option is emissions allowance banking, which provides flexibility for firms in response to inter-annual fluctuations in allowance demand that might stem from changes in weather or economic conditions. In the absence of banking, at the end of a compliance period emissions will either exceed or be less than the available emissions allowances. These results have undesirable effects in the allowance market, causing prices to spike or fall to zero, respectively. Another market design option is expanding the market geographically or linking with other markets to accommodate regional differences in fluctuations in weather or economic activity, or differences across sectors. Banking and linking are mechanisms to spread compliance responsibility over time and space and therefore directly reduce price volatility. These mechanisms also reduce costs by enabling the pooling of risk associated with the uncertainty affecting the short-run demand for permits. A third market design option intended primarily to limit costs but that also mitigates price volatility is the use of out-of-market compliance instruments, known as offsets. Many observers find there are substantial low-cost opportunities to achieve emissions reductions at unregulated sources and offsets provide a way for regulated parties to capture these low-cost emissions reduction opportunities.” (Burtraw et al, 2020)
- “The use of program revenues is also valuable for mitigating allowance price volatility because spending within the capped sector has a countercyclical effect on allowance prices. For example, in RGGI when allowance prices tend high, auction revenues increase, and states can increase their spending on energy efficiency. This in turn helps lower electricity demand and thus allowance prices. In TCI, the use of auction proceeds to accelerate emissions reductions will be a key part of overall program design; however, allowance price volatility could affect the revenues that are collected and undermine planning for the type of investments needed to induce long-term reduction in the demand for allowances.” (Burtraw et al, 2020)

Discussion and Analysis

- “NYSERDA will seek to unlock and mobilize private capital to further build, finance, and grow this clean energy economy. All these efforts will seek to create new economic opportunity and quality jobs for New Yorkers, including those New Yorkers who have been historically disadvantaged and who may be affected by the transition away from fossil fuels.” (Clean Energy, 2020, Clean Energy Economy, pg. 21: NYSERDA Financing)
- TCI participants’ current plan is to set the cap just below the business-as-usual (BAU) level of transportation sector emissions and to then tighten it over ten years, from 2022 to 2032, by reducing the number of allowances available for purchase.⁹ This tightening will cause regulated entities that most value affected fuels to continue purchasing allowances while other regulated entities look for ways to avoid purchasing as many allowances—or any at all. The final allocation of allowances in a given compliance period

will be determined by a secondary market through which the regulated entities that value them the most will purchase them.” (IPI MOU Comment, 2020)

- “Instead, several mechanisms, including the banking of allowances, long-duration compliance periods, the use of carbon offsets, and stability mechanisms, would prevent sudden and unpredictable price changes while also likely reducing compliance costs for regulated entities.” (IPI MOU Comment, 2020)
- Excluding some fuels from the “affected fuel” category is a textbook example of an incomplete policy design and can lead to emissions leakage. If the prices of some fuels that can substitute for motor gasoline and on-road diesel are unaffected by TCI, it is only rational that the implementation of TCI will drive some consumers to those fuels. If those fuels did not generate greenhouse gas emissions, this would serve the goal of TCI. But if these fuels generate a volume of greenhouse gas emissions per mile that is similar to motor gasoline or on-road diesel, then spurring consumers to switch will not serve TCI’s goal of “reducing greenhouse gas emissions from the transportation sector.” (IPI MOU Comment, 2020)
- “The most essential aspect of offset design is verifiable additionality. That is, for a project to qualify as an offset, it must yield carbon emissions reductions that would not have happened otherwise 52 For instance, decisions to simply let a 50-acre forest stand, or to plant trees in a location where they would have grown anyway, would not yield additional emissions reductions and so should not qualify as offset projects. But decisions to halt and cancel the planned clearcutting of a forest, or to acquire farmland and actively afforest it, would yield additional reductions and so could qualify as offset projects. Further, it is essential for offsets to be verified as real and permanent. This requires diligent accounting of greenhouse gas emissions from any offset funded project, and the guarantee that the project will not be undone soon after completion. Because verifying additionality and quantifying emissions attributable to offsets is difficult, offsets are a less reliable means of achieving emissions reductions than direct program compliance unless they are well designed. Further, even if the greenhouse gas emissions reductions accredited to offsets were precisely accurate and verifiably additional, offset projects are not guaranteed to provide the same co-benefits of TCI compliance described in the introduction to these comments, and so might not provide the same benefits overall.” (ICP MOU Comment, 2020)
- “Uncertainty in carbon markets is manageable through several elements of market design. One of the most useful and most direct approaches is a supply of emissions allowances that automatically adjusts to changes in allowance price. This approach can balance allowance price certainty that would be achieved under a tax with emissions certainty that would occur under a fixed emissions cap and can improve on the reliability of program revenues compared to an emissions cap. It also helps manage costs for the regulated industry. We show a price staircase with multiple price steps contributes to reliable program outcomes.” (Burtraw et al, 2020)
- “Pollution from transportation accounts for the largest portion of climate-changing carbon emissions in the Northeast and Mid-Atlantic region.” (TCI Fact Sheet, 2019)

Other Resources

Related Topics in this Document: Regional Greenhouse Gas Initiative

Financing

Green Bank, Clean Energy Fund, Cap-and-Invest, Green Bonds

New York Actions

- “NY Green Bank has been working collaboratively with Community Development Financial Institutions, housing agencies, affordable housing developers and operators, and other groups, and will launch a new initiative this fall aimed at making investments of at least \$150 million to expand clean energy and energy efficiency solutions that benefit New York's affordable multifamily housing market. Financing will be directed toward new construction and preservation of the state's multifamily affordable housing market to spur greater energy performance. In doing so, NY Green Bank will be able to demonstrate to traditional lenders and financial institutions that greener affordable housing projects can be successfully financed and adopted by the market.” (LMI Clean Energy Investments, 2020)
- “NY Green Bank Proposed Solutions: NY Green Bank has developed indicative financing frameworks to address these challenges, all subject to the due diligence and terms and conditions applicable to each individual financing opportunity:
 - Financing OEM EV Production Costs: NY Green Bank will finance the purchase of materials and labor for EV trucks or equipment based on the value of qualified purchase orders. NY Green Bank will securitize the purchase order proceeds and OEM-eligible New York State Truck Voucher Incentive Program (NYT VIP) incentive payments to service the NY Green Bank production-finance debt.
 - Financing OEM EV Fleet Lease Arrangements: NY Green Bank will finance against the value of contracted lease payments (minimum fleet size to be determined). NY Green Bank will assign a customized residual value to the vehicle after its contracted life, and advances would be based on the present value of contracted cash flows, OEM-eligible NYT VIP incentive payments, and residual value, all with an advance rate applied for further collateral protection.
 - Financing Customer EV Purchases: NY Green Bank will finance against customer loan payments and incentive payments or other reimbursements (minimum fleet size to be determined). NY Green Bank will assign a customized residual value to the vehicle after its contracted life, and advances would be based on the present value of contracted cash flows and residual value, all with an advance rate applied for further collateral protection.
 - Financing OEM Battery Lease Arrangements: NY Green Bank will consider the financing of the battery specifically of a customer's EV fleet purchase, reducing the customer's upfront capital outlay (minimum number of batteries to be determined). NY Green Bank will finance against the value of contracted battery lease payments from a customer (lessee) to a NY Green Bank-affiliated Special

Purpose Vehicle (SPV) (lessor), and advances would be based on present value of contracted cash flows, OEM-eligible NYT VIP incentive payments, and residual value, all with an advance rate applied for further collateral protection.

