

## A Legal Approach to the Improvement of Energy Efficiency Measures for the Existing Building Stock in the United States Based on the European Experience

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*Energy consumption in buildings is on the rise and represents almost half of the total greenhouse gas emissions in cities, which are the main cause of global warming on the planet. There is a great scientific consensus that improving energy efficiency of building systems and operations is a very effective way to tackle this important problem. However, despite the fact that the existing building stock has the greatest potential for greenhouse gas emission reduction, most laws and regulations have focused primarily on new buildings. Hence, improving energy efficiency in existing buildings represents a great opportunity for reducing greenhouse gas emissions worldwide. Numerous measures to increase efficiency and decrease emissions have been put in place in Europe and in the United States with Europe taking the lead, but there is still much to be done. The measures are diverse and range from conventional approaches to innovative market-based instruments. Although different proposed methods are similar to some extent, they are tailored to the specific characteristics of each region. Based on the European experience, this article seizes the opportunity to fill in the existing gap on the energy upturn of the existing building stock, giving some useful elements to legal professionals in order to improve the measures developed throughout the United States.*

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## I. INTRODUCTION

The stock of existing buildings represents a largely untapped opportunity for the reduction of greenhouse gas (GHG) emissions in the European Union (EU)<sup>1</sup> and the United States (U.S.). Existing buildings are responsible for 41% of energy consumption and 36% of carbon dioxide (CO<sub>2</sub>) emissions in the EU,<sup>2</sup> and 39% of total energy use and around 38% of CO<sub>2</sub> emissions in the U.S.<sup>3</sup> Understanding the energy consumption in

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1. The twenty-eight member states of the EU are Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and UK. *List of Countries*, EUROPEAN UNION, [http://europa.eu/about-eu/countries/index\\_en.htm](http://europa.eu/about-eu/countries/index_en.htm) (last visited Apr. 11, 2015).

2. This is the largest end-use sector, followed by transport (32%) and industry (25%). Average annual energy consumption was around 220 kWh/sqm in 2009, with a large gap between residential (around 200 kWh/sqm) and non-residential buildings (around 300 kWh/sqm). EUROPEAN COMMISSION, REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL: FINANCIAL SUPPORT FOR ENERGY EFFICIENCY IN BUILDINGS 6 (April 18, 2013), *available at* [http://www.eib.org/epec/ee/documents/report\\_financing\\_ee\\_buildings\\_com\\_2013\\_225\\_en.pdf](http://www.eib.org/epec/ee/documents/report_financing_ee_buildings_com_2013_225_en.pdf).

3. *Green Building: Why Build Green?*, EPA, <http://www.epa.gov/greenbuilding/pubs/whybuild.htm> (last updated Oct. 9, 2014). Except for China, U.S. buildings are responsible for more CO<sub>2</sub> emissions annually than those of any country. BRUCE R. KINZEY ET AL., U.S. DEP'T OF ENERGY, THE FEDERAL BUILDINGS RESEARCH AND DEVELOPMENT PROGRAM: A SHARP TOOL FOR CLIMATE POLICY (2002), *available at* [http://aceee.org/files/proceedings/2002/data/papers/SS02\\_Pan el9\\_Paper18.pdf](http://aceee.org/files/proceedings/2002/data/papers/SS02_Pan el9_Paper18.pdf).

buildings requires insight into the energy levels consumed over the years and the mix of fuels used in that energy consumption. Overall, in the EU and the U.S. (in fact, throughout the developed world), energy use in buildings is rising. Despite energy efficiency and mitigation efforts, this trend is likely to continue if insufficient action is taken to improve our buildings' performance.<sup>4</sup> Although there are several ways to reduce GHG emissions derived from energy use in buildings, scientists and governments agree<sup>5</sup> that improving the energy efficiency of building systems and operations, as well as investing in cleaner on-site power generation, is a highly effective approach.<sup>6</sup> Indeed, a new report published in the journal *Frontiers in Ecology and the Environment* concluded that improving energy efficiency will be the primary means of reducing GHG emissions in coming years.<sup>7</sup> Moreover, the latest Intergovernmental Panel on Climate Change (IPCC) report (AR5)<sup>8</sup> indicates (high agreement, robust evidence) that buildings represent a critical piece of a low-carbon future.<sup>9</sup>

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4. BUILDINGS PERFORMANCE INST. EUR., EUROPE'S BUILDINGS UNDER THE MICROSCOPE: A COUNTRY-BY-COUNTRY REVIEW OF THE ENERGY PERFORMANCE OF BUILDINGS 43 (2011).

5. The majority of carbon emissions into Earth's atmosphere are energy related and originated by fossil fuel combustion. In particular by the emissions from the so-called "diffused sectors," this is from sources that are not subject to the Kyoto Protocol (KP) emission trading mechanism (transport, residential, commercial, institutional, farming, waste treatment, and fluorated gases). Given the predominance of existing buildings in major population centers around the world, adopting energy efficiency measures for existing buildings is one of the most important and cost-effective means available to combat climate change. Furthermore, according to the United Nations, the world population is projected to reach 9.6 billion by 2050, which leads to an inevitable increase in the use of energy, especially in cities. *World Population Prospects: The 2012 Revision*, U.N., DEP'T OF ECON. & SOC. AFFAIRS: POPULATION DIV., POPULATION ESTIMATES & PROJECTIONS SECTION, <http://esa.un.org/wpp/> (last updated Apr. 14, 2014).

6. Charlie Wilson, Arnulf Grubler, Kelly S. Gallagher & Gregory F. Nemet, *Marginalization of End-use Technologies in Energy Innovation for Climate Protection*, 2 NATURE CLIMATE CHANGE 780 (2012). See also *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions*, EUROPEAN COMMISSION (Jun. 5, 2014), <http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52011DC0109>.

7. Energy efficiency was at the top of a list of five strategies compiled by National Science Foundation and NASA that included conservation programs and switching to low carbon fuels. Daniela F Cusack, Jonn Axsen, Rachael Shwom, Lauren Hartzell-Nichols, Sam White & Katherine RM Mackey, *An Interdisciplinary Assessment of Climate Engineering Strategies*, 12 FRONTIERS IN ECOLOGY AND THE ENV'T no. 5, at 280 (June 2014).

8. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE: WORKING GROUP III, CLIMATE CHANGE 2014: MITIGATION OF CLIMATE CHANGE 671-738 (2014) [hereinafter IPCC Report].

9. In July 2009, McKinsey & Company did a comprehensive study of the U.S. Building stock and found that if off-the shelf energy efficiency measures were put in place across the sector, total U.S. energy consumption would decline by 23%, yielding more than \$1.2 trillion in savings for an investment of \$520 billion. Phillip Saieg, *Energy Efficiency in the Built Environment*, in STATE OF THE WORLD 2013: IS SUSTAINABILITY STILL POSSIBLE? 184-189 (2013).

Accordingly, this paper focuses on the improvement of the energy efficiency of the existing building stock, through the formulation and implementation of measures aimed at building owners and property managers. Consumer (tenants and occupants) behavior will also be taken into account, though in a complementary manner. This focus fills an important void in the literature on GHG emissions reductions strategies. Despite the great potential for energy savings and GHG emission reductions in existing buildings, most laws and regulations adopted to improve energy efficiency have focused primarily on new buildings due to the inherent and perceived difficulties in improving the energy performance of the former.<sup>10</sup>

In a second edition of the *2014 International Energy Efficiency Scorecard*,<sup>11</sup> the American Council for an Energy Efficient Economy (ACEEE) concluded, after analyzing the world's sixteen largest economies covering more than 81% of global gross domestic product and about 71% of global electricity consumption, that even though some countries are significantly outperforming others, there are substantial opportunities for improvement in all economies. The ACEEE report further concluded that although the U.S. has made some progress toward greater energy efficiency in recent years, particularly in areas such as building codes, appliance standards, and voluntary partnerships between government and industry, among others, there is great room for improvement. Since the EU is ranked number 3 (after Germany and Italy), lessons from Europe could benefit the U.S. experience. By analyzing the best practices in Europe, this paper aims to provide some ideas for improving the measures developed in the U.S.

This article proceeds in six parts, beginning with the introduction. Then, Part II describes the range of structures that constitute the existing building stock in the EU and the U.S. Part III identifies critical barriers in both the EU and the U.S. to improving energy efficiency in decreasing GHG emissions from existing buildings. Part IV describes the energy efficiency process for existing building and surveys the range of measures nations, states, and localities have employed to overcome the barriers previously indicated, with a brief reference to the specific case of the historic buildings. Part V shows the most interesting and innovative energy

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10. An example of this is the Spanish Royal Decree 47/2007 of January 19, 2007, transposing part of Directive 2002/91/CE, of December 16, 2002, on the Energy Performance of Buildings (later modified by 2010/31/EU). The regulation on the existing building stock of the European Directives was not included in SRD 2007 and was introduced in the Spanish legal system by Royal Decree 235/2013, of April 5, 2013.

11. AM. COUNCIL FOR AN ENERGY EFFICIENT ECON., EXECUTIVE SUMMARY: THE 2014 INTERNATIONAL ENERGY EFFICIENCY SCORECARD (2014).

efficiency solutions in the EU, and provides a summary to extract some conclusions from the large volume of complex research. Finally, Part VI outlines several recommendations for the energy improvement of the existing building stock in the U.S.

## II. CHARACTERISTICS OF THE EXISTING BUILDING STOCK IN THE EU AND U.S.

### A. The Buildings

The building sector is mainly composed of two categories of buildings: residential and non-residential.<sup>12</sup> Residential buildings are comprised of single-family houses (detached and semi-detached houses) and apartment blocks. Compared to the residential sector, non-residential buildings are more heterogeneous and are usually classified by type and by branch of activity.<sup>13</sup> This paper will mainly focus on the existing residential building stock, with some references to the commercial sector, as a means of facilitating the comparison between the two categories.

Most buildings were built before 1990, during periods where there were little or no energy requirements in building codes.<sup>14</sup> Therefore, there are many fairly old buildings predominantly of low energy performance but with great potential for energy efficiency improvements.

The EU has a total building stock of 25 billion square meters (sqm), increasing 1% per year, one of the lowest growth rates in the world. The majority of the EU's built environment is residential, representing 75% of the total stock (split between 64% single family houses, and 36% apartment blocks). Non-residential buildings represent the remaining 25% of the total stock (with 28% wholesale and retail; 23% offices; 17% educational; 11% hotels and restaurants; 7% hospitals; 4% sports facilities; and another 11% other uses).<sup>15</sup>

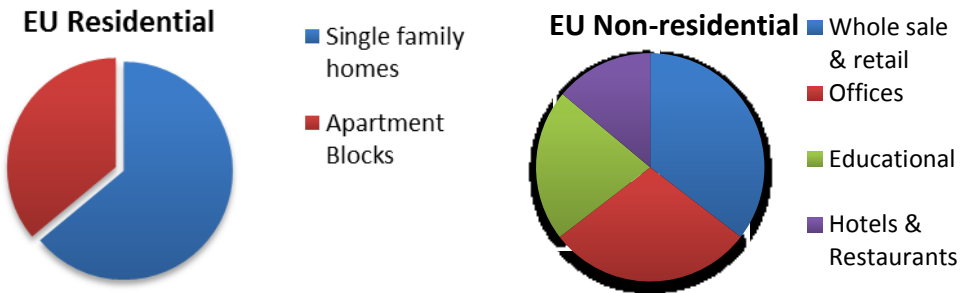
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12. A building is regarded as a non-residential when the minor part of the building (i.e., less than half of its gross floor area) is used for dwelling purposes. Non-residential buildings comprise industrial buildings; commercial buildings; educational buildings; health buildings; other buildings. *Building Type — Non-Residential Buildings*, BLDGS. PERFORMANCE INST. EUR., <http://www.buildingsdata.eu/content/definitions/building-type-non-residential-building> (last visited Nov. 8, 2014).

13. ODYSSEE-MURE PROJECT COORDINATED BY ADEME, ENERGY EFFICIENCY TRENDS IN BUILDINGS IN THE EU: LESSONS FROM THE ODYSSEE MURE PROJECT 10 (2012).

14. EUROPEAN COMMISSION, EUROPEAN FORUM FOR SCIENCE AND INDUSTRY ROUND TABLE: SCIENTIFIC SUPPORT TO ENERGY EFFICIENT BUILDINGS 1 (2013).

15. BUILDINGS PERFORMANCE INST. EUR., *supra* note 4, at 9.



Although there was a large construction boom between 1961 and 1990 in Europe, more than 40% of residential buildings were built before the year 1960. Interestingly, 80% of the residential stock in Europe is held in private ownership, and only 20% is held in public ownership.<sup>16</sup> At least 50% of residential buildings in all EU countries are occupied by the owner.<sup>17</sup>

Currently, building owners and investors in the EU tend to focus on measures with short to medium payback periods of less than ten years,<sup>18</sup> which usually generate less than 30% energy savings. However, according to Bullier and Milin,<sup>19</sup> ambitious energy and climate policies require saving up to 80% energy in buildings, which is only possible with structural interventions such as insulation of facades, or replacement of windows. These deep renovations have a payback time between fifteen and forty years in the EU, at current energy prices.<sup>20</sup>

With respect to the U.S. building stock, over 90% of the current U.S. housing stock was built before 1990; 18% was built before 1940.<sup>21</sup> The 1970s were the decade with the largest amount of housing built, with 19%

16. BUILDINGS PERFORMANCE INST. EUR., *supra* note 4, at 9.

17. BUILDINGS PERFORMANCE INST. EUR., *supra* note 4, at 4-6.

18. This varies across countries and types of buildings. The payback refers to energy investment costs (without general refurbishment measures), with stable energy prices. Adrien Bullier & Christophe Milin, *Alternative Financing Schemes for Energy Efficiency in Buildings*, in ECEEE SUMMER STUDY PROCEEDING 795, 796 (2013).

19. *Id.*

20. *Id.* at 796.

21. The information on the residential sector comes from a single reference, the 1997 Residential Energy Consumption Survey, a representative sample of all U.S. households, according to the U.S. DOE in 1997. RICHARD C. DIAMOND, AN OVERVIEW OF THE U.S. BUILDING STOCK 5 (2001), available at [http://www.inive.org/members\\_area/medias/pdf/Inive/LBL/LBNL-43640.pdf](http://www.inive.org/members_area/medias/pdf/Inive/LBL/LBNL-43640.pdf) (last visited April 30, 2015).

of the current stock built during that period.<sup>22</sup> Urban areas in the U.S. represent around 81% of total population, with around 46% located in suburbs and 35% in the central city.<sup>23</sup> The remaining households (19%) are in rural areas.<sup>24</sup>

The three basic categories of housing in the U.S. are: 1) single-family units (both detached units and row houses), 2) multifamily (both low-rise and high-rise apartments), and 3) mobile homes. In 1997, the stock was predominantly single-family units (73%) with apartments accounting for 21% of total households and 6% for mobile homes.<sup>25</sup> In 2011, single-family homes still represent the majority, but only if they are owner-occupied (88%), and if rented, they only account for 35%. In the rental market, mainly located in urban areas, multifamily units represent 61% and mobile homes 4%.<sup>26</sup>

The diversity of ownership types, housing types, housing ages, geographic locations, and climatic conditions pose a real challenge for policy-makers seeking to design the most efficient measures for greening the existing building stock. Some measures will be directed to the building itself, and others designed to foster behavioral changes in those inhabiting (or using) them. Even though this paper will be mainly focused on the former group of measures, the latter will also be addressed in a supplementary fashion.

### *B. Market Incumbents*

Several actors dominate the market for existing buildings: the so-called MUSH market actors, the commercial and industrial market actors, and the residential market actors.