- Financing EV Charging Infrastructure: NY Green Bank will finance the capital expenditures (capex) of EV charging infrastructure, with loan advances based on a) the value and term of the charging-as-a-service (CaaS) payments and b) any incentive payments, multiplied by an advance rate. Customer must be a credit-worthy entity and must guarantee a minimum “off-take” amount through one or more long-term CaaS contracts.” (Gurman, 2019, Financing Needed, pg. 223-5)

“Clean Energy Fund - Authorized by the Public Service Commission (PSC) and derived from an assessment on retail sales of electricity by State utilities – it is comprised of four portfolios: Market Development, Innovation and Research, NY-Sun, and NY Green Bank” (Clean Energy, 2020, Funding Commitments, pg. 38)

Programs Funded by the Clean Energy Fund, Listed in NY to Zero, 2019, pg. 34-36:

- Retrofit NY, See to: Standards for Existing Buildings
- New Construction Program, See to: Standards for New Buildings
- Net Zero Energy for Economic Development Program, See to: Standards for Existing Buildings
- Buildings of Excellence program, See to: Standards for New Buildings
- Net Zero Portfolio Support, See to: Standards for New Buildings
- NY Sun, See to: Community Solar
- Ground Source Heat Pump Rebate, See to: Building Heat Systems - Heat Pumps

“New York’s Metropolitan Transportation Authority (MTA) issued its first certified Climate Bond earlier this year. Funds were used to refinance existing electrified rail assets that comply with the Climate Bonds Standard’s Low Carbon Transport criteria. Because of strong investor demand, the offering was expanded from \$500 million to \$782 million, making it one of the largest muni-green bonds issued in the U.S. While most green bonds are initially sold primarily to institutional investors, the MTA has also sold this offering to the public, even running multimedia advertising.” (Ludvigsen et al, 2016, 165)

“The PSC and NYSERDA have both expressed commitment to ensuring the transparency and accountability of the Green Bank and its activities.” (Salzer, 2014, 189)

Green Banks

LPDD Recommendations

- *“States and local governments should establish green banks or similar SFOs.”*
- *“Existing state agencies and authorities, ranging from water and sewer authorities, to municipal utilities, to state treasurers, can often take on the task of sponsoring financing programs and serving some or all of the functions of an SFO.”*

Related LPDD Database Pathways

- Green Banks: <https://lpdd.org/pathway/green-banks/>
- Green Banks and Related SFOs: <https://lpdd.org/pathway/green-banks-and-related-sfos/>

Carbon Pricing

LPDD Recommendations

- “State governments should impose a GHG price through a carbon tax or fee, or through a cap-and-trade program, that allows agricultural producers to earn revenue by storing soil carbon or reducing methane or nitrous oxide emissions.”
- “State legislatures should adopt a price for carbon either through a carbon tax or through cap-and-trade systems that include new buildings.”
- “State legislatures should consider a modest carbon tax or GHG cap-and-trade program that recognizes private forest carbon capture as an emission offset, exempts emissions from sustainably produced biomass, and also imposes a tax burden on those who deforest their land through conversion.”

Related LPDD Database Pathways

- Reports on carbon price mechanism design: <https://lpdd.org/pathway/reports-on-carbon-price-mechanism-design/>
- Existing carbon price schemes: <https://lpdd.org/pathway/existing-carbon-pricing-schemes-world/>
- Proposed carbon pricing schemes (US): <https://lpdd.org/pathway/proposed-carbon-pricing-schemes-us/>

Other Recommendations

- “Explore approaches to pool purchasing power of NYC residents and businesses to procure renewable electricity” (NYC 1.5C, 2017, 2020 Climate Actions, pg. 20)
- “Invest in clean energy and sustainable infrastructure, including in support of priority energy efficiency and energy storage initiatives.” (Clean Energy, 2020, pg. 22)
- “Begin deploying \$100m in EV-related financing, as announced in 2020 State of the State.” (Clean Energy, 2020, pg. 22)
- “Continue efforts to raise at least \$1 billion in private capital.” (Clean Energy, 2020, pg. 22)
- Continue issuing targeted RFPs and organizing convenings in strategic areas to grow the clean energy investment pipeline.” (Clean Energy, 2020, pg. 22)
- NYSERDA’s role: “Address barriers to mobilization of private capital and financing for clean energy projects” (Clean Energy, 2020, pg. 22)
- “Foster capital attraction and support commercialization of products and services from clean energy startups, as well as innovative utility rate structures.” (Clean Energy, 2020, pg. 22)
- The state and New York City should support organizations developing Property Assessed Clean Energy (PACE) offerings in NYC, pursuant to Int. 1252-A (2018), which established PACE programs in the City. (NYC 1.5C, 2017, pg. 18, updated with modern information)
- “A governing structure, headed by a Coordinating Council, would be established to provide common administration and funding distribution of the State’s energy efficiency, renewable energy, and low-carbon programs. Comprised of state agencies and authorities, this council would have the flexibility to modify funding distributions, as needed, to take advantage of evolving technological advances or programmatic needs. As

revenue streams are identified and implementation mechanisms developed, broad criteria for program participation will be considered, including those that would apply for public and private participation. An advisory group, including private advisers, would also be established to advise the Coordinating Council during its decision making processes. The outflow of the funding can be guided by proportional distribution based on the inflow of revenue streams per source (fuel or, in the case of RGGI or another emission cap-and-invest 6-32 New York State Climate Action Council Interim Report 11-9-10 program, pollutant), but would not be wholly constricted by such revenue inflow, and may consider the existent needs and opportunities as recognized by the Climate Action Plan, State Energy Plan, or other State activities or studies and as deemed appropriate by the Coordinating Council. Continuing the practices of current funding streams, private recipients will be eligible to receive incentives. Until the Efficiency and Clean Energy Fund is established, the current collection methods of the existing 45 by 15 funding streams would continue as currently designed. The State should draft a transition plan from 2011 to 2015 outlining how the current funding streams would be transitioned to the Efficiency and Clean Energy Fund. The Fund will also recognize any restrictions on non-state funding streams, such as federal weatherization funding, and will accordingly continue to dedicate funding to the desired end-users; e.g., low income recipients of weatherization funding.” (CAC Report 2010, Chapter 6, page 33)

- “New York should support the establishment of a strong federal cap-and-trade program that places a national price on carbon emissions. In the absence of a federal policy, New York should build on the successful RGGI effort and work with its regional partners in RGGI to construct a cap-and-trade, or cap-and-invest, program that would cover large stationary emission sources in addition to the electricity-generating sources included in RGGI” (CAC Report 2010, Chapter 8, page 20)

Discussion and Analysis

- “Subsidies for renewable energy generation:
 - Solar and wind generation: feed in tariffs of around €55-60/MWh which are imposed for all EU countries but are stopped by either 2030 or 2035 depending on the region to reflect different starting points in the baseline. The overall early phase out reflects the already rapid reduction in generation costs will eventually mean support is no longer needed.
 - Biomass, Biogas and Geothermal: subsidies start at 80%, 20% and 50% of the investment cost respectively in 2020 and are gradually phased out to 0 by 2050

Subsidies for renewable heating:

- A subsidy of 50% of capital investment costs for all renewable heating technologies in 2020 is introduced. The subsidy is gradually phased out by 2050.” (EQuality, 2020 [EU Policy], pg. 30)
- “To date, most of the private financing activity observed in the electrification market, nationwide, has been through capital provided by strategic investors, such as traditional original equipment manufacturers (OEMs) or gasoline companies looking to take a small position in this new market, as well as investor-owned utilities (IOUs), rather than financial investors. The financial sector has not gotten comfortable with the electrification market’s risks, business models, technologies, comparable valuations,

liquidity and exit mechanisms, or potential returns, to name a few factors, and has not proven willing—yet—to make significant loans or investments in electrification. That is where NY Green Bank comes in: working to catalyze private market capital by identifying and closing financing gaps to help scale up proven technologies with immediate potential to advance New York State’s vehicle electrification efforts.” (Gurman, 2019, Financing Needed, pg. 223)

- “Financing OEM EV Production Costs: NY Green Bank will finance the purchase of materials and labor for EV trucks or equipment based on the value of qualified purchase orders. NY Green Bank will securitize the purchase order proceeds and OEM-eligible New York State Truck Voucher Incentive Program (NYT VIP) incentive payments to service the NY Green Bank production-finance debt.” (Gurman, 2019, 224)
- “Financing OEM EV Fleet Lease Arrangements: NY Green Bank will finance against the value of contracted lease payments (minimum fleet size to be determined). NY Green Bank will assign a customized residual value to the vehicle after its contracted life, and advances would be based on the present value of contracted cash flows, OEM-eligible NYT VIP incentive payments, and residual value, all with an advance rate applied for further collateral protection.” (Gurman, 2019, 224)
- “Financing Customer EV Purchases: NY Green Bank will finance against customer loan payments and incentive payments or other reimbursements (minimum fleet size to be determined). NY Green Bank will assign a customized residual value to the vehicle after its contracted life, and advances would be based on the present value of contracted cash flows and residual value, all with an advance rate applied for further collateral protection.” (Gurman, 2019, 225)
- “Financing OEM Battery Lease Arrangements: NY Green Bank will consider the financing of the battery specifically of a customer’s EV fleet purchase, reducing the customer’s upfront capital outlay (minimum number of batteries to be determined). NY Green Bank will finance against the value of contracted battery lease payments from a customer (lessee) to a NY Green Bank-affiliated Special Purpose Vehicle (SPV) (lessor), and advances would be based on present value of contracted cash flows, OEM-eligible NYT VIP incentive payments, and residual value, all with an advance rate applied for further collateral protection.” (Gurman, 2019, 225)
- “NY Green Bank will finance the capital expenditures (capex) of EV charging infrastructure, with loan advances based on a) the value and term of the charging-as-a-service (CaaS) payments and b) any incentive payments, multiplied by an advance rate. Customer must be a credit-worthy entity and must guarantee a minimum “off-take” amount through one or more long-term CaaS contracts.” (Gurman, 2019, 225-6)
- “In this indicative approach, NY Green Bank lends to a charging infrastructure developer (via an SPV for security and collateral-control purposes), which has secured a contractual arrangement with a customer to make regular (likely monthly) fixed payments for the charging service (i.e., CaaS). The NY Green Bank loan sizing is based on a) the value and terms of the CaaS and b) incentive payments (if any), with an advance rate applied for further collateral protection. Eligible uses of proceeds would be to cover the infrastructure capex and utility interconnection costs.” (Gurman, 2019, 225-6)
- “A green bond is the same as a plain “vanilla” bond except there must be a resulting environmental benefit. At first look, bond funding of green projects, such as alternative

energy, is well established. Are these green bonds? In bond market parlance, these bonds are called “unlabeled” green bonds. Most investors lack the resources to conduct due diligence to make sure unlabeled bonds are truly 100% green. So-called “responsible” or “impact” investors dislike finding out after the fact that some of their “green” investment went to non-green projects or assets.” (Ludvigsen et al, 2016, 164)

- “Labeled” green bonds were created to provide additional transparency and, ideally, assurance to investors. The Green Bond Principles (GBPs) were created in 2014 by the International Capital Market Association and are the most widely accepted guidelines for developing green bonds. Under these principles, green projects are defined as projects or initiatives that will promote progress on environmental sustainability in line with the issuer’s stated process for project evaluation and selection.” (Ludvigsen et al, 2016, 165)
- “As the labeled green bond market grows, the opportunity lies with “first movers” to capitalize on market share and customer loyalty. Organizations that start early have more time than competitors to accumulate and master knowledge in issuing, implementing, and verifying green bonds. In general, gradual market evolution and innovation provides first movers the best conditions for long-term dominance.” (Ludvigsen et al, 2016, 166)
- “Recent transactions seem to point to a growing demand in primary markets, with Brazil, China, and India issuing inaugural green bonds in the past few months. On the supply side, there are currently a limited number of investment-quality green bond offerings that fully commit to all four pillars of the GBPs (use of proceeds, project eligibility, management of proceeds, and reporting with third-party assurance). This has allowed issuers to be very selective, selling only to investors who are signatories to the GBPs or to the Global Investor Statement on Climate Change.” (Ludvigsen et al, 2016, 166)
- “The U.S. Department of Labor recently issued guidance that supports consideration of ESG-based investments by pension fiduciaries. This new guidance acknowledges that ESG factors may have a direct relationship to the economic and financial value of an investment. If they do, these factors are “more than just tiebreakers, but rather are proper components of the fiduciary’s analysis of the economic and financial merits of competing investment choices.” (Ludvigsen et al, 2016, 167)
- “Perhaps the most recognized risk related to green bonds is “greenwashing,” which is defined as a superficial or insincere display of concern for the environment shown by an organization. In other words, the issuer labels a bond as green when there is no verifiable environmental benefit... it is incumbent on the issuers and underwriters to provide sufficient and reliable environmental impact information to allow an informed decision. If there is a failure to provide such information, responsible investors must risk-adjust their anticipated non-financial returns due to the increased uncertainty.” (Ludvigsen et al, 2016, 167)
- “Based on these projections, and the anticipated \$1-billion capitalization of the Green Bank (which would be leveraged on an approximately 8:1 basis with private funds, and which would therefore account for roughly \$9 billion in total clean energy capitalization), the role of the Green Bank would be expected to be that of a catalyst only. It would remain for the private sector, spurred by examples of Green Bank success, to supply the remaining \$76 billion if New York’s clean energy economy is ultimately to reach its full

potential. By one account, however, the Green Bank's total capitalization "is expected to grow to \$8 billion in assets within a decade." (Salzer, 2014, 181)

- "It is the view of the Green Bank's founders and advocates that EE/RE deployment is at an impasse most fundamentally because the risk/return characteristics of EE/RE assets are not yet well understood by risk-averse capital markets, relegating EE/RE developers to less liquid, less efficient capital sources. The resulting higher transaction costs of EE/RE development are impeding their competitiveness vis-a`-vis conventional fuel sources. By bearing some of the risks, and by facilitating more fulsome data flows concerning EE/RE assets, the Green Bank hopes to lure reticent capital market resources to the table. The sections that follow provide further detail regarding these barriers that the Green Bank hopes to overcome." (Salzer, 2014, 181)
- "In order to address this incumbency advantage of traditional real estate investments (such as expenses for landlords, benefits for tenants) over new EE/RE investments, the Green Bank contemplates, among other things, devoting substantial resources to data aggregation and distribution measures that will help create broad indices of "comparables" with meaningful track records in the energy efficiency space." (Salzer, 2014, 182)
- "Such efforts embody two key features: first, high "first costs," and second, a generally quite lengthy amortization (or "payback," in the submarket's terms) period with respect to those first costs. Saliently, there exists a set of natural investors in and lenders to such assets. These are the various so-called institutional investors, such as pension funds, life insurance companies, infrastructure funds and sovereign wealth funds (as well as certain other classes of asset managers). Institutional investors such as these, which deploy their capital in the liquid capital markets, are well accustomed to making large initial capital outlays with long payback periods and moderate return rates—constraints they are willing to place on substantial portions of their investment capital, in exchange for operating in a relatively low-risk investing environment." (Salzer, 2014, 182)
- "Some of the technologies and interventions that make up the budding EE/RE industries (such as certain advanced building energy management systems and electricity storage systems) are currently struggling to cross the first metaphorical valley; many others (such as rooftop photovoltaic solar generation and combined heat and power), having managed to survive the first valley, now stand before the second. The Green Bank's main focus is on the second category. Generally speaking, the technologies in this category are sound and well developed. Their research and development phase is behind them, and in most cases the applications have already been commercialized. However, their deployment at a massive scale has yet to be achieved." (Salzer, 2014, 183)
- "Because these subsectors have not yet managed to package their assets in a modular, standardized, user-friendly fashion for ease of review and comparative analysis, they are relegated to a limited collection of capital sources—in particular, tax equity investors, private equity investors and commercial banks." (Salzer, 2014, 183)
- "Unlike New York's Green Bank, which is a division of a broader state energy authority, CEFIA is a stand-alone entity. (As one consequence, private investment directly in CEFIA may occur.) It is possible that New York's Green Bank will be spun out as a similarly separate vehicle when it has established a track record, but for the time being it is a NYSERDA entity." (Salzer, 2014, 184)