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22. The information on the residential sector comes from a single reference, the 1997 Residential Energy Consumption Survey, a representative sample of all U.S. households, according to the U.S. DOE in 1997. RICHARD C. DIAMOND, *supra* note 21, at 4.

23. *2010 Census Urban and Rural Classification and Urban Area Criteria*, UNITED STATES CENSUS BUREAU, <https://www.census.gov/geo/reference/ua/urban-rural-2010.html> (last visited May 1, 2015).

24. Less than a quarter of the U.S. population was living in suburbs in 1950 so, according to the 2010 data, there has been an important increase. Meanwhile, the central city population, which makes up approximately a third of the entire population, has remained relatively fixed. John Rennie Short, *Metropolitan USA: Evidence from the 2010 Census*, INTERNATIONAL JOURNAL OF POPULATION RESEARCH, Mar. 14, 2012, available at <http://www.hindawi.com/journals/ijpr/2012/207532/>.

25. RICHARD C. DIAMOND, *supra* note 21, at 4.

26. CENTER FOR HOUSING STUDIES OF HARVARD UNIVERSITY, *AMERICA'S RENTAL HOUSING. EVOLVING MARKETS AND NEEDS* 3-4 (2013).



### 1. The MUSH market

Actors in the so-called MUSH market<sup>27</sup> include municipalities, universities, schools, and hospitals. These building owners usually have tight operating budgets but also have access to a wide range of energy efficiency financing options. According to survey work completed by the National Association of Energy Service Companies (NAESCO),<sup>28</sup> the majority of Energy Service Companies (ESCOs) projects dedicated to providing integrated services for energy efficiency, as will be further explained throughout the article, have been completed in MUSH and government owned buildings, representing around a 74% of the market activity.<sup>29</sup>

Indeed, the MUSH market has been very profitable for ESCOs for many years as many of the buildings in that market are very old and often lack the capital funds for building retrofits or to achieve LEED certification. However, the bureaucratic hurdles traditionally associated with this market are making it easier for competitors to move into it.<sup>30</sup>

### 2. Commercial and industrial market

Actors in the commercial and industrial market include those private buildings that are not for residential purposes. They represent 65% of the total end-user energy efficiency potential in the U.S.<sup>31</sup>

The main barrier for energy efficiency investment in existing commercial buildings is the so-called “split incentive,” according to which the incentives of the building owner and the tenant are often not aligned to support efficiency measures (see Section III, paragraph D) below), the return on investment is considered too long (elevated hurdle rate), and the upfront capital costs too high for the owner. Financiers may be unwilling to bear the credit risk of privately-owned commercial and industrial buildings because the chances of default are high relative to municipal and public-building risk. From the building owner’s perspective, the

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27. The MUSH market is composed of municipalities, universities, schools, and hospitals (“MUSH”).

28. See generally, NATIONAL ASSOCIATION OF ENERGY SERVICE COMPANIES (2015), [www.naesco.org](http://www.naesco.org).

29. THE ROCKEFELLER FOUND. & DB CLIMATE CHANGE ADVISORS: DEUTSCHE BANK GROUP, UNITED STATES BUILDING ENERGY EFFICIENCY RETROFITS: MARKET SIZING AND FINANCING MODELS 41 (2012).

30. Debbie Van Der Hyde, *The MUSH Market: Problems and Opportunities*, GREEN ECONOMY POST (2010), <http://greeneconomypost.com/mush-market-9172.htm>.

31. MCKINSEY GLOBAL ENERGY & MATERIALS, UNLOCKING ENERGY EFFICIENCY IN THE U.S. ECONOMY 7 (July 2009), available at [http://www.greenbuildinglawblog.com/uploads/file/mckinseyUS\\_energy\\_efficiency\\_full\\_report.pdf](http://www.greenbuildinglawblog.com/uploads/file/mckinseyUS_energy_efficiency_full_report.pdf).

opportunity cost of capital for others to see a greater return on investment could create further disincentives to undertake a costly retrofit of the building. Also, owners often do not realize how inefficient a building is, how they can improve the building's efficiency, the cost of doing so, or the economic savings of such an investment.<sup>32</sup>

### 3. Residential market

The residential market includes unoccupied or occupied, rented, owned, single or multifamily houses, and mobile homes; however, it does not include institutional housing.<sup>33</sup> In single-family homes, traditional sources of funding (such as loans or grants, among others) are the primary instrument of energy retrofit financing in the U.S. Also, rebates are being used for "low-tech" retrofitting projects and new and innovative financing models, including Property Assessed Clean Energy (PACE) and On-Bill Financing and On-Bill Repayment (OBF & OBR) instruments, which are now expanding<sup>34</sup> (see Subsection V.B.1.c. below).

Because energy costs, generally speaking, are typically small relative to other costs in residential buildings, it is easy for most consumers to ignore them.<sup>35</sup> Energy costs are also often heavily subsidized,<sup>36</sup> which, despite its consideration as a right that must be made available to everyone, prevents consumers from knowing the real cost. Therefore, energy efficiency is rarely a high priority issue in the residential market relative to other factors due to its low-perceived value, which does not reflect its true associated societal costs.

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32. NEXT 10, UNTAPPED POTENTIAL OF COMMERCIAL BUILDINGS: ENERGY USE AND EMISSIONS 15-16 (2010).

33. The institutional housing is usually referred to as any institution within the definitions of "maternity home," "nursing home," "home for the aged," "day nursery," "kindergarten," "child caring institution," and "group care home for physically handicapped or mentally handicapped children." An example of this is Chapter 8.24, Hospitals and Institutional Homes, of the City Code and Charter of Portland, Oregon, U.S.

34. TIMOTHY BLOCK, IAN FISHER, STEVE MORGAN, & JENNIFER WEISS, WHITE PAPER: THE OPPORTUNITY FOR ENERGY EFFICIENCY FINANCING PROGRAMS IN THE SOUTHEAST 15 (2014).

35. I cannot neglect to mention the tragic "energy poverty" situation in which more than 50 million people in the EU (not to mention the rest of the world) find themselves. As indicated in the 1990s by Dr. Brenda Boardman of the University of Oxford, the term refers to the incapacity of a household to obtain an appropriate amount of energy services income using 10% of their disposable income. See generally, *Environmental Change Institute: Dr. Brenda Boardman*, UNIVERSITY OF OXFORD: SCHOOL OF GEOGRAPHY AND THE ENVIRONMENT, <http://www.eci.ox.ac.uk/people/boardmanbrenda.php> (last visited Apr. 12, 2014). This is especially serious in Spain, as the population at energy poverty risk has increased by two million from 2010 to 2012, due to the 2008 financial crisis.

36. UNEP, REFORMING ENERGY SUBSIDIES. OPPORTUNITIES TO CONTRIBUTE TO THE CLIMATE CHANGE AGENDA (2008).

This brings indirect consequences such as the energy technicians' negative motivation to do the extra work to design and implement innovative energy efficiency solutions, as the fee structure will not pay for the extra work they represent. Financial barriers in the residential market are associated with the initial cost barrier of the projects and the uncertainty associated with them. A systematic ex-post evaluation of energy efficiency projects is too costly.<sup>37</sup> There is also a lack of standardized measurement and verification protocols that raise the perception of risk among financiers.<sup>38</sup> Additionally, because in most residential buildings the owner and the tenant are different people, the split incentive problem is again an issue. Other problems include the risks associated with small size projects compared to other investments and the lack of information about the economic benefits of an energy efficiency project among consumers, building owners, and the financial sector.<sup>39</sup>

Each actor confronts barriers to energy efficiency action. Some barriers are overlapping among them, some are unique to each. Due to their importance, these market barriers will be further explained in Section III, in order to contribute to the improvement of the energy efficiency solutions for the existing building stock.

### *C. Main Energy Uses in Buildings*

Energy is used on-site in buildings to provide a multitude of services related to business and human needs, including heating and cooling, lighting, refrigeration, information and communication, health care, education, and entertainment.<sup>40</sup>

But buildings come in a wide variety of shapes, sizes, and purposes and they have been built at different times according to different standards.

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37. BLDGS. PERFORMANCE INST. EUR., FINANCING ENERGY EFFICIENCY (EE) IN BUILDINGS: BACKGROUND PAPER INPUT TO THE EUROPEAN ROUNDTABLE 14 (2010).

38. The International Performance Measurement and Verification Protocol (IPMVP) was developed at the end of the 1990s in the U.S. to support ESCOs dealing with performance-based contracts. In a number of countries it is considered the de facto standard practice for measurement and verification, but it is not as prevalent in the EU. Financial institutions tend to evaluate an investment in energy efficiency as a standard asset. The more standardized the approach to the project, the clearer the investment plan, the less risky, the easier the financing. MICHAEL TEN DONKELAAR, JAN MAGYAR, YANNIS VOUGIOUKLAKIS, M. THEOFILIDI, C. TOURKOLIAS, DANIELE FORNI & VERONICA VENTURINI, CONCERTED ACTION ENERGY SERVICES DIRECTIVE, MEASUREMENT AND VERIFICATION, IPMVP AND OTHER APPROACHES 2 (2012).

39. INTERNATIONAL ENERGY AGENCY & AGENCE FRANCAISE DE DÉVELOPPEMENT, PROMOTING ENERGY EFFICIENCY INVESTMENTS: CASE STUDIES IN THE RESIDENTIAL SECTOR 33-40 (2008).

40. New York State Energy Planning Board, *New York: Shaping the Future of Energy*, in 2014 DRAFT NEW YORK STATE ENERGY PLAN: VOLUME 2, END-USE ENERGY 8 (2014).

Consequently, addressing energy use in any given building requires a holistic approach to ensure the best results.<sup>41</sup> There are several elements that play an essential role in the energy consumption and use of buildings.<sup>42</sup>

*Building design*: specifications of the building, including its size, established by architects and engineers, that can help determine the amount of lighting, heating, and cooling required by a building.<sup>43</sup> This applies, obviously, to new buildings, which will not be considered in this article. Only in the case of a major renovation of the existing building are the measures related to their design pertinent to this research.<sup>44</sup>

*Building envelope*: the interface between the interior of a building and the outdoor environment. Improving the insulation, air sealing, and windows of a building can play an important role in minimizing heat transfer and, therefore, reducing the need for space heating or cooling.<sup>45</sup>

*On-site or distributed generation*: energy generation mechanisms produced at the point of use and serve as an alternative or supplement to grid-supplied electricity, to help reduce the need of energy in the normal operation of the building.<sup>46</sup>

*Energy end uses*: end uses in buildings are dominated by space heating, cooling and air conditioning (HVAC), and lighting. Improvements in these uses not only bring energy use reductions but also a variety of co-benefits, including lower monthly utility bills and greater energy security. These functions may be improved by making use of natural ventilation and natural sources of heat, minimizing unwanted heat and humidity gains from lights and appliances, minimizing energy losses in conventional systems by upgrading equipment or downsizing the scale of the equipment, and integrating new efficient technologies. Likewise, lighting can be reduced by decreasing the amount of artificial light required and/or using more efficient technology. Finally, reduction in the use of energy in buildings can be achieved by behavioral changes, increasing the individual commitment to this objective.<sup>47</sup>

*Embodied energy*: Energy required for extracting, manufacturing, transporting, installing, and disposing of building materials. Although the

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41. *Buildings Overview*, CENTER FOR CLIMATE AND ENERGY SOLUTIONS (May 2009), <http://www.c2es.org/technology/overview/buildings>.

42. *Id.*

43. *Green Building: Reducing Energy Use*, EPA, <http://www.epa.gov/greenhomes/ReduceEnergy.htm> (last updated Dec. 19, 2012).

44. *Buildings Overview*, *supra* note 41.

45. *Id.*

46. *Id.*

47. *Id.*

GHG emissions associated with the embodied energy of a building are not usually attributed to “buildings,” efforts to reduce this energy use and associated emissions can be made as part of a larger effort to reduce emissions from buildings. The activity related to embodied energy would only be relevant to existing buildings in the case of major renovations that require a lot of material movement. However, this element will not be taken into account for the purpose of this research.<sup>48</sup>

Understanding energy end uses in the buildings sector is complicated because of the information failure barrier due to its asymmetric access, the simple lack of available information (especially in the tertiary sector),<sup>49</sup> its highly technical nature, puzzling for non-experts in the matter,<sup>50</sup> and the large variety of building categories. However, there is enough data available to define at least some measures to maximize energy savings in the existing building stock, with respect to the most relevant household energy uses (heating, cooling, appliances, electronics and lighting), on which this article will focus.

### 1. Heating and cooling

Space heating, space cooling, and lighting were the dominant end uses in the U.S. in 2010, accounting for close to half of all energy consumed in the buildings sector.<sup>51</sup> In the EU, energy use for space heating per sqm is decreasing almost everywhere, except in a few countries with mild winters where winter comfort is improving.<sup>52</sup> Particularly, energy consumption for thermal uses<sup>53</sup> in buildings in developed countries

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48. *Id.*

49. The tertiary sector is also called the service sector. It consists of the activities where people offer their knowledge and time to improve productivity, performance, potential, and sustainability. The basic characteristic of this sector is the production of services instead of end products. According to academic opinion, it comprises energy users outside industry, agriculture, construction, households and transport, e.g., offices, shops and hospitals. A large part of energy consumption in the service sectors comprises energy used in public and private buildings. It also includes the energy used for public services, such as public lighting and water distribution. ODYSSEE-MURE PROJECT COORDINATED BY ADEME, *supra* note 13, at 53.

50. INTERNATIONAL ENERGY AGENCY & AGENCE FRANCAISE DE DEVELOPPEMENT, *supra* note 39, at 35.

51. *Introduction*, UCSD BUILDINGS | KPI, <http://ucsdkpi.weebly.com/> (last visited Spring 2015).

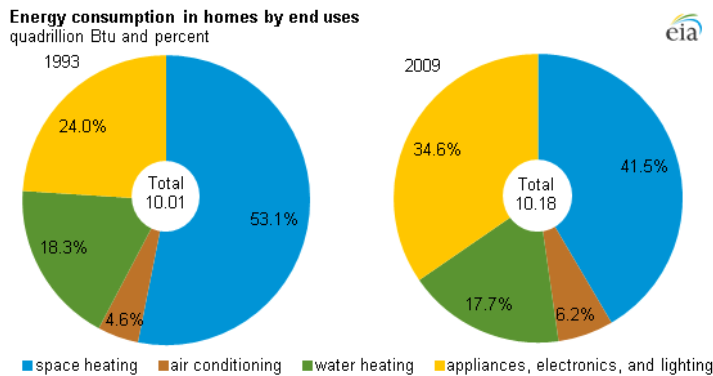
52. ODYSSEE-MURE PROJECT COORDINATED BY ADEME, *supra* note 13, at iii.

53. Thermal energy is the energy that is generated and measured by heat. *Thermal-energy*, YOURDICTIONARY, <http://www.yourdictionary.com/thermal-energy> (last visited Nov. 4, 2014). This type of energy is used for heating and cooling buildings, as well as powering certain industrial processes. The majority of this energy comes from fossil fuels, but it is now starting to utilize more efficient energy sources. *Renewable Thermal Energy*, OREGON DEPARTMENT OF ENERGY, [http://www.oregon.gov/energy/RENEW/pages/renewable\\_thermal\\_energy.aspx](http://www.oregon.gov/energy/RENEW/pages/renewable_thermal_energy.aspx) (last visited Nov. 4, 2014).

accounts for most of energy consumption in the world, though there is little expectation that this demand will grow in the coming years.<sup>54</sup> By contrast, there is an important growth tendency in developing countries due to the increasing number of both households and area per household.<sup>55</sup>

The breakdown of the household energy consumption by end-use in the EU differs substantially between member states.<sup>56</sup> Space heating represents the largest share of household energy use (on average, 60% to 80% of total energy consumption), with a clear correlation with cold winters.<sup>57</sup> That is then why southern countries, such as Cyprus, Portugal, and Spain, use a small fraction of energy for space heating.<sup>58</sup> Interestingly, the Swedish, despite their weather, do not have a high-energy consumption for that use, probably due to substantial energy use for other purposes and to the large diffusion of heat pumps with greater efficiency than that of other heating equipment.<sup>59</sup> Air conditioning still represents a marginal share of dwelling consumption among member states.<sup>60</sup>

For decades, heating and cooling have accounted for more than half of all residential energy consumption in the U.S. From 76% of energy consumption for heating and cooling in 1993, the end-use chart has moved to 65.4% in 2009.<sup>61</sup> Moreover, estimates from the most recent Residential



54. IPCC Report, *supra* note 8, at 671, 688, 694.

55. *Id.* at 683.

56. ODYSSEE-MURE PROJECT COORDINATED BY ADEME, *supra* note 13 at 21.

57. *Id.*

58. *Id.*

59. *Id.*

60. ODYSSEE-MURE PROJECT COORDINATED BY ADEME, *supra* note 13, at 21.

61. *Heating and cooling no longer majority of U.S. home energy use*, U.S. ENERGY INFORMATION ADMINISTRATION, <http://www.eia.gov/consumption/residential/> (last visited May 3, 2015).

Energy Consumption Survey (RECS), collected in 2010 and 2011 and released in 2011 and 2012, show that same trend.<sup>62</sup>

Clearly, energy consumption levels depend, to a large extent, on climate characteristics. A comparison of some of the major cities in the EU and U.S. helps further illustrate this point.

City	Average temperatures (°F)		Precipitation (inches)
	Winter (coldest month)	Summer (hottest month)	
NYC	26°F to 39°F	68°F to 85°F	49.9
Thessaloniki	34°F to 50°F	68°F to 88°F	18
Madrid	35°F to 52°F	64°F to 91°F	17.2
Paris	37°F to 46°F	59°F to 77°F	25.1
London	41°F to 48°F	59°F to 73°F	23.3
Copenhagen	30°F to 39°F	55°F to 71°F	23.6

These climatic differences produce different energy demands for heating and cooling, both in terms of quantity and timing. These different patterns of demand, in turn, indicate that different approaches to lowering emissions and improving efficiency will be required.

## 2. Appliances, electronics and lighting

Energy efficient appliances, lighting, information communication (ITC), and media technologies can reduce the substantial growth in electricity consumption that is expected due to the proliferation of appliance ownership and use.<sup>63</sup> In fact, better planning of the technological options can achieve large reductions in buildings energy use, up to 50% to 75% in existing buildings.<sup>64</sup>

The traditional large appliances, such as refrigerators and washing machines, are still responsible for most household electricity consumption in developed countries<sup>65</sup> despite the important improvement in their energy efficiency, due to policies focused on efficiency standards, labels,

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62. *Today in Energy: Heating and Cooling No Longer Majority of U.S. Home Energy Use*, U.S. ENERGY INFORMATION ADMINISTRATION: INDEPENDENT STATISTICS AND ANALYSIS (Mar. 7, 2013), <http://www.eia.gov/todayinenergy/detail.cfm?id=10271&src=%E2%80%B9%20Consumption%20%20%20%20Residential%20Energy%20Consumption%20Survey%20%28RECS%29-b1>.

63. IPCC Report, *supra* note 8, at 671, 675.

64. *Id.* at 687-688.

65. *Id.* at 683, 686-687.

subsidies, and technological progress.<sup>66</sup> Examples include certain types of lights, such as LEDs, which are expected to be widely used. In fact, despite the projected increase in the stock of domestic appliances, and in new types of electronic equipment for ITC, like satellite receivers, if the best available technology were to be installed, appliance energy consumption could be reduced.<sup>67</sup> But this has not yet happened. Indeed, in the U.S., despite the fact that many electric end-uses are covered by federal efficiency standards or voluntary programs like ENERGY STAR, increases in both the percentage of homes with those devices and, in the case of electronics like televisions and computers, the number of devices per household have offset efficiency gains in residential electricity use.<sup>68</sup>

In the EU, during the period between 2000 and 2010, electricity consumption for appliances and lighting increased in all member states except Bulgaria and Slovakia. In fact, the fraction of energy devoted to space heating is decreasing, partly due to the relative growth in the consumption of electrical appliances. The strongest growth recorded has been for small appliances. The highest share for electrical appliances and lighting is found in Cyprus (about 30%). After Cyprus, Spain, Sweden, and Greece all have shares around 20%.<sup>69</sup> In Baltic countries and Romania, the share for appliances is much lower (around 10%) than the EU average due to lower per capita income.<sup>70</sup> In Germany and Belgium, the share of appliances (around 12%) is significantly lower than the EU average, due to greater efficiency of the products.<sup>71</sup> The energy improvement in European appliances started in 1992 with the establishment of an energy efficiency rating system (energy labels)<sup>72</sup> to help consumers in choosing

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66. According to the AR5 of the IPCC, energy use by the most efficient appliances available today is still 30-50% less than required by standards, and saving potentials identified for individual equipment by the AR5 are typically 40-50%. *Id.* at 692.

67. INTERNATIONAL ENERGY AGENCY, MORE DATA, LESS ENERGY: MAKING NETWORK STANDBY MORE EFFICIENT IN BILLIONS OF CONNECTED DEVICES 7 (2014).

68. For example, according to EIA's Residential Energy Consumption Survey (RECS) in 1993, only 22% of households had three or more televisions, and by 2009, nearly half of all homes contain three or more televisions. *Today in Energy: Two Perspectives on Household Energy Use*, U.S. ENERGY INFORMATION ADMINISTRATION: INDEPENDENT STATISTICS AND ANALYSIS (Mar. 6, 2013), <http://www.eia.gov/todayinenergy/detail.cfm?id=10251>.

69. ODYSSEE-MURE PROJECT COORDINATED BY ADEME, *supra* note 13 at 22.

70. *Id.*

71. *Id.*

72. It was first introduced by Directive 92/75/EEC of September 22, 1992, on energy labeling, and updated by Directive 2010/30/EU, of May 19, 2010 and Directive 2012/27/EU of October 25, 2012.



products that save energy (and money), and to provide incentives for the industry to develop and invest in energy efficient product design.<sup>73</sup>

### III. THE MOST COMMON BARRIERS TO ENERGY EFFICIENT BUILDINGS

Experience over the years (even decades) has helped identify the most important barriers for the renovation of the built environment. They represent a complex bundle of issues that affect all stakeholders of the building value chain.<sup>74</sup> These are the main barriers.

#### *A. Financial barriers and cost of investment.*

This is perceived as the most important barrier for energy efficiency improvements in the existing building stock, and is comprised of lack of funds, payback expectations and investment horizon, uncertainty of the appropriateness of the investment, and the consumer's mismatch in perception between the price of energy and the cost of its production. Indeed, any investment in renovation requires money. Therefore, the inability to secure finances is one of the most common barriers to energy efficiency investment. Even though in the majority of cases the investment will be cost effective in the long run, upfront funding is necessary and may be unavailable.

Also, in some cases, the problem is the payback expectations or the horizon for recouping one's initial investment. Here, alternative financing mechanisms through which those who benefit from retrofitting pay the costs are appropriate. Sometimes, energy efficiency investments are not visible or attractive to homeowners, but to renters. This could be reinforced with more generous subsidies. Finally, market barriers to energy efficient investment also exist due to low energy prices or the adverse effects of fiscal incentives. Indeed, energy-pricing structures do not reflect the full environmental costs of producing energy, in particular those related to climate change. This means that energy costs represent a small share of household expenditure, resulting in little motivation for the great majority of consumers to take important steps towards energy efficiency renovation.<sup>75</sup>

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73. *Energy savings: Commission sets up new energy labels for televisions, refrigerators, dishwashers, and washing machines*, EUROPEAN COMMISSION PRESS RELEASE DATABASE (Sept. 28, 2010), available at [http://europa.eu/rapid/press-release\\_IP-10-1182\\_en.htm](http://europa.eu/rapid/press-release_IP-10-1182_en.htm).

74. BUILDINGS PERFORMANCE INST. EUR., *supra* note 4, at 56-61.

75. BUILDINGS PERFORMANCE INST. EUR., *supra* note 4, at 9.

*B. Institutional and administrative barriers.*

Experience has shown that fragmentation, delay, and gaps in regulatory action have prevented the public sector from providing energy efficiency measures in the existing building stock. Also, the complexity of the administrative bodies involved in the programs is sometimes very intricate and diverse among states (in the U.S.) or nations (in the EU). Finally, other barriers exist if multiple landlords and/or tenants are involved.

*C. Awareness, advice and skill barriers.*

The renovation market can only work efficiently if information and the right energy advice for taking action are available and if the services required to implement the measures are guaranteed to the customer. Today, ESCO companies are not designed to undertake deep renovations with complex procedures involving different stakeholders. Also, the rapid advance of new technology makes it more difficult to implement best practices. In fact, few architects and specialists anywhere in the world are proficient in energy efficiency measures. Uncertainty, lack of knowledge, lack of awareness, and confusion concerning definitions, processes and contract provisions related to ESCOs and Energy Performance Contracts (EPCts) are widely recognized as key barriers to further market development.<sup>76</sup> There is, indeed, a lack of knowledge and competence in this “embryonic market”.<sup>77</sup>

*D. The “split incentive” problem.*

Perhaps the most complex barrier among all is the one generated when the building owner and user are different people or entities. The split incentive problem exists where building owners are responsible for investment decisions, but tenants pay the energy bills. Owners have little interest in commissioning energy-efficient buildings.<sup>78</sup> Hence, for them to be involved, any investment that would reduce the energy bill has to be perceived as financially advantageous also for the building owner. To

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76. *About eu.ESCO*, EUROPEAN ASSOCIATION OF ENERGY SERVICE COMPANIES, <http://www.eu-esco.org/index.php?id=12> (last visited Apr. 12, 2014).

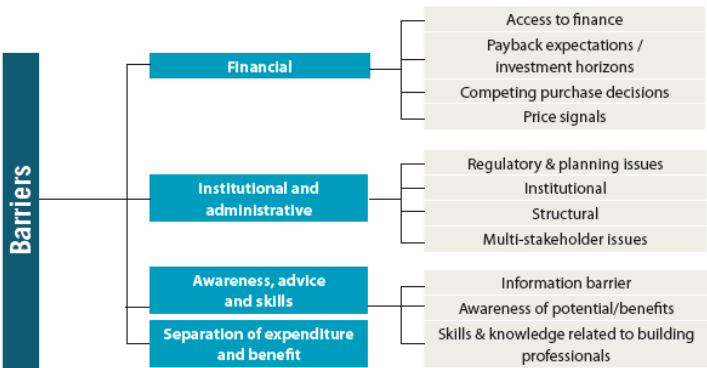
77. Energy efficiency is a mature market but the world still lacks a vibrant marketplace for funding energy efficiency projects. Therefore, and despite its immense promise, energy efficiency is still at an immature stage relative to other cleantech sectors. THE CARBON WAR ROOM: GREEN CAPITAL OPERATION, IMPROVING BUILDING PERFORMANCE 9 (2012).

78. DANIELE FORNI & ANETT ZAJAROS, SPLIT INCENTIVES: EXECUTIVE SUMMARY WG 5.4 (2014), <http://www.esd-ca.eu/reports/working-group-executive-summaries/energy-services-split-incentives>.

solve this problem, well-targeted policy packages should be designed by governments; no one measure alone will solve it.

E. The “rebound factor”

The “rebound factor” refers to people’s tendency to use more energy and buy additional appliances as soon as they see that they have reduced their energy bills. This reinforces the “Jevons Paradox,”<sup>79</sup> according to which increased energy efficiency results in raising demand for energy in the economy as a whole.



Source: Building Performance Institute Europe (BPIE)

Needless to say, in developing countries corruption, inadequate service levels, subsidized energy prices, and high discount rates, represent additional barriers.<sup>80</sup>

IV. The Energy Efficiency Process

Energy efficiency involves doing the same amount of work, or producing the same amount of goods or services, with less energy.<sup>81</sup> In the case of the existing building stock, energy efficiency measures are aimed at reducing the amount of energy used by particular processes commonly

79. According to the British economist W. Stanley Jevons in his book, *The Coal Question*, conservation of fuel paradoxically leads to increased consumption of fuel: if large numbers of people start conserving fuel, this will lower the price of that fuel which, in turn, will encourage increased consumption. HERBERT GIRARDET & MIGUEL MENDONÇA, A RENEWABLE WORLD: ENERGY, ECOLOGY, EQUALITY 134 (2009).

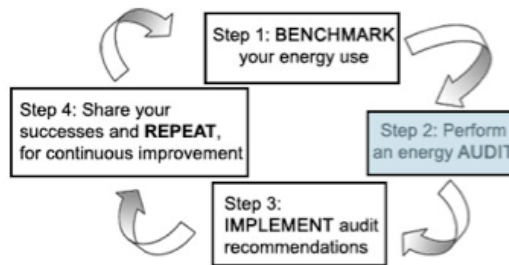
80. IPCC Report, *supra* note 8, at 671, 676.

81. John C. Dernbach, *U.S. Policy, in* GLOBAL CLIMATE CHANGE AND U.S. LAW, 61, 69 (2007).

used in buildings (such as heating, lighting, and cooling),<sup>82</sup> and at updating technology or facility infrastructure of the buildings (including windows, lighting, water, and/or insulation systems).

The specific measures adopted in a given case (during the implementation phase, as explained below in subsection IV.C) will usually depend on the results of an energy audit (explained in subsection IV.B). Such audits are conducted, in most cases, by an ESCO, a business (commercial or non-profit) that provides integrated services for the implementation of energy efficiency projects.<sup>83</sup>

The energy efficiency process includes the following steps:



Graphic from [www.epa.gov](http://www.epa.gov)

The sections that follow provide an overview of the energy efficiency process in existing buildings and some of the policy mechanisms for

82. Some organizations, like the Carbon War Room Foundation, focus their methodology for energy efficiency on energy consumption as opposed to energy cost savings, which can be also achieved not only through upgrades but also through demand response programs that usually requires occupant sacrifice. In this article, participation of citizens acting on the demand of energy will also be considered as part of the energy efficiency process.

83. ESCOs develop, install, and fund projects designed to improve energy efficiency and reduce operation and maintenance costs in their customers' facilities. They generally act as project developers for a wide range of tasks and assume the technical and performance risk associated with the project. In the United States, there are two types of ESCOs: a) U.S. Department of Energy (DOE) ESCOs companies that have competed for and been awarded a master DOE ESPC contract; and b) Qualified ESCOs, companies that have been screened by a qualifications review board composed of representatives of the Federal Interagency Energy Management Task Force and DOE. In the EU, the European Association of Energy Service Companies (eu.ESCO) was founded in 2009 by the European Building Automation and Controls Association (eu.bac) and aims at boosting the energy services market by increasing its transparency and its trustworthiness. In this sense, the eu.ESCO provides best practices and knowledge sharing to drive standardization and to accelerate Energy Performance Contracting (EPC) use. *List of Qualified Energy Services Companies*, U.S. DEP'T OF ENERGY (Apr. 2013), [http://energy.gov/sites/prod/files/2015/04/f21/doe\\_ql.pdf](http://energy.gov/sites/prod/files/2015/04/f21/doe_ql.pdf). *Members of eu.bac*, EUROPEAN ASSOCIATION OF ENERGY SERVICE COMPANIES, <http://www.eu-esco.org/index.php?id=25> (last visited May 21, 2014).

implementing specific energy efficiency measures. Each section defines the relevant component and gives examples of legislation, regulation, and other initiatives undertaken in the EU and the U.S. The study conducted for the EU (see subsection V.A.3) simplifies the comparative analysis in order to draw conclusions that could eventually improve the energy efficiency process in the existing U.S. building stock.