- “It appears that the Green Bank may, at least de facto, play a role in rationalizing and coordinating the multiplicity of state programs, program offerings and organizations. The concern has been expressed that there is a long way to go to reach a “customer-centric model” because “[a]t present, wading through the programs . . . is very complicated and often discourages people from pursuing energy efficiency.” (Salzer, 2014, 185)
- “As mentioned above, the basic strategy of the New York Green Bank is to bridge clean energy financing gaps by transitioning the use of a portion of ratepayer funds, already earmarked for EE/RE advancement, away from the currently dominant subsidy-based clean energy policy model, in favor of a public- private investment partnership model. The new model seeks to better leverage some of the increasingly scarce public funds that do remain available for clean energy advancement, by using them not to provide grants but to strategically provide recyclable financing (in the form of loans to and partnerships with private clean energy finance intermediaries, as well as credit support for appropriate clean energy project financings), thereby attracting private investment dollars in multiples of the public funds.” (Salzer, 2014, 185)
- “The theory underpinning the Green Bank’s strategy is that the market for clean energy assets can be transformed by strategically applying credit enhancement mechanisms and information standardization techniques in the context of public-private partnership settings to systematically triage and close financing gaps. Green Bank advocates analogize to historical market transformations catalyzed by government in various infrastructure sectors as well as in automobile finance, credit card receivables and other industries. The fundamental idea is to remove an element of risk from a new market so as to attract institutional investor interest, and to standardize a new industry’s component assets so they can be gathered as they are formed, and warehoused until they reach scale, at which point self-sustaining access to the capital markets should become available. In sum, the Green Bank expects that it “will operate at the near-frontier—one standard deviation away from where private sector markets are functioning today. These are areas where there is market interest, but a lack of access to capital. A fundamental premise of the Green Bank, then, is that it will be a facilitator for a robust clean tech marketplace, and not a competitor against any market participants.” (Salzer, 2014, 187)
- “A comment on one online analysis of the Green Bank’s potential indicated that the Green Bank could seek to expand this “bankability horizon” by employing “selective interventions that will make the difference [I]t will be important to avoid areas that don’t have trouble getting funding (like public buildings) and to focus on areas where buying down the cost of capital is what will make a real difference.” (Salzer, 2014, 187)
- “Among the financial products the Green Bank expects to offer are credit enhancements (which may include first-loss guarantees, letters of credit and other instruments), loan loss reserves, loan warehouse facilities, and pooling and securitization vehicles...It is the translation of these tools to the clean energy industry, particularly in the P3 context, that is innovative. In that setting, the Green Bank will look to apply these tools in seamless integration with the wide variety of existing models and strategies that EE/RE actors are currently using to spark greater market activity.” (Salzer, 2014, 188)
- The Climate Action Council’s 2010 Interim Report outlines the need for the creation of a “Efficiency and Clean Energy Fund”. The Fund would facilitate investment in clean

energy sources and could consolidate current funding streams (such as the Systems Benefit Charge [SBC], Energy Efficiency Portfolio Standard [EEPS], Renewable Portfolio Standard [RPS], Regional Greenhouse Gas Initiative [RGGI] or weatherization). The Climate Action Council recommends it be combined with new revenue sources such as oil and propane public-benefit surcharges as well as code-based user charges. The Fund would be tailored to support the whole range of energy efficiency and clean energy product and service development: from research and analysis through technology development and demonstration through business and market development through market commercialization and adoption to standardized practice.” (CAC Report 2010, Chapter 6, page 32)

- “New York should support the establishment of a strong federal cap-and-trade program that places a national price on carbon emissions. In the absence of a federal policy, New York should build on the successful RGGI effort and work with its regional partners in RGGI to construct a cap-and-trade, or cap-and-invest, program that would cover large stationary emission sources in addition to the electricity-generating sources included in RGGI... It would also provide a source of revenues for clean energy investments that contribute to economic development and job growth in New York by providing that all proceeds from the auction of allowances are reinvested in complementary programs to deploy energy efficiency, renewable energy and other low-carbon technologies or policies. Steps would have to be taken to address leakage/imports of electricity from sources in uncapped jurisdictions. At this time, RGGI covers only the power sector but this policy recommends that consideration be given to including industrial sources in the program as well as fuels used in the transportation and building sectors.” (CAC Report 2010, Chapter 8, page 20)
- “The program would be designed to mitigate impacts on energy-intensive industries that are subject to interstate or international competition. As an alternative to including the emissions associated with transportation and building fuels in the cap, a carbon fee could be applied to the use of those fuels at a per ton carbon level that is comparable to, or based on, the clearing price for allowances used in the cap-and-invest program. Placing a carbon price on building and transportation fuels would provide an incentive for energy efficiency and low-carbon renewable sources of energy and a source of revenues to fund some of the policy initiatives discussed in the RCI and TLU sections of this report. In addition, if the scope of the cap-and-invest program is expanded beyond RGGI, offsets should be expanded beyond those available under the current RGGI program if the offsets meet the fundamental requirements of RGGI and other credible emission reduction programs (the offsets must be real, additional, verifiable, enforceable, and permanent).” (CAC Report 2010, Chapter 8, page 20)
- “Implementing strong complementary measures directed at the power sector, such as the LCPS and RPS, will have a tendency to reduce the cost of emission allowances under the cap-and-invest program, thereby reducing the cost to New York ratepayers. However, if other states participating in a regional cap-and-invest program do not make similar investments, this benefit will be diluted, thereby raising the cost of the cap-and-invest program to New York. Therefore, New York would need to work with its partners in the RGGI to seek deployment of similar programs in the other RGGI states and explore the possibility of regional implementation of an LCPS. Another possible way of ensuring that

New York reaps the benefits of its other policies is to base the percentage allocation of allowances that New York receives in a regional program on state emissions baselines that do not consider the emission reductions that will result from other policies, such as implementation of the LCPS, expanded RPS and other complementary measures.” (CAC Report 2010, Chapter 8, page 20)

- “Design of the cap-and-invest program will need to address leakage of emissions. Among the mechanisms to be used would be implementation of complementary measures to reduce electricity demand and deploy renewable energy (including the RPS and LCPS), allocating a portion of the allowances for free to sources in energy-intensive, competitive industries, and including imported energy within the scope of the program. Regulating the carbon intensity of electricity imported into the state would have to be implemented in a manner that complies with the constitutional principles governing state regulation of interstate commerce.” (CAC Report 2010, Chapter 8, page 20)
- “Ideally, in the long term, the regional cap-and-invest program would transition into, or form a part of, a national program that is enacted through legislation or regulation. In deliberations over the design of a federal cap-and-trade program, New York should advocate for measures to ensure that emission reductions achieved under an LCPS or other similar measures have value when a federal cap is in place.” (CAC Report 2010, Chapter 8, page 20)