### *A. Benchmarking*

Benchmarking is the process of comparing the energy performance of a building or building type to similar buildings or building types. According to various authors,<sup>84</sup> *benchmarking* generally includes a comparison of energy performance with other buildings, whereas *baselining*<sup>85</sup> generally involves a comparison of past energy performance of a single building with current energy performance. More concretely, benchmarking consists of a comparison of building indicators with a sample of similar buildings or with best-practice buildings. Thus, benchmarking informs organizations about how and where they use energy and what factors drive their energy use.

The most common indicator used for benchmarking is the *Energy Performance Indicator* (EPI) or *Energy Use Intensity* (EUI), which expresses annual energy use per floor area. Other indicators such as energy per worker (in case of office buildings) or energy per bed (in case of hotels) may also be used.

Benchmarking may be either *quantitative* (a comparison of numerical measures of performance, in either a historical or an industrial context), or *qualitative* (looking at the management and operational practices across a portfolio of buildings, in order to identify best practices or areas for improvement). Many benchmarking projects combine quantitative and qualitative measures.

Knowledge about the building stock energy data of a country is a significant tool for energy benchmark establishment. However, gathering

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84. T. Nikolaou, D. Kolokotsa & G. Stavrakakis, *Review on Methodologies for Energy Benchmarking, Rating and Classification of Buildings*, 5 ADVANCE IN ENERGY RESEARCH no. 1, at 53 (2011).

85. Energy baselines are defined in ISO 50001 as “quantitative references providing a basis for comparison of performance” that apply to a specific time period and provide a reference for comparison before and after the implementation of energy improvements. Information collected by measuring a building’s energy performance for a minimum of 12 months (36 months preferred) will establish a baseline for its energy consumption. This baseline will serve as a starting point for setting energy efficiency improvement goals as well as a comparison point for evaluating future efforts and trending overall performance. *Establishing a Baseline for Current Energy Consumption*, SUSTAINABILITY ROADMAP FOR HOSPITALS (Nov. 5, 2014), <http://www.sustainabilityroadmap.org/pims/22#.VFuxpE3u3cs>.

energy information to fill a database with a representative sample of the building stock is expensive and technically complex.<sup>86</sup> The most common method for creating a database is through the collection of building data in audits (as indicated below in subsection IV.B). Therefore, steps one and two of the energy efficiency process may take place simultaneously. However, given its difficulty, data simulators have been proved to constitute reliable and time-saving substitutes for the real building data collection.<sup>87</sup>

There are many benchmarking tools on the market to deal with site energy consumption as a single rating criterion, or to combine environmental factors with a single rating scheme. Examples of the former are the Home Energy Rating system (HERS), the ASHRAE Standard, the ENERGY STAR system,<sup>88</sup> and the European CEN Standard EN 15203. The Building Research Establishment Environmental Assessment Method (BREEAM), or the LEED system, are both examples of the latter.

Benchmarking is of interest and practical use to a number of experts, like ESCOs and EPCts, to help energy managers determine the key metrics for assessing energy performance and to set goals for energy improvements.<sup>89</sup> Energy experts use “typical” and “best-practice” benchmarks for the communication of energy saving potentials, and their involvement facilitates improvement in energy efficiency, as it is perceived as an extremely low-risk, high-yield investment.<sup>90</sup>

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86. Example of this is the U.S. Energy Information Administration (EIA) database and later surveys for both the residential sector (Residential Energy Consumption Survey (RECS), EIA, 2001) and commercial buildings. Nikolaou et al., *supra* note 84, at 8.

87. Nikolaou et al., *supra* note 84, at 11.

88. ENERGY STAR is a U.S. Environmental Protection Agency voluntary program established in 1992 under the authority of the Clean Air Act Section 103(g), that helps businesses and individuals save money and protect our climate through superior energy efficiency. *Energy Star*, EPA (May 21, 2014), <http://www.energystar.gov/about/>.

89. *Chapter 2 – Benchmarking*, ENERGY STAR BUILDING UPGRADE MANUAL 2 (revised Apr. 2008), available at <http://www.energystar.gov/buildings/tools-and-resources/energy-star-building-upgrade-manual-chapter-2-benchmarking>.

90. Saieg, *supra* note 9, at 184, 185.

### *B. Auditing*

According to European regulations,<sup>91,92</sup> energy audits are “systematic procedures” used to identify, quantify, and report existing energy consumption profiles and energy savings opportunities in buildings, industrial or commercial operations or installations, and in private or public services.<sup>93</sup> Energy audits are an integral part of Energy Management Systems (EMS), which are the set of elements included in plans establishing energy efficiency objectives and strategies to achieve them.

Energy auditing identifies cost-effective energy improvements and operational changes that will result in energy savings. It involves a study of how energy is currently being used in the specific building (which fully explains its direct connection to benchmarking) along with a series of recommendations on ways to improve its energy efficiency and energy cost.

Audits can range in complexity and level of analysis, from a preliminary examination or walk-through audit (ASHRAE Level 1 audit), to detailed process audits (ASHRAE Level 2 or Level 3).<sup>94</sup> Also, traditional retro commissioning (RCx), also known as Existing Building Commissioning, is a systematic process developed to evaluate, document,

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91. Energy efficiency establishes the obligation for large EU companies to carry out an energy audit at least every four years, with a first energy audit at the latest by 5 December 2015, as well as incentives for small and medium sized companies to undergo energy audits to help them identify the potential for reduced energy consumption. Also, according to article 5, member states shall also encourage public bodies, including those at regional and local level, to put in place EMS, including energy audits. Member states should develop programs to encourage small and medium sized companies (the so-called SMEs) to undergo energy audits. Energy audits should be mandatory and regular for large enterprises, as energy savings can be significant. Section 24 of the Preamble of Directive 2012/27/EU.

92. Directive 2012/27/EU, on energy efficiency establishes the obligation for large EU companies to carry out an energy audit at least every four years, with a first energy audit at the latest by 5 December 2015, as well as incentives for small and medium sized companies to undergo energy audits to help them identify the potential for reduced energy consumption. Also, according to article 5, member states shall also encourage public bodies, including those at regional and local level, to put in place EMS, including energy audits. Member states should develop programs to encourage small and medium sized companies (the so-called SMEs) to undergo energy audits. Energy audits should be mandatory and regular for large enterprises, as energy savings can be significant. Section 24 of the Preamble of Directive 2012/27/EU.

93. “[E]nergy audit” means a systematic procedure with the purpose of obtaining adequate knowledge of the existing energy consumption profile of a building or group of buildings, an industrial or commercial operation or installation or a private or public service, identifying and quantifying cost-effective energy savings opportunities, and reporting the findings. *See Nikolaou, supra* note 84, Article 1.

94. For more information, visit *Water & Energy Efficiency in Water and Wastewater Facilities*, EPA (May 21, 2014), <http://www.epa.gov/region9/waterinfrastructure/audit.html>.

and improve the operation of base building systems.<sup>95</sup> This type of audit is designed to capture building data, support energy simulation and modeling, and sometimes even provide an on-going monitoring component.<sup>96</sup>

It is clear that detailed process audits provide more comprehensive information on different matters, for example, on the pay-back periods associated with the recommended measures. The first requirement for an effective energy efficiency policy is to have standardized measurement procedures to determine the energy quality of a building. Then, the building may be classified according to its level of performance: i) the minimum, which is set by law; ii) the best practice level, which describes a reasonably achievable level with good design and practice, and often works with subsidies; and iii) the state of the art level, which describes the maximum level achievable with the best available technology, and is used to promote and demonstrate new options for the future. This information comes as a result of the auditing procedure once it is accomplished; the design of best measures to improve the energy performance of a building will then need to be implemented.

### C. Implementation

Once steps one and two are completed, step three entails the implementation of the energy improvement measures identified in the previous steps. Even when the proposed measures do not require large outlays of capital investment, it can still be a challenge to implement them, as many non-monetary resources, namely knowhow and technical skills, are essential. On top of that, sometimes experts, like ESCOs, need to be hired.

Four main policy instruments are widely used to promote energy efficiency in the built environment<sup>97</sup> worldwide: regulatory instruments; economic-based and market-based instruments; financial instruments and incentives; and support, information and voluntary actions, as explained below.<sup>98</sup> Needless to say, each policy has its own specific benefits as well

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95. *Retro-Commissioning (RCx) or Existing Building Commissioning*, HEALTHY BUILDINGS (May 21, 2014), <http://healthybuildings.com/commissioning/retro-commissioning-rcx-or-existing-building-commissioning/>

96. Nikolaou, *supra* note 84, at 22.

97. Built environment is defined as “the buildings and all other things constructed by human beings”. COLLINS ENGLISH DICTIONARY (Mar. 25, 2015), [http://www.collinsdictionary.com/dictionary/english/the-built-environment#the-built-environment\\_1](http://www.collinsdictionary.com/dictionary/english/the-built-environment#the-built-environment_1).

98. For detailed information on the different energy efficiency policy tools, see Alexandra B. Klass & John K. Harting, *State and Municipal Energy Efficiency Laws*, in *THE LAW OF CLEAN ENERGY: EFFICIENCY AND RENEWABLES* 57, 58-71 (Michael Gerrard ed., 2011).



as its weaknesses. Therefore, the challenge is to find the best combination of all policies in order to meet the energy efficiency target.

### **1. Regulatory instruments**

The main regulatory instruments are energy codes and standards, which set minimum efficiency requirements for new and existing buildings (when going through a major renovation), assuring reductions in energy use and emissions over the life of the building. Energy codes and standards are typically part of building codes, which set baseline requirements and govern building construction. However, they are usually focused on a single-element performance approach and not a whole-building approach,<sup>99</sup> which would be much more environmentally and economically efficient. Energy codes typically specify requirements for “thermal resistance” in the building shell and windows, minimum air leakage, and minimum efficiency for heating and cooling equipment.

Therefore, more and clearer information on the energy performance of buildings (benchmarking) and on the regulation in force, as well as further inspection, compliance, and enforcement would be a good leverage for this new sector.

When regulations are upheld for a sufficiently long time, they enable a genuine change in the market and can prove sustainable.

### **2. Market-based instruments**

Market-based instruments provide incentives for energy efficiency improvements through market-led measures and price signals, such as EPCts, ESCOs, White Certificates, and alternative mechanisms and measures, such as voluntary agreements.

**EPCt** is an innovative financing technique that uses cost-savings from reduced energy consumption to repay the cost of installing energy

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99. As stated by the AR5, the holistic approach includes different measures and combines them. According to this approach, no single policy is sufficient to achieve potential energy savings. A combination of policies can have results that are bigger than the sum of the individual policies. Several case studies from all over the world have revealed that a) in the residential sector, the most comprehensive retrofits packages in detached single-family homes can achieve 50-75% energy use reduction; in multi-family housing, 80% to 90% reductions in space heating requirements, approaching, in many cases, the Passive house standards for new buildings; and b) in the commercial sector, savings of 25% to 51% in total HVAC energy use can be achieved through upgrades to equipment and control systems, without changing the building envelope, and eventual recladding of building façades, especially when the existing has a high solar heat gain coefficient, no external shading, and no provisions for Passive house ventilation and cooling. IPCC report, *supra* note 8, at 63, 24.

conservation measures.<sup>100</sup> Under an EPCt, an ESCO implements a project to deliver energy efficiency (or a renewable energy project, to be precise) and uses the stream of income from the cost savings (or the renewable energy produced) to repay the costs of the project, including the costs of the investment. Essentially the ESCO will not receive its payment unless the project delivers energy savings as expected.<sup>101</sup> A typical EPCt project delivered by an ESCO consists of the following elements: i) a turnkey service, the ESCO provides all of the services required to design and implement a comprehensive project at the customer facility; ii) comprehensive measures, the ESCO tailors a comprehensive set of measures to fit the needs of a particular facility; iii) project financing, the ESCO arranges for long-term project financing that is provided by a third-party financing company; and iv) project saving guarantee; the ESCO provides a guarantee that the savings produced by the project will be sufficient to cover the cost of project financing for the life of the project.<sup>102</sup> These types of agreements are especially convenient for those customers that are creditworthy but suffer from a lack of liquidity. The EPCt, in the end, provides the owner of the building with an excellent return on investment with a lower level of risk (variable, depending of the specific type of contract).<sup>103</sup>

**Market-based policy portfolios** build on suppliers' obligations to foster energy efficiency improvements. These portfolios are usually based on quantified energy savings obligations imposed on energy market operators (energy distributors or suppliers), eventually coupled with various types of trading instruments: i) trading systems for energy efficiency measures resulting in certified energy savings (tradable white certificates); ii) trading of eligible measures without formal certification;

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100. *Energy Performance Contracting*, U.S. DEPT. OF HOUSING AND URBAN DEVELOPMENT (Dec. 9, 2014), [http://portal.hud.gov/hudportal/HUD?src=/program\\_offices/public\\_indian\\_housing/programs/ph/phecc/epperformance](http://portal.hud.gov/hudportal/HUD?src=/program_offices/public_indian_housing/programs/ph/phecc/epperformance).

101. In EPCts, ESCO remuneration is based on demonstrated performance; a measure of performance is the level of energy savings or energy service. EPC is a means to deliver infrastructure improvements to facilities that lack energy engineering skills, manpower or management time, capital funding, understanding of risk, or technology information. See *Energy Performance Contracting*, JOINT RESEARCH CENTRE: INSTITUTE FOR ENERGY AND TRANSPORT (ITE) (May 21, 2014), <http://iet.jrc.ec.europa.eu/energyefficiency/european-energy-service-companies/energy-performance-contracting>.

102. ICF INTERNATIONAL & NATIONAL ASSOCIATION OF ENERGY SERVICES COMPANIES, INTRODUCTION TO ENERGY PERFORMANCE CONTRACTING 2-3 (Oct. 2007), [http://www.energystar.gov/ia/partners/spp\\_res/Introduction\\_to\\_Performance\\_Contracting.pdf](http://www.energystar.gov/ia/partners/spp_res/Introduction_to_Performance_Contracting.pdf).

103. *Energy Efficiency Topics*, AMERICAN COUNCIL FOR AN ENERGY-EFFICIENT ECONOMY (May 21, 2014), <http://www.aceee.org/topics/eers>.

or iii) trading of obligations.<sup>104</sup> The energy savings obligations are also known as energy efficiency obligations (EEOs), supplier obligations, distributor obligations, utility obligations, and in the U.S. context, energy efficiency resource standards.<sup>105</sup>

The **Feed-in-Tariff** (FIT) is a new instrument that is already used for the promotion of renewables, which has not yet been largely introduced for energy efficiency improvements in any country, though it is now being tested. FITs are the obverse of EEOs, because instead of establishing the quantity of savings desired and letting the market determine their price, FITs establish a price and let the market determine the quantity that will be delivered.<sup>106</sup> Therefore, unlike EEOs imposed on energy suppliers, FITs do not necessarily ensure that a prescribed level of savings will be achieved. Only time and experience will tell if this new instrument has the potential to deliver cost-effective energy savings.

### 3. Financial instruments and incentives

One of the most important barriers to improving energy efficiency in the built environment is the high capital cost of the projects, as mentioned above. In order to overcome this problem, several financial instruments have been adapted or created specifically for energy efficiency projects. Financial instruments and incentives include **tax credits, rebates, low-interest loans, energy-efficient mortgages, and innovative financing**, all of which address the barrier of first costs.

A wider use of financial instruments will enable better leverage of private capital and renewed liquid flows towards investment in energy efficiency measures, as they are very effective in overcoming financial barriers allowing at least a temporary shift in the market responding to a specific and clear need.<sup>107</sup> However, other problems have also arisen:

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104. *Suppliers Obligations & White Certificates*, JOINT RESEARCH CENTRE: INSTITUTE FOR ENERGY AND TRANSPORT (ITE) (Dec. 9, 2014), <http://iet.jrc.ec.europa.eu/energyefficiency/white-certificates>.

105. PAOLO BERTOLDI & SILVIA REZESSY, ENERGY SAVING OBLIGATIONS AND TRADABLE WHITE CERTIFICATES, REPORT PREPARED BY THE JOINT RESEARCH CENTRE OF THE EUROPEAN COMMISSION 4 (Dec. 2009), *available at* [https://yoursri.com/users/ca7b936106630af01a6ce95f4e7ccf67/384a7a2f41d7e4ab0a0facf92d823983/@/download/fs/2009\\_12\\_Energy%20Saving%20obligations%20and%20tradable%20white%20certificates.pdf](https://yoursri.com/users/ca7b936106630af01a6ce95f4e7ccf67/384a7a2f41d7e4ab0a0facf92d823983/@/download/fs/2009_12_Energy%20Saving%20obligations%20and%20tradable%20white%20certificates.pdf).

106. CHRIS NEME & RICHARD COWART, ENERGY EFFICIENCY FEED-IN-TARIFFS: KEY POLICY AND DESIGN CONSIDERATIONS 2 (April 2012), *available at* [www.raponline.org/document/download/id/4908](http://www.raponline.org/document/download/id/4908).

107. The new UK's Energy Company Obligation (ECO 2013) will be specifically targeted at higher-cost measures to incentive deep renovations, although without any requirement to undertake a "whole-house" approach. The ECO 2013 is a scheme funded by the energy supplier to increase energy efficiency and decreasing energy bills at no front cost to the consumer, which started in January 2013

governmental subsidies in general (like rebates and grants) maintain the idea of the fundamental need of these incentives to make energy efficiency feasible, they do not have a long lasting impact (because they vanish when the programs finish), and they all lack flexibility. Rebates only incentivize the investment in specific pieces of equipment and not a systemic approach, which makes them lose the opportunity for a comprehensive retrofit of the building. Therefore, subsidies will be particularly efficient in dealing with short term financing needs.

#### **4. Support, information, and voluntary actions**

Support, information, and voluntary action policies that focus on consumer behavior and buildings' operational practices help create an integrated policy approach towards achieving energy efficient targets for the built environment.<sup>108</sup> They include measures on the following.

**Awareness raising, promotion, and education** are a focus of government agencies or utilities when designing public information campaigns to educate and mobilize the public towards energy efficiency behavior. Accurate information helps end users better understand the long-term impact of energy use on their bills, and hence, to calculate the payback period and the potential cost savings of energy efficiency measures. Moreover, information programs increase the effectiveness and the long-term impact of other policy instruments.<sup>109</sup>

**Detailed billing and disclosure** must be kept, through which detailed information about energy consumption is provided to the energy user. It increases the user's awareness of the quantity of energy employed, thus helping make his behavior more efficient. Detailed billing and disclosure programs can generate substantial energy savings and assist utilities in strengthening their relationship with customers by providing useful value added services. For these programs to be successful, they have to be evaluated regularly and be combined with other mechanisms that provide feedback for the energy saving incentives.

**Statistical inventory** is maintained in order to help the inspection and monitoring of energy performance in a building and also to inform the public on the energy efficiency compliance.

**Voluntary certification and labeling programs** should be kept to alert the end users about the energy performance of a product, allowing

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as part of the Energy Act (2011). MARK LEVINE ET AL., BUILDING ENERGY EFFICIENCY: BEST PRACTICE POLICIES AND POLICY PACKAGES (2012) [hereinafter *Levine*].

108. *Id.* at ES-4.

109. A more detailed study on behavioral models can be found in: Jillian C. Sweeney et al., *Energy saving behaviors: Development of a practice-based model*, 61 ENERGY POLICY 371 (2013).

them to make informed purchasing decisions. These programs also contribute to the development of a stronger market for all energy efficient products. Voluntary labeling is very effective when combined with integrated awareness campaigns on energy efficiency products, and it can serve as a bridge to future mandatory programs. In fact, according to the EU Commission, voluntary agreements are expected to achieve the policy objectives more quickly or at lesser expense than mandatory requirements.<sup>110</sup>

**Public leadership and demonstration** that target the public sector, one of the largest energy end users in any country. The public sector should demonstrate energy efficiency leadership. These types of programs help reduce government expenses, save taxpayers money, and, more importantly, demonstrate that investing in energy efficiency is cost effective. Public leadership programs usually focus on large office buildings, MUSH (see section II.B), and military facilities. They should be leveraged to create a positive impression for end users to follow suit. Savings generated with reduced energy bills can then be invested in other public projects.

Control and regulatory instruments		Economic & market-based instruments	Fiscal instruments & incentives	Support, information & voluntary action
<b>Normative:</b>	<b>Informative:</b>			
<b>Appliance standards</b>	Mandatory audits	Energy performance contracting	Energy & carbon taxes	Voluntary certification and labeling
<b>Building codes</b>	Utility demand-side management programs	Energy efficiency certificate schemes	Tax exemptions/reductions	Voluntary & negotiated agreements
<b>Procurement regulations</b>			Public benefit charges	
<b>Energy efficiency obligations and quotas</b>	Mandatory labeling and certification programs	Kyoto Protocol Clean Development Mechanisms (CDM) & Joint Implementation	Capital subsidies, grant, subsidized loans	Public leadership programs
				Awareness raising, education,

110. Article 10.2.c) of Directive 2010/30/EU.

Classification of policy instruments on energy efficiency in buildings. Source: CIB-CSTB Carnot Institute.<sup>111</sup>

### *D. Brief Reference to The Specific Case of Historic Buildings*

Historic buildings mostly use inefficient energy systems, but with the implementation of energy efficiency measures adapted to their specific characteristics, they can also be energy efficient. Problems arise when the retrofitting interferes with preservation requirements. For that reason, refurbishing a historic building can be very difficult or sometimes even impossible.

## **1. U.S. Historic Buildings**

In the U.S., to be considered a historic building, either at the national or state level, the building must be a certain age (normally more than 50 years old), and possess a certain integrity and significance. At the national level, this requires meeting the National Register Criteria for Evaluation.<sup>112</sup> At the state level, the criterion is similar. There is legislation that considers the importance of energy efficiency projects in historic buildings in the U.S., such as: i) *Energy Policy Act (2005)*, which requires all federal buildings to achieve specific levels of energy efficiency, including historic buildings; ii) *National Historic Preservation Act (1966)*, which encourages the preservation of historic buildings; and iii) *Executive Orders*, which encourage public and private collaboration to meet goals for both energy efficiency and preservation in historic buildings.

Also of interest to this matter is the U.S. Department of the Interior's *Illustrated Guidelines for Rehabilitating Historic Buildings (1992)*,<sup>113</sup> designed to further enhance overall understanding and interpretation of basic preservation principles. The chapter on "Energy Conservation" was recently replaced by the *Guidelines on Sustainability for Rehabilitating Historic Buildings*. These Guidelines offer specific guidance on how to make historic buildings more sustainable, preserving their historic

111. ICB – CSTB CARNOT INSTITUTE, THE IMPLEMENTATION OF ENERGY EFFICIENT BUILDINGS POLICIES: AN INTERNATIONAL COMPARISON. ENERGY AND THE BUILT ENVIRONMENT- REVIEW OF ACTIVITIES 2009-2012, FINAL REPORT (AUG. 2013), available at [http://www.labeec.ufsc.br/sites/default/files/pub\\_386.pdf](http://www.labeec.ufsc.br/sites/default/files/pub_386.pdf).

112. *National Register Criteria for Evaluation*, NATIONAL PARK SERVICE (Jun. 12, 2014), [http://www.nps.gov/nr/publications/bulletins/nrb15/nrb15\\_2.htm](http://www.nps.gov/nr/publications/bulletins/nrb15/nrb15_2.htm).

113. *Illustrated Guidelines for Rehabilitating Historic Buildings*, NATIONAL PARK SERVICE (Nov. 12, 2014), <http://www.nps.gov/TPS/standards/rehabilitation/rehab/index.htm>.

character, in line with *The Secretary of the Interior's Standards for The Treatment of Historic Properties*.

**The Standards** (Department of the Interior regulation 36 CFR 67) apply to all historic properties listed in or eligible for listing in the National Register of Historic Places, and have been developed to guide the work undertaken on them. There are separate standards for preservation, rehabilitation, restoration, and reconstruction. However, any repair or alteration on a historic building must not damage or destroy materials, features or finishes that are important in defining the building's historic character.<sup>114</sup>

**The Guidances** are general and intended to provide direction in interpreting and applying the Standards to all rehabilitation projects. Like the Standards, the Guidelines pertain to historic buildings of all materials, construction types, sizes, and occupancy. They apply to exterior and interior work, as well as new additions, and the building's site and environment. Therefore, they are not meant to give case-specific advice. They are presented in a *Recommended* (those that are consistent with the Standards) vs. *Not Recommended* (those that are inconsistent with the Standards) format, referring to: planning, maintenance, windows, weatherization, insulation, HVAC, solar technology, wind power, roofs, site features, and day lighting.<sup>115</sup>

An example of a success story is the retrofit at the Smithsonian Renwick Gallery, a masonry building completed in 1875. In the first year after the retrofit, the gallery had energy savings of 50% and utility bills savings of 60%. The project's payback was expected to take six to seven years, but it was completed in only two, much faster than anticipated.<sup>116</sup>

In New York City with over 30,000 historically landmarked buildings<sup>117</sup> and a world-class community of design and preservation professionals, the discipline of energy efficient historic preservation is highly valued.<sup>118</sup> Demonstration projects jointly carried out by the City,

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114. The list of the 10 Standards of Rehabilitation can be found at: *Introduction to the Standards*, NATIONAL PARK SERVICE (Nov. 12, 2014), <http://www.nps.gov/TPS/standards/rehabilitation/guidelines/standards.htm>

115. More information on each one: *Introduction to the Guidelines*, NATIONAL PARK SERVICE (Nov. 12, 2014), <http://www.nps.gov/TPS/standards/rehabilitation/guidelines/guidelines.htm>.

116. More information at: *Historic Preservation and Energy Efficiency in Federal Buildings*. U.S. DEP'T OF ENERGY (Jun. 16, 2014), [http://www1.eere.energy.gov/femp/news/news\\_detail.html?news\\_id=10482](http://www1.eere.energy.gov/femp/news/news_detail.html?news_id=10482).

117. *Committee Commemorates Landmarks Preservation*, GAZETTE, Apr. 17, 2013, <http://www.nyclandmarks50.org/pdfs/articles/CommitteeCommemoratesLandmarks.pdf>.

118. See generally, THE MUNICIPAL SOCIETY OF NEW YORK, GREENING NYC'S HISTORIC BUILDINGS: GREEN ROWHOUSE MANUAL, available at <http://www.nyc.gov/html/lpc/downloads/pdf/pubs/Manual%20-%20Greening%20Rowhouses%20-%202012.pdf>

building professionals, New York State Energy Research and Development Authority (NYSERDA), and building owners, covering a suite of historic building types, could seek up to 50% energy savings without compromising architectural character, and could create examples to be followed by the rest of the industry. Targeted incentives, voluntary performance-based energy standards, and an education program could facilitate these projects and increase market uptake of best practices.<sup>119</sup> PlaNYC,<sup>120</sup> a plan launched in 2007 to prepare NYC for long-term challenges, climate change among them, includes these types of buildings in its new strategy designed to remove barriers and incentivize action for energy efficiency.<sup>121</sup>

## 2. EU Historic Buildings

Europe is a special case. Around a quarter of its existing building stock was built prior to the middle of the last century.<sup>122</sup> Such buildings represent a trademark of many cities, because they reflect their unique character and identity, but they are very energy inefficient as they use conventional fossil-fuel based energy systems. Renovation of the historic building stock is not an easy task, as authorities at all levels set tight limitations to what can be done. Indeed, the EU regulation<sup>123</sup> allows member states to exempt officially protected buildings from observance of energy performance requirements for the rest of the building stock.<sup>124</sup> However, some countries, such as Germany and Austria, have already set up regional or national guidelines for the energy efficient renovation of historic buildings, and there are also plans for guidelines at a European level, as part of the Horizon 2020 program.<sup>125</sup> A project funded by the EU

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119. PLANYC, NEW YORK CITY'S PATHWAYS TO DEEP CARBON REDUCTIONS 45, 97 (Dec. 2013), available at [http://s-media.nyc.gov/agencies/planyc2030/pdf/nyc\\_pathways.pdf](http://s-media.nyc.gov/agencies/planyc2030/pdf/nyc_pathways.pdf).

120. For more information on PlaNYC, visit: *Mayor's Office of Recovery & Resiliency*, NYC MAYOR'S OFFICE OF SUSTAINABILITY (Jan. 25, 2015), <http://www.nyc.gov/html/planyc/html/about/about.shtml>.

121. PlaNYC, *supra* note 119.

122. EUROPEAN COMMISSION, HORIZON 2020 WORK PROGRAMME 2014-2015, 10 SECURE, CLEAN AND EFFICIENT ENERGY REVISED 15 (2014), available at [http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014\\_2015/main/h2020-wp1415-energy\\_v2.0\\_en.pdf](http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/main/h2020-wp1415-energy_v2.0_en.pdf).

123. Directive 2010/31/EU.

124. "... member states may decide not to set or apply the requirements referred to in paragraph 1 to the following categories of buildings: (a) buildings officially protected as part of a designated environment or because of their special architectural or historical merit, in so far as compliance with certain minimum energy performance requirements would unacceptably alter their character or appearance." *Id.* at Article 4.

125. The activities included in the first work programme of the Horizon 2020 Energy Challenge contribute to the three focus areas "Energy Efficiency," "Competitive Low-Carbon Energy" and "Smart Cities and Communities". These activities cover the full innovation cycle – from "proof of



Seventh Framework Program, called 3ENCULT, bridges the gap between conservation of historic buildings and climate protections, and demonstrates the feasibility of “Factor 4” to “Factor 10” reduction in energy demand, depending on the case and the heritage value.<sup>126</sup>

### 3. Other Worldwide Historic Buildings

Best practice examples include a number of specific technical solutions, like a highly energy-efficient conservation-compatible window prototype, installed at the Public Weigh House in Bolzano, Italy, now commercially available, and a LED based wall-washer, developed for Palazzo d'Accursio in Bologna, Italy, already being used in two other buildings. Other innovations include capillary active internal insulation, which is being piloted in four buildings around Dresden, Germany, a low impact ventilation system based on the active overflow principle currently being tested at the Höttinger School in Innsbruck, Austria, wireless sensor networks at the Palazzina della Viola in Bologna, Italy, and the first version of a dedicated BMS (Building Management system), under review at the Engineering School in Bejar, Spain.<sup>127</sup> Another example is the guidance for the retrofitting of historic buildings in the city of Westminster,<sup>128</sup> London, UK, for its sensitive upgrade approach for historic and other important buildings, to improve their environmental performance.

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concept” to applied research, pre-commercial demonstration and market uptake measures. *Secure, Clean and Efficient Energy*, EUROPEAN COMMISSION 15 (Nov. 11, 2014), [http://ec.europa.eu/research/horizon2020/pdf/work-programmes/secure\\_clean\\_and\\_efficient\\_energy\\_draft\\_work\\_programme.pdf](http://ec.europa.eu/research/horizon2020/pdf/work-programmes/secure_clean_and_efficient_energy_draft_work_programme.pdf).