Other Resources

Related Topics in this Document: EV Incentives and Purchases, Carbon Taxation and Pricing

Research and Innovation

Topics

New York Actions

- “Department Of Health And Mental Hygiene - DOHMH is collecting and analyzing data on climate change and climate-related health outcomes and is integrating climate change risk and vulnerability assessments into its emergency preparedness activities, with an emphasis on how these threats will impact health disparities and exacerbate existing inequities. This evidence-based empirical data draws on the nexus between climate and health issues, informing efforts to prevent or mitigate adverse health outcomes, and directs resiliency resources to communities that are most impacted.” (NYC 1.5C, 2017, Agency Highlights, 33)
- “CUNY’s campuses are offering degrees and programs related to sustainable urban planning and design, as well as technical programs relating to EV and building energy management. CUNY’s researchers are focusing on breakthroughs in battery storage and environmental adaptability such as the resiliency of Jamaica Bay.” (NYC 1.5C, 2017, Agency Highlights, 33)

- “The coastal states and federal authorities have initiated processes to collaborate on various aspects of offshore wind project development and to a limited degree, technology development. Affected organizations include the US Offshore Wind Collaborative, Atlantic Offshore Wind Energy Consortium lead by the U.S. Department of the Interior, the Mid-Atlantic Regional Council on the Ocean; and specific to New York, New York State Department of State, NYSERDA, Con Edison Company, Long Island Power Authority, and the New York Power Authority. These organized efforts to address pressing technology and project development is expected to drive the agenda for applied research and development activities for the ocean and offshore environment. New York’s share could represent an investment of upwards of \$60 million should the costs be shared by coastal states. The research agenda encompasses the following areas: scale up of turbine size and evolution of gearbox and blade designs and materials, development of alternative/deep water/floating foundations, development of facilities for component testing/validation, comprehensive resource characterization / measurement campaigns, aerodynamic flow modeling, codes and standards, deployment and servicing strategy formulation and infrastructure development, avian and marine ecological evaluation, and grid integration.” (CAC Report 2010, 10, 19)

LPDD Recommendations

- *“State governments should consider technology mandates for deep decarbonization, but only as a last resort when the technology objective is clear and no other approach is available to ensure achievement of the technology goal.”*
- *“State governments should assist in R&D toward the goal of reducing battery costs.”*
- *“State governments should provide tax incentives to encourage investment in R&D supporting modification of existing pipeline systems to make them compatible with ethanol or biodiesel.”*
- *“State legislatures could provide tax credits or grant funding to stimulate investment in R&D focused on the costs and benefits of pre-transport processing of bioenergy feedstocks.”*
- *“States can fund additional research, technology, and development on a range of distribution network and smart grid developments, including energy storage.”*
- *“State environmental agencies should conduct regional research to understand how black carbon emissions contribute to warming.”*
- *“State agricultural agencies could provide funding for, and otherwise support, research into new methane emissions reduction techniques from enteric fermentation.”*
- *“To achieve CO₂ removal at the necessary scale within a relevant time frame, state legislatures should significantly boost the funding available to support negative emissions technology (NET) research proposals.”*

Related LPDD Database Pathways

- Funding Innovation in Transmission, Distribution, and Storage:
<https://lpdd.org/pathway/funding-innovation/>
- Using Government Procurement to Support Innovation:
<https://lpdd.org/pathway/using-government-procurement-to-support-innovation/>

- Prizes and Competitions to Support Innovation: <https://lpdd.org/pathway/prizes-and-competitions-to-encourage-innovation/>
- Promoting Decarbonization through R&D: <https://lpdd.org/pathway/promoting-decarbonization-through-rd/>
- Reports on Advancing Decarbonization Technologies: <https://lpdd.org/pathway/reports-on-advancing-decarbonization-technologies/>
- Biofuel Research and Development: <https://lpdd.org/pathway/biofuel-research-and-development/>
- CCS R&D: <https://lpdd.org/pathway/ccs-rd/>
- Supporting Climate-Friendly Agriculture R&D: <https://lpdd.org/pathway/supporting-climate-friendly-agriculture-rd/>

Other Recommendations

- “Research areas that need more attention include: software advancements to plan and run a zero-carbon grid; opportunities to decarbonize heavy industry (direct reduction of hydrogen to make steel, low-GHG alternatives to clinker in cement production, electrification to the extent practical); hydrogen generated from clean electricity and used to meet both stationary and certain mobile energy needs; biochemistry and synthetic chemistry; materials efficiency and advanced recycling; new materials like low-carbon cement, steel, and plastic substitutes; as well as carbon capture and removal. Applications for hydrogen and associated R&D are especially important, as discussed above in the Industry section. In addition to “conventional” research and development, support for demonstration projects is also critical. A public-private partnership structure built on the loan guarantee program would be one place to start.” (Federal Policies for Net Zero, 2020, 17)
- “We urge the Commission to immediately begin the process of developing accurate and full accounting of the costs to utility ratepayers of the 100-foot rule subsidy. Having accurate cost numbers is an important first step in evaluating the role of the 100-foot subsidy relative to minimizing infrastructure investments.” (Nowak et al, 2020)
- “Incorporate updated GHG emissions accounting methodologies developed for the statewide GHG emissions limit and reporting requirements of the CLCPA” (NY Pathways, 2020, 46)
- “Continue to evaluate peak heat impacts of a transition to electric space heating in New York State, which is ongoing through the Carbon Neutral Buildings Roadmap” (NY Pathways, 2020, 46)
- “Improve characterization of GHG emissions from refrigerants, including those associated with heat pump adoption, and assess mitigation options in detail with a focus on the use of low-GWP refrigerants in heat pumps” (NY Pathways, 2020, 46)
- “Evaluate the impacts of electrification on the future of natural gas distribution within the State” (NY Pathways, 2020, 46)
- “Analyze local transmission needs to serve customers with 100% zero emissions electricity” (NY Pathways, 2020, 46)
- “Explore in detail implications of resource portfolios on renewable development siting, considering protected and sensitive lands within the State” (NY Pathways, 2020, 46)

- “Improve assessment of carbon capture and storage potential within the state, especially focusing on geographic opportunities for carbon storage and utilization” (NY Pathways, 2020, 46)
- “Improve characterization of non-combustion emissions sources, such as landfills, and associated mitigation opportunities.” (NY Pathways, 2020, 47)
- “Continue to assess potential quantity and cost-effective conversion pathways of sustainable bioenergy resources and develop scenarios that explore different sectoral allocation of these resources” (NY Pathways, 2020, 47)
- “Hydrogen emits no carbon when combusted and can be readily produced from water through electrolysis, using zero-carbon electricity sources. However, more research is needed on industrial, as well as transportation, applications to unlock this potential. R&D funds should be directed to reducing the cost of producing hydrogen via electrolysis, which uses electricity to split water into hydrogen, so that electrolysis can replace natural gas as the dominant source of hydrogen production.” (Federal Policies for Net Zero, 2020, 8)
- “Develop an intellectual and practical knowledge base for research and outreach planning based on:
 - A quantitative soil health assessment in agricultural, urban, and natural areas across the state, and identify key regional and sector challenges and opportunities
 - Economic and feasibility analyses for expanded adoption of soil health practices for specific land uses, regions, soil types, etc.
 - Research on best methods to incentivize adoption of soil health practices
 - Identified needs and opportunities in technology and farm equipment
 - Fundamental soil biology and ecology research” (NYSH, 2019, 23)
- “Develop research and outreach agendas specifically for:
 - Underserved areas of the state and underserved land managers/owners such as apple, grape, organic, and other farmer groups, and managers of grasslands, pastures, forests, and urban landscapes
 - Developing and evaluating new cover crop varieties and species mixtures, novel rotation schemes, agroforestry, and perennial grain crops
 - Integrating cover crops and/or double crops into cash crop systems
 - Technical support for transitioning to new soil health practices, including “workbooks”, mobile phone apps, etc.
 - Ground cover management for perennial fruit crops
 - Optimizing soil health for weed, disease, and insect pest management
 - Improvement and expanded use of quantitative measurements of soil health, such as Cornell’s CASH protocol (<http://soilhealth.cals.cornell.edu>)
 - On-farm demonstrations, educator-farmer and farmer-to-farmer training” (NYSH, 2019, 25)
- “•Develop statewide education programming regarding the benefits of soil health for climate change mitigation and resiliency of our food system
 - Expand research and outreach for supporting adoption of soil health practices for:
 - Resilience to drought, flooding, and erosion
 - Reducing emissions of nitrous oxide and methane, as well as carbon dioxide
 - Soil carbon sequestration, including:
 - ◇ Establishing soil carbon baselines and potential for sequestration at farm, regional, and state levels
 - ◇ Developing low-cost approaches to monitoring soil carbon change
 - ◇ Supporting basic research on factors leading to