126. *EeB PPP Project Review*, ENERGY EFFICIENT BUILDINGS ASSOCIATION (Jul. 2012), available at [http://ec.europa.eu/research/industrial\\_technologies/pdf/eeb-ppp-project-review-2010-2011\\_en.pdf](http://ec.europa.eu/research/industrial_technologies/pdf/eeb-ppp-project-review-2010-2011_en.pdf).

127. The project is available at: *Efficient energy for EU cultural heritage*. THE EUROPEAN ACADEMY OF BOZEN/BOLZANO (EURAC) (Jun. 12, 2014), <http://www.3encult.eu/en/project/welcome/default.html>.

128. According to the report, Westminster is particularly rich in historic buildings; three quarters of Westminster housing was constructed prior to 1915, with half prior to 1870. It has over 11,000 listed building, in 56 Conservation Areas, which together cover 76% of the City. These older properties are often sought after for their character, which has a cultural as well as economic value. In Westminster such buildings are well protected and valued. But with rising fuel prices pushing more people into fuel poverty and new obligations on landlords coming into force, from 2018 the most inefficient properties cannot be rented out. Energy efficiency improvement is a great solution for those buildings in order to be attractive for tenants. *Retrofitting Historic Buildings for Sustainability*, CITY OF WESTMINSTER (Jan. 2013), available at [http://transact.westminster.gov.uk/docstores/publications\\_store/Retrofitting\\_Historic\\_Buildings\\_for\\_Sustainability\\_January\\_2013.pdf](http://transact.westminster.gov.uk/docstores/publications_store/Retrofitting_Historic_Buildings_for_Sustainability_January_2013.pdf).

## V. ENERGY EFFICIENCY SOLUTIONS FOR THE EXISTING EUROPEAN BUILDING STOCK AND THEIR SUITABILITY IN THE UNITED STATES

Energy efficiency is necessary for achieving climate change mitigation targets. However, most countries struggle with finding effective energy efficiency policies. According to the AR5, pricing is less effective than programs and regulation. Financing instruments policies and other opportunities are available to improve energy efficiency in buildings, but the results obtained to date are still insufficient to deliver their full potential. Combined and enhanced, the different approaches could provide significant further improvements in terms of both energy access and energy efficiency.<sup>129</sup>

The chosen path here to improve the energy efficiency performance of the existing building stock is a top-down approach led by the initiatives established in Europe. What follows is a description of best practices developed in the EU for the improvement of the energy efficiency of its existing building stock. The conclusions drawn will help fill gaps found in the analysis of U.S. best practices, and outline several recommendations for the energy improvement of any existing buildings in the United States.

It should be noted, anyhow, that energy efficiency improvement “best practice” refers to the case in which an increase in energy efficiency has occurred as a result of technological, behavioral, and/or economic changes.<sup>130</sup> Those changes are created by the different measures described hereafter.

### *A. Examples of European Best Practices for the Energy Performance of the Existing Building Stock*

The EU has traditionally led the fight against climate change. This makes its experience of remarkable value in finding best practices for energy efficiency improvement in other parts of the world, such as the U.S.

In the EU, a number of directives, regulations, and initiatives to encourage and support Member States, regional authorities, companies, and individuals to increase energy efficiency in all sectors of economic activity, including buildings, have been introduced. The EU is still behind schedule to achieving a 20 percent increase in energy efficiency set by the Energy Efficiency Plan (2011) for 2020.<sup>131</sup> However, its leaders remain confident in the EU’s capacity to achieve the target. Furthermore, during

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129. IPCC report, *supra* note 8.

130. See IPCC report, *supra* note 8, Article 2.6; and in the same line, [www.epa.gov](http://www.epa.gov).

131. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, *supra* note 6.

the last European Council of October 2014, the EU has assumed even more ambitious commitments.<sup>132</sup> It is, therefore, clear that there is political determination in Europe to contribute to the objective of combating climate change and that energy efficiency measures will play an important role in that fight. The measures are diverse and have shown different results depending on their implementation in each Member State. Therefore, some general conclusions may be drawn based on the best national performances of the EU regulation to improve the U.S. experience.

Before going further, it is interesting to take a step back and review the European legal order to provide for its energy policy before getting into the specifics of the EU's energy efficiency measures.

### 1. A brief guide to the EU Legal System

The European Member States must take all appropriate measures to ensure fulfillment of the obligations arising from the Treaties or resulting from actions taken by the institutions of the Union. The Treaties (and the annexes, appendices and protocols attached to them, and latter additions) set the constitutional framework for the life of the EU, and hence, contain the basic provisions on the EU's objectives, organization, and *modus operandi*, and parts of its economic law.

The regulation derived from the Union's institutions through exercising the powers conferred on them is referred to as secondary legislation. It consists of regulations, directives, decisions, recommendations, and opinions. The Treaty on the Functioning of the European Union defines these terms in article 288.<sup>133</sup>

**Regulation.** A regulation shall have general application. It shall be binding in its entirety and directly applicable in all Member States.

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132. During the last European Council meeting, on the 23rd and 24th of October 2014, a target at the EU level of at least 27% was set for improving energy efficiency in 2030 compared to projections of future energy consumption based on the current criteria. It will be delivered in a cost-effective manner and it will fully respect the effectiveness of the ETS-system in contributing to overall climate goals. This will be reviewed by 2020, having in mind an EU level of 30%. *Conclusions on 2030 Climate and Energy Policy Framework*, EUROPEAN COUNCIL (Oct. 23, 2014), [http://www.consilium.europa.eu/uedocs/cms\\_data/docs/pressdata/en/ec/145356.pdf](http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/145356.pdf).

133. This information has been extracted from: Klaus-Dieter Borchardt, *The ABC of European Union law*, EUROPEAN COMMISSION (Jan. 7, 2015), [http://europa.eu/documentation/legislation/pdf/oa8107147\\_en.pdf](http://europa.eu/documentation/legislation/pdf/oa8107147_en.pdf).

**Directive.** A directive shall be binding, as to the result to be achieved, upon each Member State to which it is addressed, but leaves to the national authorities the choice of form and methods.

**Decision.** A decision shall be binding in its entirety. A decision which specifies those to whom it is addressed shall be binding only on them.

**Recommendations.** Recommendations and opinions shall have no binding force.

Type of Act	Addressees	Effects
Regulation	All Member States, natural and legal persons	Directly applicable and binding in their entirety
Directive	All or specific Member States	Binding with respect to the intended result. Directly applicable only under particular circumstances
Decision	Not specified All or specific Member States; specific natural or legal persons	Directly applicable and binding in their entirety
Recommendations	All or specific Member States, other EU bodies, individuals	Not binding
Opinions	All or specific Member States, other EU bodies	Not binding

Like any legal order system, that of the EU provides a system of legal protection for the purpose of recourse to and the enforcement of Union law. This protection is guaranteed by the EU’s legal system (Court of Justice, General Court and Specialized courts) and by a series of procedures that recognize the right of the individuals to effective judicial protection of the rights derived from EU law.

The EU legal order is not a self-contained system and therefore relies on the support of the national systems for its operation. However, there are sometimes conflicts between them. Two fundamental principles arise underlying the construction of EU law: the direct applicability of Union law and the primacy of Union law over conflicting national law. The former means that the Union law confers rights and imposes obligations not only on the Union’s institutions and Member States but also on the

Union's citizens. The latter allows Union law to supersede all national provisions that diverge from a Union rule and take their place in the national legal orders.

## 2. The energy strategy

Within this system, energy has been a subject of structural supranational interest in Europe since the beginning of the EU project. Energy was first ruled by the European Coal and Steel Treaty of 1951 and the European Atomic Energy Treaty of 1957, and more recently, after the Lisbon Treaty (2007), energy is a shared competence between the Community and the member states.<sup>134</sup> This has given rise to the development of an energy policy in the context of the establishment and functioning of the internal market, with regard to the need to preserve and improve the environment (article 194, TFEU). Accordingly, the EU policy on energy includes guidelines, actions, and projects of common interest approved by member states to, among other goals, promote energy efficiency and energy saving.

In the current context of deep economic crisis, and given the state of development of the single market, the European policy on energy seeks to play a more important role in an economy that is taking on the challenge of sustainability by reducing energy consumption and improving supply security without losing competitiveness. It has been precisely this convergence of the global financial and economic crisis with a rising awareness of the threat of climate change that has enabled the principle of sustainable development to effectively penetrate diverse public policies both at European and national levels, imposing its rationale on them.

Since the drafting of the "European Spatial Development Perspective" document in 1999 (which reaffirms the compact city model, through the development of a polycentric and more balanced urban system, in conjunction with the development and protection of nature and the natural/cultural heritage of the European regions), the move from a territorial strategic approach towards a specific urban one, has intensified.<sup>135</sup> The latest document, called the "Toledo Declaration," adopted at the Informal Meeting of Urban Development Ministers on June 22, 2010, seeks solutions to the challenges arising from the growing pressure on economic competitiveness, the need for eco-efficiency, and

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134. Article 4.2.i of the Treaty on the Functioning of the European Union.

135. Teresa Parejo Navajas, *The Quest for Global Governance in a Cited World: Towards Sustainable Urban Development Based on the Commitments of the Kyoto Protocol (and/or the Legal Instruments that Replace it)*, 7 EUROPEAN JOURNAL OF LEGAL EDUCATION 41-47 (2012), available at <http://elfa-afde.eu/app/download/5799273808/ejle.vol7.n1.sep.2012.pdf>

the challenges of social cohesion and civic progress in order to ensure peoples' quality of life and wellbeing, now and in the future.<sup>136</sup>

This process, which has been largely affected by the need to guarantee energy supply efficiency and security, is especially notable in urban and territorial planning policies, not so much in relation to cities' growth, but in relation to their appropriate management and continuous improvement on both new and existing buildings. Indeed, based on the concept of the city as "a whole" as per the Leipzig Charter of 2007, the Toledo Declaration of 2010 seeks to integrate urban regeneration into the European framework on sustainable cities.<sup>137</sup>

### 3. EU Specific Measures to Achieve the Energy Efficiency Goal

Reducing energy consumption and eliminating energy waste are among the EU's primary objectives, as both factors are essential to the EU's economic competitiveness, overall energy security, and meeting international commitments related to climate change.<sup>138</sup>

The 20-20-20 targets enacted through the Climate and Energy package (2009) were set by EU leaders in March 2007, when they committed Europe to become a highly energy-efficient, low carbon economy.<sup>139</sup> The energy efficiency target is addressed by three instruments: (i) the Energy Strategy (2010), which defines energy priorities for the next ten years and sets actions to be taken to comply with the 2020 goals;<sup>140</sup> (ii) the Energy Efficiency Plan (2011), an integrated approach to climate and energy policy that precisely aims to combat climate change, increase the EU's energy security and strengthen its competitiveness strategy, and sets out ideas for measures to save energy and increase energy efficiency;<sup>141</sup> and (iii) the Energy Efficiency Directive (Directive 2012/27/EU), which establishes a common framework of

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136. *ESDP European Spatial Development Perspective*, EUROPEAN COMMISSION ON SPATIAL DEVELOPMENT, available at [http://ec.europa.eu/regional\\_policy/sources/docoffic/official/reports/pdf/sum\\_en.pdf](http://ec.europa.eu/regional_policy/sources/docoffic/official/reports/pdf/sum_en.pdf) (last visited May 3, 2015).

137. Parejo Navajas, *supra* note 135.

138. *The 2020 Climate and Energy Package*, EUROPEAN COMMISSION, CLIMATE ACTION (Mar. 26, 2015), [http://ec.europa.eu/clima/policies/package/index\\_en.htm](http://ec.europa.eu/clima/policies/package/index_en.htm).

139. *Id.* The 20-20-20 targets are named as such for the 20% reduction in EU GHG emissions from 1990 levels; the share of EU energy consumption produced from renewable resources raised to 20%; and 20% improvement in the EU's energy efficiency.

140. *Energy: Commission presents its new strategy towards 2020*, EUROPEAN COMMISSION (Nov. 10, 2010), [http://europa.eu/rapid/press-release\\_IP-10-1492\\_en.htm?locale=en](http://europa.eu/rapid/press-release_IP-10-1492_en.htm?locale=en).

141. *Energy Efficiency Plan 2011*, EUROPA: SUMMARIES OF EU LEGISLATION, [http://europa.eu/legislation\\_summaries/energy/energy\\_efficiency/en0029\\_en.htm](http://europa.eu/legislation_summaries/energy/energy_efficiency/en0029_en.htm) (last visited Spring 2015).

measures for the promotion of energy efficiency in the EU,<sup>142</sup> as will be explained further below.

The EU is also offering to increase its emissions reduction goal to 30% by 2020 if other major economies in the developed and developing world commit to undertake their fair share of a global emissions reduction effort, and in July 2009, EU leaders and the G8 announced a more ambitious GHG emissions reduction target in the so-called Roadmap 2050, by at least 80% below 1990 levels by 2050.<sup>143</sup> Furthermore, the abatement objective for the EU and other developed economies was set at 80-90% below 1990 levels by 2050 in October 2009, while in October 2014, the EU committed member states to an indicative target of at least 27% for improving energy efficiency in 2030 compared to projections of future energy consumption based on the current criteria, which will be reviewed by 2020, having in mind an EU level of 30%.<sup>144</sup>

The specific energy efficiency measures adopted in the EU in order to accomplish the targets are as follows.

#### a) Regulatory Instruments and Voluntary Standards

In accordance with its overall energy related goals, the EU has adopted an ambitious vision for the energy performance of buildings, which has led to regulation (primarily through the use of Directives) aiming at complying with the Energy Efficiency 2020 goal.

As far as the existing building stock is concerned, it is important to keep in mind that its characteristics differ significantly between member states in terms of age, type, ownership, renovation rates and energy performance.<sup>145</sup> “Therefore, while national policies and regulatory frameworks share common themes, measures to improve the building

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142. “This Directive establishes a common framework of measures for the promotion of energy efficiency within the Union in order to ensure the achievement of the Union’s 2020 20 % headline target on energy efficiency and to pave the way for further energy efficiency improvements beyond that date.” Article 1.1 of Directive 2012/27/EU of 25 October 2012, on energy efficiency, *available at* <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012L0027&from=EN>.

143. *Roadmap 2050*, ROADMAP 2050, <http://www.roadmap2050.eu/project/roadmap-2050> (last visited Mar. 26, 2015).

144. During that meeting, the European Council meeting endorsed four targets regarding climate change and energy policy framework: 1) a binding EU target of 40% less GHG emissions by 2030, compared to 1990; 2) a target of at least 27% renewable energy consumption; 3) a 27% energy efficiency increase; and 4) the completion of the internal energy market achieving the existing electricity interconnection target of 10% and linking the energy islands, in particular the Baltic and the Iberian Peninsula. *See* European Council Meeting Minutes October 23-24, 2014, *available at* <http://data.consilium.europa.eu/doc/document/ST-169-2014-INIT/en/pdf>.

145. REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL, *supra* note 2, at 4.

stock will have to take these differences into account.”<sup>146</sup> Indeed, “building energy codes in Europe are typically developed at the national level, adopted at the state level, and implemented and enforced by local governments.”<sup>147</sup>

EU regulation of energy efficiency in buildings is generally based on Directives, which set minimum requirements for all member states and have to be transposed into member state legal systems (with equal or more stringent requirements) in order to be effective. These Directives include specific energy efficiency standards for both the new and the existing building stock, as explained below.

In all, there are **six core legislative instruments at the EU-level**, which are designed to achieve the targets established to reduce the energy consumption of the existing building stock or related objectives.

- **Directive 2009/28/EC** of the European Parliament and of the Council of April 23, 2009, on the promotion of the use of energy from renewable sources (and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC), establishes a common framework for the use of energy from renewable sources in order to limit GHG emissions (and to promote cleaner transport).<sup>148</sup> This regulation is applicable to the building stock as it obliges member states to set up sector-specific targets for renewable heating and cooling; requires them to adopt support policies for RES-H projects (for heating and cooling)<sup>149</sup> for new buildings and for existing ones that are subject to major renovations; defines technology-specific

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146. *Id.*

147. *Building Codes for Energy Efficiency*, EPA (Mar. 27, 2015), <http://www.epa.gov/clean-energy/documents/suca/buildingcodesfactsheet.pdf>.

148. *Directives*, OFFICIAL JOURNAL OF THE EUROPEAN UNION (Mar. 27, 2015), <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0028&from=EN>.

149. “The RES H/C SPREAD project aims at **developing six regional pilot plans in the field of the heating and cooling** with renewable energies. The project involves six pilot Regions pertaining to as many European countries representing the EU main climatic zones, with a prevalence of the Mediterranean nations. The planning exercise aims at setting harmonized and standard baselines to better allow the developers to set their targets and policies. In each Region, Country Governance Committees will be constituted to support the plans implementation and to help reach the consensus on the proposed policies among the Regional Authorities, key stakeholders and citizens’ representatives. The plans will then developed in accordance with the regional demand for heating and cooling and, in particular, in line with the EED requirements, “optimize the utilization of locally available residual and waste sources of heat, cooling and RES through the use of district heating & cooling networks in areas of sufficient heat and cooling demand.” *RES Heating and Cooling - Strategic Actions Development (RES.H-C.SPREAD)*, INTELLIGENT ENERGY EUROPE, EUROPEAN COMMISSION (Jan. 25, 2015), <http://ec.europa.eu/energy/intelligent/projects/en/projects/resh-cspread>.



restrictions for heat pumps and bioliquids; and requires member states to ensure that new public buildings that are subject to major renovation fulfill an important and exemplary role in the context of the use of RES-H projects.

- **Directive 2009/125/EC** of the European Parliament and of the Council of October 21, establishing a framework for the setting of eco-design requirements for energy-related products (Ecodesign Directive), which sets minimum efficiency standards for technologies used in the building sector (e.g. boilers, hot water generators, pumps, ventilation, etc.).<sup>150</sup> The EU Ecodesign Directive was introduced in 2005 and updated in 2009. Within its framework, EU-wide minimum energy and environmental performance standards for products are set-out to remove the most inefficient and poorest performing products from the market. It applies to energy using products<sup>151</sup> and energy related products, with specific measures implemented for over twenty product groups, with this number also increasing over time.<sup>152</sup>
- **Directive 2010/30/EU** of the European Parliament and of the Council of May 19, on energy labels, which obliges member states to establish efficiency labeling schemes for a number of technologies used in the building sector. The mandatory EU Energy Label was first introduced in 1992, and updated by the current recast Directive 2010/30/EU (and has been amended by Directive 2012/27/EU, as indicated hereafter). It now applies to more than ten appliance product groups, with this number slowly increasing over time. The main element of the label is a 7-class scale, A-G, which rates the energy efficiency of a product, and which can be extended above class A to A+, A++ and A+++, where necessary. The lowest class may be F, E or D, as there are no longer products on the market belonging to the classes below them.<sup>153</sup> The label also includes information on energy consumption and in

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150. THE ECONOMIST: INTELLIGENCE UNIT, INVESTING IN ENERGY EFFICIENCY IN EUROPE'S BUILDINGS. A VIEW FROM THE CONSTRUCTION AND REAL ESTATE SECTOR, GBPN 11 (2013), [http://www.gbpn.org/sites/default/files/06.EIU\\_EUROPE\\_CaseStudy.pdf](http://www.gbpn.org/sites/default/files/06.EIU_EUROPE_CaseStudy.pdf).

151. *Evaluation of Energy Labeling Directive and certain aspects of the Ecodesign Directive*, EUROPEAN COMMISSION (Mar. 27, 2015), [https://ec.europa.eu/energy/sites/ener/files/document\\_s/en\\_directive2013.pdf](https://ec.europa.eu/energy/sites/ener/files/document_s/en_directive2013.pdf).

152. *Energy Efficiency*. EUROPEAN COMMISSION (Aug. 22, 2014), [http://ec.europa.eu/energy/efficiency/consultations/doc/2013\\_energy\\_directive/en\\_directive2013.pdf](http://ec.europa.eu/energy/efficiency/consultations/doc/2013_energy_directive/en_directive2013.pdf).

153. *Evaluation of Energy Labelling Directive and certain aspects of the Ecodesign Directive*, EUROPEAN COMMISSION DIRECTORATE-GENERAL FOR ENERGY, [https://ec.europa.eu/energy/sites/ener/files/documents/en\\_directive2013.pdf](https://ec.europa.eu/energy/sites/ener/files/documents/en_directive2013.pdf) (last visited Mar. 27, 2015).

most cases on other product specific parameters, such as size/capacity, noise, and water efficiency.<sup>154</sup> Energy labels indirectly improve the overall efficiency of the products that are produced and purchased due to the accurate, relevant, and comparable information on energy efficiency and energy and other resource consumption of the product they provide before consumers make their purchasing decision.<sup>155</sup>

- **Directive 2010/31/EU** of the European Parliament and of the Council of May 19, on the energy performance of buildings (also known as EPBD), lays down a number of requirements that have to be implemented by the member states, encouraging the introduction of intelligent energy consumption metering systems whenever a building is constructed or undergoes major renovation, in order to:
  - Calculate the energy performance of buildings; take the necessary measures to ensure that minimum energy performance requirements for buildings (in new buildings and existing buildings that undergo major renovation) are set, applied, and met in order to achieve cost-optimal levels;
  - Take measures to optimize the performance, installation, appropriate dimensioning, adjustment, and control of the technical building systems installed in the existing buildings;
  - Ensure that all new buildings are NZEB (nearly zero-energy buildings) by the end of 2020 and by 2018 for public buildings;<sup>156</sup> ensure that all accessible parts of the heating and air-conditioning systems are regularly inspected and that the heating installations older than fifteen years are assessed (with respect to their energy performance);<sup>157</sup> and
  - Implement the Energy Performance Certificates schemes according to a number of requirements defined by the Directive.

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154. *Id.*

155. *Id.*

156. Council Directive 2010/31/EU, art. 9, 2010 O.J. (L 153) 21.

157. WOLFGANG EICHHAMMER ET AL., FINANCING THE ENERGY EFFICIENT TRANSFORMATION OF THE BUILDING SECTOR IN THE EU (2012); THE ECONOMIST INTELLIGENCE UNIT LTD., INVESTING IN ENERGY EFFICIENCY IN EUROPE'S BUILDINGS (2013).

- **Commission Delegated Regulation (EU) No 244/2012**, of January 16, 2012, supplementing EPBD, establishes a comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements;<sup>158</sup> and
- **Directive 2012/27/EU** of the European Parliament and of the Council of October 25, 2012, on energy efficiency (also known as the Energy Efficiency Directive or EED, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC), that establishes a common framework of measures for the promotion of energy efficiency within the Union, in order to ensure the achievement of the Union's 20-20-20 percent headline target on energy efficiency and to pave the way for further energy efficiency improvements beyond that date;<sup>159</sup> including among others, the institution of a long-term strategy which should encompass the identification of cost-effective approaches to renovations of the existing building stock relevant to its type and climatic zone (first step for adaptation). Certainly, Article 4 of the EED indicates that the strategy for mobilizing investment in the renovation of the national building stock must include:<sup>160</sup>
  - An overview of the national building stock based, as appropriate, on statistical sampling;
  - The identification of cost-effective approaches to renovations relevant to the building type and climatic zone;
  - Policies and measures to stimulate cost-effective deep renovations of buildings, including staged deep renovations;
  - A forward looking perspective to guide investment decisions of individuals, the construction industry and financial institutions; and
  - An evidence-based estimate of expected energy savings and wider benefits.

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158. Commission Delegated Regulation (EU) No 244/2012, 2012 O.J. (L 81/18) 1.

159. Council Directive 2012/27/EU, art. 1, 2012 O.J. (L 315) 1.

160. *Id.*

The obligation to renovate central government buildings stated in Directive 2012/27/EU complements Directive 2010/31/EU, which promotes the improvement of the energy performance of buildings within the Union, taking into account outdoor climatic and local conditions, as well as indoor climate requirements and cost-effectiveness.

These are very appropriate measures given that the existing building stock represents the single biggest potential sector for energy savings in the EU. Moreover, buildings are crucial to achieving the EU's ambitious objectives set by the 2050 Roadmap and by the European Council meeting held in October 2014. For that purpose, the EU has repeatedly affirmed that the rate of building renovation needs to be increased and that the bet should start with the public sector as they represent a considerable share of the total building stock and have high visibility in public life.<sup>161</sup>

By the time the first energy efficiency Directive was introduced in 2003, most member states had building codes but they varied in the level of performance required. Some states had demonstrated excellent practice, like Germany or Denmark, but some others like Spain, have failed to comply with the building regulation.<sup>162</sup> However, according to BPiE most current renovation activity is minor, resulting in much more modest levels of energy savings.<sup>163</sup> This is due to the government's incentive programs that encourage installation of single measures (efficient heating plants, renewable energy measures, etc.), but are rarely geared towards achieving the maximum energy savings for the building as a whole.<sup>164</sup>

Despite the importance of this regulation, problems such as the following remain to be overcome:

1. Construction works in existing buildings are treated differently by the general technical building regulations, and in more than half of EU countries there are no specific regulations for existing buildings;<sup>165</sup>

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161. ARMIN MAYER & ANDA GHIRAN, *EU PUBLIC-SECTOR EXPERIENCES WITH BUILDING EFFICIENCY: EXPLORING BARRIERS TO PERFORMANCE CONTRACTING AND DEEP ENERGY RETROFITS* (2011).

162. MARINA ECONOMIDOU ET AL., *EUROPE'S BUILDINGS UNDER THE MICROSCOPE* (2011).

163. *Id.* at 109.

164. THE ECONOMIST INTELLIGENCE UNIT LTD., *INVESTING IN ENERGY EFFICIENCY IN EUROPE'S BUILDINGS* (2013).

165. COSTA BRANCO DE OLIVEIRA PEDRO, J.A., FRITS MEIJER & HENK VISSCHER, *TECHNICAL BUILDING REGULATIONS IN EU COUNTRIES: A COMPARISON OF THEIR ORGANIZATION AND FORMULATION* (2010).

2. Member state regulatory instruments are the dominating measures addressing heating consumption and electricity, either in the residential or the commercial sectors;<sup>166</sup>
3. Member states' obligations to achieve certain amounts of final energy savings to drive energy efficiency improvements frequently fall short in at the implementation stage;
4. Member states must report their implementation progress to the EU, but these reports often are not detailed enough and even if they are they tend to describe an overly optimistic picture; and
5. Statistical data about the energy performance of buildings and related indicators is irregular at best in most EU countries.<sup>167</sup>

As a result, compliance and enforcement of building regulations remains a key issue in many EU countries even though such efforts are essential to deliver the full potential of energy efficiency savings.<sup>168</sup>

In 2010, the rates of compliance in the EU member states varied from 45% to 55% for existing buildings and 70% for new buildings, and while the efficiency of new buildings has improved over time, most of Europe's existing building stock has yet to be affected by energy performance requirements.<sup>169</sup> For those who do not comply with the regulation, the European Commission can open an infringement procedure. In 2010, eight infringement proceedings for EPC and boiler and air-conditioning system inspections were open.<sup>170</sup> Enforcement is systematic in Belgium, Denmark, Finland, and the Netherlands, but considered a failure in Spain.<sup>171</sup>

#### *b) Market-based instruments*

In Europe, the EPCt was first identified as a key instrument to finance and implement ambitious energy efficiency investments. Directive

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166. Only Spain, among all member states, has reported a rather high number of measures also for all types of building, including the ones included in the so-called tertiary or service sector, in which this type of information is more difficult to find. WOLFGANG EICHHAMMER ET AL., *supra* note 157.

167. According to a recent review on EU methodologies for energy benchmarking, at the European level, the unavailability of building energy use databases has restricted the development of benchmarking tools. T. Nikolaou, D. Kolokotsab & G. Stavrakakis, *Review on methodologies for energy benchmarking, rating and classification of buildings*, 5 ADVANCES IN BLDG. ENERGY RESEARCH 53, 70 (2011).

168. FRANK KLINCKENBERG & MINNA SUNIKKA, BETTER BUILDINGS THROUGH ENERGY EFFICIENCY: A ROADMAP FOR EUROPE (2006).

169. *Buildings Performance Institute Europe*, EUROPEAN CLIMATE FOUNDATION (2013), <http://europeanclimate.org/bpie/>.

170. Levine, *supra* note 107, at 57.

171. Levine, *supra* note 107, at 58.

2012/27/EU obliges member states, among other things, to establish financing facilities for energy efficiency measures. However, there are still some barriers that need to be overcome, like the lack of understanding and information, distrust in suppliers, high transaction costs, inadequate accounting and procurement rules, different procedures in each country, and problems with access to financing.<sup>172</sup> This is why the use of EPCs though ESCOs has been heterogeneous among member states. In July, 2014, the new *European Code of Conduct for Energy Performance Contracting* was elaborated to define the basic values and principles that are considered fundamental for the successful preparation and implementation of EPCs projects in Europe.<sup>173</sup>

EEOs have been used in the European energy efficiency market, and EU regulations oblige member states to introduce EEO schemes as the objective of the Union 2020 could be better achieved, at least at this stage, by means of national EEOs schemes for energy utilities or other alternative policy measures that achieve the same amount of energy savings.<sup>174</sup> The first schemes in the world with a white certificate-trading element were introduced in Australia and the UK.<sup>175</sup> Since then, governments around the world have endeavored to improve end-use energy efficiency by designing and implementing EEOs schemes. Currently in the EU, the Danish EEOs are the strongest in relation to energy efficiency in the industry, in contrast to France, Italy, and the UK, where households and the public sector dominate. However, EEOs are more frequently used in the U.S. than in the EU.<sup>176</sup>

More common than the two previous are Energy Performance Certificates (EPCs), which EU member states use as mandatory comparative performance labels. EPCs were introduced by Directive 2002/91/EC, to be issued when a building is constructed, sold, or let, and must include reference values, such as current legal standards, in order to make it possible for consumers to compare and assess energy

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172. *Energy performance contracting*, INTELLIGENT ENERGY EUROPE, EUROPEAN COMMISSION (Jan. 19, 2015), <http://ec.europa.eu/energy/intelligent/in-action/energy-performance-contracting/>.

173. DAMIR STANIČIĆ ET AL., EUROPEAN CODE OF CONDUCT FOR ENERGY PERFORMANCE CONTRACTING (Jul. 11, 2014).

174. Council Directive 2012/27/EU, art. 7, 2012 O.J. (L 315) 1.

175. PAOLO BERTOLDI & SILVIA REZESSY, ENERGY SUPPLIER OBLIGATIONS AND WHITE CERTIFICATE SCHEMES: COMPARATIVE ANALYSIS OF RESULTS IN THE EUROPEAN UNION (2010).