long-term carbon storage ◇ Scaling up production and use of biochar for carbon sequestration” (NYSH, 2019, 26)

- “Address unique soil health challenges and opportunities for dairy and other mixed crop-animal production systems with expanded research and outreach for: ° Optimized seasonal distribution of manure waste on crop lands ° Quality control and scaling up production of manure products such as compost and nutrient-enriched biochar ° New approaches to commercialize manure distribution (e.g., manure banks) ° Reducing investment and management costs for anaerobic digesters •Integrate soil health with optimized management of nitrogen and other nutrients, including the emerging “4R Nutrient Stewardship” program •Establish a research and outreach program focused on soil health economic benefits related to water quality and management, including (but not limited to): ° Nutrient loading to waterways and harmful algal blooms (HABs) ° Soil erosion and sedimentation of waterways ° Drainage and flood control ° Reduced irrigation needs on healthy soils •Develop statewide education programming regarding the benefits of soil health for maintaining water quality for recreational use and a safe drinking water supply” (NYSH, 2019, 27)
- “Support industrial research and development Projects in early stages of technological development tend to need grant support due to lack of income. By contrast, pilot projects aiming at testing close-to-market technologies, or scaling-up/replicating market-ready technologies may be supported with financial instruments.” (Embodied Carbon, 2019, 46)
- “National and regional governments with substantial industrial emissions should begin programs to understand their heat-related emissions. This should include data gathering and dissemination, analytical programs to assess the nation’s potential vulnerabilities and opportunities, and potential supply chain and infrastructure limits to substitute options for low-carbon heat.” (Low Carbon Heat, 2019, Findings And Conclusions, 59)
- “State governments and land-grant institutions played a critical role in the growth of sustainable and organic agriculture before the federal government began providing consistent, if relatively meager, research funding in the 1990s. They are now beginning to do the same for climate-friendly practices. Both Maryland and Hawaii, for example, passed legislation in 2017 providing support for research, education, and technical assistance focused on agricultural practices that build healthy soils and sequester carbon. 194 The California Department of Food and Agriculture also appropriated \$7.5 million in FY 2016/2017 for the Healthy Soils Program, an incentive and demonstration program for farmers and ranchers designed to increase soil carbon sequestration and reduce agricultural greenhouse gas emissions. 195 Other state legislatures, agencies, and land-grant institutions should expand on these efforts, giving programs designed to spread climate-friendly practices sufficient funding to develop robust research, education, and technical assistance arms. “ (Carbon-Neutral Agriculture, 2017, 16)
- “Advancements are needed in all areas, from basic research into new battery chemistries, innovations in public transit technology and performance, new products, and business models that enable electric vehicle charging or on-demand public transit. As noted above, the RD&D investment strategy must be inclusive of near, mid, and long term

elements and recognize those aspects of RD&D that are best accomplished at a national, regional, or State level.” (CAC Report 2010, 10, 12)

- “To address New York’s pressing transportation challenges, a multi-dimensional program involving NYSERDA, State agencies (New York State Department of Transportation, NYC DOT, and New York State Department of Environmental Conservation), universities, and the private sector is necessary. The program should not supplant the responsibilities of State agencies, but should provide coordination of energy efficiency-sustainability measures, sponsor research and pilot projects that validate benefits, and accelerate the utilization of products, processes and alternative measures. In addition, funds should be utilized to educate, subsidize, and accelerate the early adoption of solutions in both the public and private sectors. Extensive use of the private sector will foster in-state economic and intellectual property development.” (CAC Report 2010, 10, 15)
- “Meeting electric demand in a manner that satisfies climate protection goals will require continued advances in the performance of current renewable and traditional generating resource technologies, the development of new sources of renewable generation including generation utilizing fuels derived from sustainable chemical conversions and the fuels they will require, new technologies associated with the efficient management (storage and regulation) of increased intermittent renewable energy upstream from customers (e.g., large wind) and downstream, at the end use level (e.g., distributed solar), the development of technologies and operating practices for the transmission and distribution system (delivery system) that enable the penetration of these new renewable resources while maintaining system reliability and increasing the efficiency of the delivery system. Finally, electric supply and delivery systems must evolve to accommodate the expectation for electrification of transportation and the resulting impacts on electric use and peak demand.” (CAC Report 2010, 10, 16)
- “State-funded research with respect to on-shore wind technology should be limited to advanced wind resource forecasting/mapping and turbine condition monitoring and diagnostics, and such efforts in these areas should continue in support of State policy objectives. Increased performance of the existing fleet of turbines should be expected to occur during the next decade (2010–2020) and improvements on the order of 1–2 percent in terms of energy capture are realistic. Such an effort would require a modest investment of several million dollars over the next five years.” (CAC Report 2010, 10, 19)
- “Additional research is needed to prepare utilities and other stakeholders for the eventual integration of larger amounts of PV at the distribution voltage level. Analytical tools and models must be developed that establish the value proposition for PV at this voltage level including estimation of the benefits and costs to grid operations associated with deeper penetrations of this technology coupled perhaps with local storage devices. Any research agenda should also include the development of assessment tools and guidance for the integration of PV systems with building energy management systems and infrastructure. In addition, since the large scale deployment of solar has largely been a southwest exercise, the New York/Northeast performance expectations and optimizations will require investigation. Investment for this research could approach several million dollars over the next five years.” (CAC Report 2010, 10, 20)

- “Advances in biomass conversion processes (e.g., gasification, direct combustion, pyrolysis) as well as advances in sustainable fuel generation (e.g. water splitting, carbon dioxide reduction, fuel generation catalysis) should continue to be pursued. Equally important are the application of life-cycle assessments of project attributes and fuel/feed stock (e.g., minimization of environmental impact, i.e., carbon neutrality) and feed stock depletion. The question of what will constitute low carbon or carbon neutral application of biomass and other sustainable chemical conversions to create fuels is critical in terms of determining the contribution that biomass and sustainable chemical conversions may make to long-term renewable energy production goals. For biomass to be a material contributor to renewable energy goals, the definition of sustainability with specific regard to carbon must be answered. The question of feed stock availability for power generation (bio-power) was the subject of extensive review/analysis. Any research agenda for biomass should take into consideration the findings contained therein. Investment in this research agenda could approach several million dollars over the next five years.” (CAC Report 2010, 10, 20)
- “With respect to improvements in the delivery system to increase its efficiency, enable greater penetration, delivery, and value of renewable energy, New York stakeholders will have a more influential role in research, development, and demonstration. The New York Independent System Operator and utilities (transmission owners) will need to consider how best to deliver energy associated with increasing penetration of intermittent, wind generation (land-based in the coming years; off-shore by the last years of this decade) at both ends of the system. They will do this as they consider making the delivery system more efficient and reliable and as they consider transforming the grid from an electromechanical to digitally controlled system and making the delivery system more intelligent (smart grid). Energy storage will play a key role in enabling smart grid functionality. NY-BEST will serve as a key stakeholder in the development and demonstration of a wide variety of energy storage technologies for stationary power applications.” (CAC Report 2010, 10, 20)
- “Research should continue the development of technologies, practices, and programs that promise to improve the efficiency and operation of transmission and distribution systems. Such activities could include the automation of communication and control processes (e.g., deployment and testing of advanced sensors and communication devices) to reduce energy losses and extend equipment life, and would involve demonstrations, testing, and validation to aid in making determinations as to the scale, phasing, and the expected costs of implementation. As the power supply system in New York grows less-carbon intensive over time, the value of electric system efficiency improvements will decline and the research focus shift toward evolving end-use technologies such as electric-vehicle charging and distributed storage that offer the potential for improved grid load shape, asset utilization, and reliability. Research of electric vehicles and batteries, consumer and vehicle load profiling, smart charging and storage technologies at the distribution voltage level, and related consumer metering and billing are expected to be a key components of the RDD&D program over the next 10 years.” (CAC Report 2010, 10, 21)
- “The research agenda can be categorized into the following broad areas: Reduce the carbon intensity of agricultural and forest management activities and optimize the ability

of agriculture and forestry lands to sequester carbon. Develop, demonstrate, and commercialize technologies and processes to convert sustainable resources into fuels, chemicals, and products that will result in an overall reduction in carbon. Support and optimize market participants along the relevant supply chains to ensure that products can efficiently reach the customer. Invest in research activities to continuously develop new crops and cultivation techniques that will supply the conventional customer base and the renewable feedstock customer base as efficiently as possible. Develop and implement adaptation strategies to allow for the continuation of resource supply as environmental conditions change. Maximize urban green space, avoid forest land conversion, and improve the long-term storage of carbon in New York's rural forests. Maximize waste prevention and recovery and utilization of recyclable materials...Academic research institutions (land-grant universities) serve as the foundation of research and training for these sectors. Private landowners will need to make commitments to the goals of the program and commercial businesses will have the primary responsibility to convert sustainable feedstock into fuels, chemicals, and products and establish the supply chain.” (CAC Report 2010, 10, 22)

- “The recommended program involves the long-term commitment and investment of financial support on the part of all participants. Early in the program, supported activities provide a baseline of information and tools to define, for example, sustainable and best management practices, and appropriate methods to verify performance, for agriculture and forestry; provide insight into biomass resource competition to develop a sustainable feedstock/materials management strategy that first aims to reduce or eliminate waste and divert materials for reuse, recycling and composting; and analyze the waste stream to determine the amount, availability and characteristics of waste biomass and trends in industrial and municipal solid waste generation among rural, suburban, and urban areas. These are core activities that can bring research and market participants up to a common level of knowledge. As outlined below, there are some activities that with both federal and state roles. Also identified below is an activity that is likely to be primarily a state effort.”(CAC Report, 2010, 10, 23)
- “Currently New York-specific data quantifying Food Miles Traveled and the resulting benefits has not been thoroughly studied. Additionally, it needs to be recognized that food mile reductions must be assessed on a product-by-product basis that includes life-cycle analyses of the numerous crop specific inputs and concomitant production methods... Conduct research on strategies to connect consumers with farmers who direct market their products (i.e. farmers' markets) that will work in rural, suburban, and urban communities and with a broad base of consumers within each community. Such strategies may include various means of transportation, outreach, and incentive programs.” (CAC Report, 2010, 10, 25)

Discussion and Analysis

- “Industrial Heat Research: Detailed technoeconomic assessments of specific facilities and assets: The viability of retrofit approaches remains a central question. To understand the viability, detailed engineering models and studies are required on both representative assets (e.g., a generic steel mill) or specific facilities (e.g., US Steel's Mon Valley facility). Each of these sectors will require assessment and validation, ideally using

detailed process engineering data and models (e.g., in ASPEN Plus). Applied RD&D on novel methodologies: It seems clear that more options are needed. Some approaches, such as direct electrical heating using radio frequency energy, or hydrogen production using the iodine-sulfur cycle, show great promise but require additional maturation. Progress will require dedicated federal and industrial RD&D investments in many potential approaches.” (Low Carbon Heat, 2019, 61-62)

- “Technoeconomic assessments are only one component of economic study. Many questions regarding market response, leakage risk, macroeconomic consequences, and related topics remain largely unexplored. For example, improved representation of industrial in integrated assessment models used by governments and international agencies for planning and analysis would help shed light on potential economic opportunities and risks associated with fuel substitution or system replacement.” (Low Carbon Heat, 2019, 62)
- “Nearly all buildings are subject to financial decisions that favor property market values over reductions in energy costs therefore technologies need to be exceptionally robust in terms of return on investment. Building design, production, and warranty are performed by different entities, as compared to other mass-produced goods, and require substantial external impetus and coordination of RD&D activities to cost effectively achieve the performance necessary for a low carbon economy.” (CAC Report 2010, 10, 19)
- “Examples of high-impact State-supported RD&D include the development of heavy-duty hybrid–electric drives for transit busses, and energy storage products designed to capture train braking energy in electrified rail and subway applications. State-supported RD&D in these areas has and is developing products that are providing huge energy efficiency benefits to New York and creating jobs for New Yorker’s manufacturing products that are being sold to the rest of the country. State, regional, and local RD&D is also validating the benefits of new technologies and approaches prior to transportation agencies making major commitments.” (CAC Report 2010, 10, 13)
- “A robustly funded RD&D program would be most effective if it is consistent with a State Transportation Research Master Plan. The RD&D investment strategy should define individual research programs, each focused on a specific segment of the Transportation and Land Use sector. Each program area should be staffed and administered by representatives from governmental units having responsibility in that segment and advised by representatives from universities, industry, government, and private sector stakeholders.” (CAC Report 2010, 10, 15)
- “It generally takes 10 to 15 years after initial introduction for a new technology (microwave oven, cell phone, hybrid vehicle) to have significant market penetration. If we are to achieve 2030 goals the technologies and approaches that will get us there must at a minimum be at a point of initial introduction with public policy commitment by 2015.” (CAC Report 2010, 10, 16)

Other Resources

Related Topics in this Document: Research Organization & Funding

Organization

Other Recommendations

- “Policy coordination between the City and State needs to be strengthened. The current governor and the leadership of the PSC, NYSEERDA, and NYPA share a progressive and sophisticated clean energy policy vision and a strong team carrying it out. The mayor’s roadmap for 80x50, and other initiatives described here, demonstrate the City’s commitment to decarbonization. The City, however, lacks jurisdictional control of the energy system, which limits what it can do. Impressions obtained from discussions with various stakeholders indicate that members of the mayor’s and governor’s offices do not have ongoing policy dialogue or steady work relationships. The long-standing process of setting the City government’s own energy procurement path via cooperation between DCAS and NYPA continues, and NYSEERDA is engaged with the City’s Retrofit Accelerator project—but there appears to be a need for a higher-level State-City policy task force that devises joint strategies and coordinates their implementation.” (Kass, 2018, 55-56)
- “The formation of a statewide RD&D Advisory Council (Council) will be necessary in order to effectively manage expenditures across all sectors in a manner that optimizes collective value. Representatives from each mitigation sector (RCI, TLU, PSD, and AFW) will serve on the Council. The first task will be to define a technology development framework consistent with New York’s carbon mitigation abatement curve (the development of this abatement curve is currently underway). Specific RD&D initiatives will be prioritized and sequenced in an effort to systematically build on previous investments and carbon reductions in the most cost-effective manner.” (CAC Report 2010, Chapter 10, page 5)
- “Although the Council will map out a high-level coordinated statewide strategy, the individual sectors will be responsible for establishing multidisciplinary teams (including representatives from industry, academia, government and the investment community) to execute specific carbon reduction projects. Technology, environmental, and business milestones will be established before a project is started in order to provide tangible benchmarks for gauging performance along the way. Projects failing to meet predetermined targets will be quickly abandoned and RD&D funds will be allocated to other more promising areas within the sector. Federal and private sector financial commitments to support a project throughout the entire innovation process—assuming successful completion of all milestones—will be required before State funds are assigned to the project. The specific roles of the federal/State governments and the private sector may vary depending on the type of project pursued.” (CAC Report 2010, Chapter 10, page 5-6)
- “Establish concurrent requirements to enable path-to-market; provide support for manufacturing capacity development; increase consumer acceptance and education; and coordinate government policy (codes, standards, regulation, deployment). Utilize public, university and private partnerships where appropriate.” (CAC Report 2010, Chapter 10, page 9)

- “This research can best be accomplished at a regional level to address the unique building stock, climate conditions, construction practices, and industrial activities at the local level. Demonstration and evaluation of whole building systems will be critical to advancing net zero-energy buildings. As we attempt to ramp up building performance, understanding the human interface will also be critical. The State should also continue to support various building science and industry application consortia in New York and facilitate university and industry collaborations.” (CAC Report 2010, Chapter 10, page 10)

Discussion and Analysis

- “Technology development: states can play a critical and potentially game changing role at this point in the innovation process where the so-called Valley of Death often presents a virtually insurmountable obstacle. This area requires significant State investment to assist New York companies with a wide array of risk-sharing and technology and business development support.” (CAC Report 2010, Chapter 10, page 7)
- “Technology demonstration: this is a very expensive step (often referred to as the Mountain of Death) and limited State resources cannot be expected to carry the high capital costs associated with large-scale technology demonstrations. The State should participate at a minimum level to gain access to important technical information that may be useful for New York businesses in a strategic position to supply value-added parts/components/services associated with the technology. The State should also begin the development of innovative policies that reinforce, streamline, and accelerate ultimate commercial adoption.” (CAC Report 2010, Chapter 10, page 7)
- “The commercial adoption step provides an opportunity for states to exploit potential workforce development and training opportunities resulting from widespread technology market penetration. This may at first blush seem outside the realm of RD&D activities, but the initial mobilization of qualified engineers, scientists, technicians, and service personnel can require innovative training methods and catered instruction techniques developed in partnership with a variety of New York academic institutions.” (CAC Report 2010, Chapter 10, page 8)
- “The development period to commercialize a new technology and apply an existing one can be long. This delay is often the result of start-up companies lacking the business skills to advance a technology from the R&D phase to the commercialization phase, or of mature companies unaware of potential partnering opportunities. Mechanisms need to be developed to provide start-up companies with executive level mentoring and management advice to help them make the jump between these stages.” (CAC Report 2010, Chapter 10, page 10)
- “To achieve our clean economy goals, the rate at which new options such are developed and validated must be accelerated through RD&D programs that select sponsored efforts based on merit, mitigate risk, provide creditable third party evaluation of performance, and disseminate the results via technology transfer programs.” (CAC Report 2010, Chapter 10, page 14)
- “State RD&D should promote clusters of technical expertise that develop innovative products and services, create jobs, and produce innovative solutions to New York problems. Helping private firms minimize the technical and financial risk inherent to

research activities provides public benefits. Once technical risk or profitability risk is reduced, it is the role of the private sector to complete development and commercialize the advancement.” (CAC Report 2010, Chapter 10, page 14)

- “Demonstration and assessment of newly emerged products, services, and approaches is an important role for State and local RD&D and frequently the final step in verifying to the private sector that their continued investment is warranted. In well designed research programs, cost to benefit ratios, and best practices can be determined even in areas where cause and effect can be difficult to assess and benefits difficult to quantify such as eco-driving education programs, some DSM measures and ITS technology. This is what differentiates a research program from financial assistance and deployment incentives.” (CAC Report 2010, Chapter 10, page 14)

Other Resources

Related Topics in this Document: Research Topics, Funding

Funding

New York Actions

- “NYSERDA's FlexTech program shares the cost to produce an objective, site-specific, and targeted study on how best to implement clean energy and/or energy efficiency technologies. Incentives: Offers cost-sharing up to 50%, or \$500,000 whichever is less” (Retrofit Accelerator, 2020)
- “State funds are predominantly used to increase the competitive performance of proposals submitted by New York universities and companies to federal agencies seeking very high leveraging, typically more than 10:1. State support can provide significant value and has recently demonstrated successful results yielding five Energy Frontier Research Centers (EFRCs) and a variety of Advanced Research Projects Administration—Energy (ARPA-E) grants in New York through DOE.” (CAC Report 2010, Chapter 10, page 7)

Other Recommendations

- “The ideal form for such an approach would be a research, development, and demonstration component to a broader sectoral agreement with firm funding guarantees by parties. This could be grounded in a cooperative research agenda to develop and commercialize critical cement technologies such as aluminosilicate cements that did not rely on lime as Portland Cement does. Such an approach could follow the example of the International Thermonuclear Experimental Reactor, which splits costs among European participating parties and staffs the resulting project with a multinational staff to ensure an equitable distribution of the end result of the research. 87” (Imbabi et al, 2012)
- “Companies will provide valuable engineering and equipment/facilities to test and validate concepts that they and academia collaborate on. State and federal government will partner with these types of entities to buy down or cover risks that these and other private sector participants (e.g., venture capital and infrastructure capital investors) are unable or unwilling to fund. As the menu of options necessary to meet ambitious climate

protection goals expands, existing institutions for business incubation will grow in significance and number.” (CAC Report 2010, Chapter 10, page 22)

Discussion and Analysis

- “The RD&D program needed to achieve the 80 by 50 GHG reduction goal only works when federal, State, and private-sector organizations collaborate. Risk profiles need to be fully understood and costs equitably allocated to promote innovation. In the long-term, a private to public energy RD&D funding ratio exceeding 2:1 will be necessary to ensure continued development and market introductions of innovative low-carbon technologies. This will take some time to achieve. The adoption of a national climate and energy policy is critical to promoting long-term and sustainable levels of private sector RD&D investment within the energy sector.” (CAC Report 2010, Chapter 10, page 8)
- “State and federal commitments to early-stage research, technology validation, and demonstration will be critical to enticing increased infusion of private sector capital that will become necessary over the longer-term to take new products to market and to finance the scale of renewable generating projects that are expected to be necessary to achieve ambitious climate preservation goals. Such a commitment will validate the significance and vitality of climate change policies and reduce risks to levels where private capital will become vested in amounts sufficient to meet policy goals.” (CAC Report 2010, Chapter 10, page 17)
- “Achieving the CLCPA’s nation-leading goals will mean not only expanded deployment of existing technologies, but also substantial investment in the State’s clean energy innovation economy to develop entirely new solutions for a low-carbon future. New York’s ecosystem of start-ups will develop these technology and business-model solutions for demonstration and use in New York, as well as for export to markets across the globe.” (Clean Energy, 2020, Clean Energy Economy, pg. 21)

Other Resources

Related Topics in this Document: Research Topics, Financing, Carbon Taxation and Pricing