176. As of 2009, almost half of the states in the USA have some kind of energy efficiency or energy savings obligations, either as a stand-alone target (referred to as energy efficiency resource standards, EERSs) or as part of renewable energy obligations (referred to as renewable portfolio standards, RPSs). *Id.*

performance.<sup>177</sup> Also, they have to be accompanied by recommendations for cost-effective improvement options to raise the performance and rating of the building. The recast of the Directive in 2010 (Directive 2010/31/EU) strengthened the role of EPCs, for example, by demanding publication of the energy performance indicator of the EPC at the time of advertising a building for sale or rental, rather than only at the time of signing a purchase agreement or rental contract.<sup>178</sup>

Given the EU's subsidiarity principle, there is significant room for member states to detail the mechanisms and manner of implementation of EPCs.<sup>179</sup> For instance, all EU member states have adopted building energy labels based on rating systems, but implementation and effectiveness vary among them depending on a range of factors, including the local political and legal context, related incentives and subsidies, and the characteristics of the local property market.<sup>180</sup> Perhaps as a result of this inconsistency, according to the recent European Commission's report regarding implementation of EPCs in the EU there have been significant differences among countries with respect to the effectiveness of the EPCs bringing about real change in energy efficiency in the building stock.<sup>181</sup> Accordingly, the current implementation picture for EPCs is patchy at best, and needs strengthening.

The regional implementation of Directive 2010/30/EU on energy labels in Austria may be regarded as a best practice example. It is streamlined by a national guideline (OIB-Richtlinië) to help the regions with development of the major aspects of the Directive while at the same time providing flexibility to each region if necessary.<sup>182</sup> Other examples are available as well. For instance, in the Netherlands, many aspects concerning the implementation of the EPCs are regularly discussed in working groups composed of different relevant stakeholders, while in Portugal the energy agency ADENE has played a key role in the successful

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177. SHAILENDRA MUDGAL ET AL., ENERGY PERFORMANCE CERTIFICATES IN BUILDINGS AND THEIR IMPACT ON TRANSACTION PRICES AND RENTS IN SELECTED EU COUNTRIES (2013).

178. *Id.*

179. Article 5.3 of the Treaty on the European Union states “[u]nder the principle of subsidiarity, in areas which do not fall within its exclusive competence, the Union shall act only if and in so far as the objectives of the proposed action cannot be sufficiently achieved by the member states, either at central level or at regional and local level, but can rather, by reason of the scale or effects of the proposed action, be better achieved at Union level.” Treaty of Lisbon Amending the Treaty on European Union and the Treaty Establishing the European Community, Dec. 13, 2007, 2007 O.J. (C 306) 1.

180. SHAILENDRA MUDGAL ET AL., *supra* note 177.

181. *Id.*

182. BLDG. PERFORMANCE INST. EUROPE, ENERGY PERFORMANCE CERTIFICATES ACROSS EUROPE FROM DESIGN TO IMPLEMENTATION (2010).

implementation of EPC scheme by actively getting relevant stakeholders involved in the process. In Denmark, years of consistent communication by the government that energy performance is important, has raised awareness among its citizens.<sup>183</sup> Along the lines of more strict approaches, many member states have implemented penalties for non-compliant building owners, as provided for in the Directive.

### c) Incentives

A number of incentive schemes have been developed across Europe to harness the huge potential to reduce energy use in the existing stock,<sup>184</sup> both in residential and in non-residential buildings. These instruments essentially fall into eight categories: preferential loans, subsidies, grants, third party financing, trading (white certificates/energy certificates), tax rebates, tax deductions, and VAT (value added tax) reductions.<sup>185</sup> Nevertheless, most member states have opted for more traditional financial instruments such as loan and tax incentives, and less frequently for market-based ones, such as obligation schemes (sometimes structured in the form of white certificates or EEOs), audits, third-party financing (including financing offered through ESCOs), and Feed-in Tariffs (FITs).<sup>186</sup>

**Grants and Subsidies:** examples of grants and subsidies are found in a) Austria, with the KlimaAktiv project, which is aimed at introducing and promoting climate friendly technologies and services in existing and new buildings,<sup>187</sup> b) subsidies to households for improving energy efficiency in Belgium, through improvement in the insulation and the efficiency of electrical and heating equipment,<sup>188</sup> c) the Green Saving Programme (sic.) of the Czech Republic, for new and existing residential buildings,<sup>189</sup> focused on supporting heating installations utilizing

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183. *Id.* at 20-22.

184. *Levine, supra* note 107.

185. KLINCKENBERG CONSULTANTS, MAKING MONEY WORK FOR BUILDINGS (2010).

186. Feed-in tariffs (FIT) is an economic policy created to promote active investment in and production of renewable energy sources. Feed-in tariffs typically make use of long-term agreements and pricing tied to costs of production for renewable energy producers. By offering long-term contracts and guaranteed pricing, producers are sheltered from some of the inherent risks in renewable energy production, thus allowing for more diversity in energy technologies. *Feed-In Tariff*, INVESTOPEDIA (2015), <http://www.investopedia.com/terms/f/feed-in-tariff.asp>.

187. More information available at *klimaaktiv*, THE AUSTRIAN CLIMATE INITIATIVE (2015), <http://www.klimaaktiv.at/english.html>.

188. More information available at *Energiesparverband*, AUSTRIA, <http://www.esv.or.at/> (last visited Nov. 17, 2004).

189. More information available at *About New Green Savings Programme*, NZU, <http://www.novazelenasporam.cz/en/> (last visited Nov. 17, 2014).



renewable energy sources and investment in energy savings, and d) the KfW Program Energy-Efficient Rehabilitation in Germany, which is aimed at reducing energy consumption through insulation measures, improvement of heat pumps and ventilation of buildings, or the KfW programme Housing modernization, for the rehabilitation or refurbishment of residential buildings through the renewal of central heating installations and other housing features.<sup>190</sup> The success of the KfW programs is mostly due to the fact that the KfW constitutes an immense fund.<sup>191</sup>

**Carbon Taxes:** some EU countries have set up energy and carbon taxes in order to internalize the negative externalities of energy consumption in the final prices of goods and services. Austria, Denmark, Finland, Germany, Italy, Sweden and the Netherlands have done so with very good results. The International Monetary Fund (IMF) has indicated that the carbon tax is the most effective instrument for encouraging businesses and individuals to reduce energy use and switch to cleaner fuels.<sup>192</sup>

Denmark is one of the world's first countries to introduce a carbon tax on both households and businesses, to reduce the use of coal and to promote the use of natural gas, as well as renewable sources of energy, and to decrease imports through lower private energy consumption.<sup>193</sup> Sweden is another example of success, as it has pushed the energy sector towards renewable sources.<sup>194</sup> The Italian program provides tax credits to households and companies for single measures such as thermal insulation, installation of solar panels, and replacement of heating and air-conditioning systems, or for comprehensive retrofit work, covering up to

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190. According to the KfW report on the Impact on public budgets of the KfW promotional programmes "Energy efficient construction," "Energy-efficient refurbishment" and "Energy-efficient, infrastructure" (2011), Taken together, the KfW programmes "Energy-efficient construction," "Energy-efficient refurbishment" and "Energy-efficient infrastructure" can therefore be considered as a financial instrument for residential and climate policy applications which is yielding positive effects, most notably on the budgets of social insurance institutions, but also on the budgets of the federal government, states and municipalities. With the marked effect achieved in the labor market, the budgetary impact for the federal government is positive and led to benefits in 2011 of approximately € 560 million in the case of induced investment and approximately € 2,200 million in the case of promoted investment. KfW BANKENGRUPPE, IMPACT ON PUBLIC BUDGETS OF KfW PROMOTIONAL PROGRAMMES IN THE FIELD OF ENERGY-EFFICIENT BUILDING AND REHABILITATION (2011).

191. *Id.* at 81.

192. *Factsheet; Climate, Environment, and the IMF*, INTERNATIONAL MONETARY FUND (Apr. 9, 2015), <https://www.imf.org/external/np/exr/facts/enviro.htm>.

193. Cindy Bae, *Denmark's Carbon Tax Policy*, COMMODITY PRICE ANALYSIS AND POLICY ANALYSIS (Feb. 7, 2013), <http://blogs.ubc.ca/cindybae/2013/02/07/denmarks-carbon-tax-policy/>.

194. JENNY SUMNER, LORI BIRD, & HILLARY SMITH, CARBON TAXES: A REVIEW OF EXPERIENCE AND POLICY DESIGN CONSIDERATIONS (2009).

55 percent of the energy-related cost, but not exceeding a maximum value indicated in the specific measure.<sup>195</sup> From June 6, 2013, to December 31, 2013, (June 30, 2014, for renovations in communal parts of apartment blocks) the tax credits were temporarily increased to 65 percent of the purchase and installation costs.<sup>196</sup>

**Loans:** loans offered by public entities or managed by private commercial financial institutions in public-private partnerships, are being used in countries such as Germany, Hungary, Latvia and Spain. In this last country, grants and preferential loans have financed the Spanish Energy Efficiency Action Plan (2008-2012), for the rehabilitation of the thermal envelope of the existing buildings, the improvement in the existing thermal installations and internal lighting plants, and the promotion of the rehabilitation of existing buildings with high-energy ratings.<sup>197</sup>

**FITs:** The “Green Deal” financial mechanism is an innovative variant of FITs to be introduced in the UK. It eliminates the need for the consumer to pay upfront for energy efficiency measures and instead provides reassurances that the cost of the measures should be covered by savings on the electricity bill.<sup>198</sup>

There are six main European sources of funding for energy efficiency investments: the European Regional Development Fund (ERDF), the Cohesion Funds, the European Investment Bank (EIB), the EU Emissions Trading Scheme (EU ETS), the Intelligent Energy Europe Programme (IEE), and the European Local Energy Assistance fund (ELENA).<sup>199</sup> In addition, there are examples of policy mechanisms that use a combination of grants and preferential loans, like the German *Bank aus Verantwortung* (KfW), the Spanish support for energy efficiency in buildings (2008-2012), or the financial stimulation for energy efficiency renovation and sustainable buildings of new buildings (2008-2016) in Slovenia.<sup>200</sup>

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195. BENGT JOHANSSON, ECONOMIC INSTRUMENTS IN PRACTICE 1: CARBON TAX IN SWEDEN.

196. Anna Alberini & Andrea Bigano, *How Effective are Energy-Efficiency Incentive Programs? Evidence from Italian Homeowners* (FEEM Working Paper No. 097.2014, 2014), available at <http://ssrn.com/abstract=2527863>.

197. *Energy Saving and Efficiency Strategy Action Plan 2008-2012 in Spain*, INSTITUTO PARA LA DIVERSIFICACIÓN Y AHORRO DE LA ENERGÍA, <http://www.idae.es/index.php/id.67/re/menu.333/lang.uk/mod.pags/mem.detalle> (last visited Nov. 17, 2014).

198. WOLFGANG EICHHAMMER ET AL., *supra* note 157.

199. For a complete list of funding sources see KLINCKENBERG CONSULTANTS, MAKING MONEY WORK FOR BUILDINGS (2010).

200. *Id.*

*d) Voluntary actions*

With respect to voluntary standards, although they are not as important as the mandatory regulations, one originally from Europe, has made important contributions to architectural techniques and, moreover, has created a “whole-approach building philosophy.”<sup>201</sup> The Passive House (Passivhaus, in German) is the oldest voluntary standard for super-efficient buildings in Europe and refers to a rigorous, voluntary standard for energy efficiency in a building.<sup>202</sup> It contains the most stringent standards with regard to heating requirements, which prescribes a heating load (assuming a uniform indoor temperature of 20°C) of no more than 15 kWh/sqm/yr, irrespective of the climate.<sup>203</sup> It typically entails a high-performance thermal envelope combined with mechanical ventilation with heat recovery to ensure high indoor air quality. This standard represents a factor of 6–12 reduction in heating load in mild climates (such as Southern Europe) and up to a factor of 30 reduction in cold climate regions with minimal insulation requirements.<sup>204</sup> Where buildings are not currently heated to comfortable temperatures, adoption of a high-performance envelope can aid in achieving comfortable conditions while still reducing heating energy use in absolute terms.<sup>205</sup>

Even though the passive house standard has been used mostly for new buildings, it can also be applied to retrofitting projects. With respect to new construction, the first Passive Houses were built in Germany in 1991, and the vast majority of them are located in German-speaking countries and Scandinavia. As of August 2010, there were approximately 25,000 such certified structures of all types in Europe, while in the U.S. there were only thirteen, with a few dozen more under construction.<sup>206</sup> Two have been

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201. There are other examples like the Swiss MINERGIE Standards or the French Effinergie Criteria, but the most important one is the Passive house.

202. A passive house is a house insulated to the highest standards that does not need a central heating system. Even in the depths of winter, it can be kept warm by capturing energy from the sun and from the heat given off by the people and electrical appliances it contains. Passive house constructions can help dramatically reduce the need for electric air conditioning as well. CHRIS GOODALL, *TEN TECHNOLOGIES TO SAVE THE PLANET: ENERGY OPTIONS FOR A LOW-CARBON FUTURE* (2010).

203. *Id.*

204. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE., *CLIMATE CHANGE 2014: MITIGATION OF CLIMATE CHANGE.*, CAMBRIDGE UNIVERSITY PRESS 688 (2015)

205. GABRIELE C. HEGERL ET AL., INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *FOURTH ASSESSMENT REPORT: CLIMATE CHANGE 2007* (2007) AND INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE., *CLIMATE CHANGE 2014: MITIGATION OF CLIMATE CHANGE.*, CAMBRIDGE UNIVERSITY PRESS 688 (2015).

206. Tom Zeller Jr., *Can We Build in a Brighter Shade of Green?* N.Y. TIMES, September 25, 2010, [http://www.nytimes.com/2010/09/26/business/energy-environment/26smart.html?\\_r=1&ref=earth&pagewanted=all](http://www.nytimes.com/2010/09/26/business/energy-environment/26smart.html?_r=1&ref=earth&pagewanted=all).

recently completed aimed at being aggressive toward climate change.<sup>207</sup> One is the first mid-sized apartment building designed to Passive House standards in the U.S. is the Knickerbocker Commons in Brooklyn, New York, completed in May 2014, and the other, a dozen new developments in Red Hook, Brooklyn.<sup>208</sup> In 2012, the number of Passive Houses increased to approximately 57,000 buildings in thirty-one European countries, covering 25.15 million square meters with examples as far north as Helsinki, with significantly more that meet or exceed the standard but have not been certified due to the higher cost of certification.<sup>209</sup> Austria, with around 4,500 passive houses (2014 data) and expecting to double them in two years, is the country with the largest number of passive houses in the world.<sup>210</sup> Interestingly, this philosophy has inspired new holistic projects (whole-building approach)<sup>211</sup> that have moved beyond energy efficiency to focus on other systems that are part of our buildings.

One example of such movement is exhibited by the “Living Building Challenge” (International Living Future Institute), a U.S. building certification program, advocacy tool, and philosophy which calls for the creation of building projects at all scales that defines the most advanced measure of sustainability in the built environment possible today.<sup>212</sup> It “operates as cleanly, beautifully and efficiently as nature’s architecture,”<sup>213</sup> but only for new constructions. Another such example is the “Enterprise” project, which introduces energy efficiency solutions for green

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207. Tobias Salinger, *Bushwick affordable passive house apartments nearly complete*, NEW YORK DAILY NEWS, April 30, 2014, <http://www.nydailynews.com/new-york/brooklyn/affordable-passive-house-apartments-complete-article-1.1774462>.

208. In fact, NYC’s government has committed to achieving a 35% emissions reduction in 10 years by, among other measures, looking to Passive house strategies to inform the standards. Message from the Mayor to city populace (Sep. 21, 2014), <http://www.nyc.gov/html/builttolast/pages/home/home.shtml>. Hana R. Alberts, *Passively Designed 255 Columbia Launches Sales From \$900K*, CURBED (October 1, 2013), <http://curbednetwork.com/titles/curbed>.

209. GABRIELE C. HEGERL ET AL., INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, FOURTH ASSESSMENT REPORT: CLIMATE CHANGE 2007 20 (2007).

210. Guido Wimmers, *The Austrian Passive House Group Visits Canada: Promoting the Building of Tomorrow*, OFFICE OF SCIENCE AND TECHNOLOGY AUSTRIA (Sept. 2006) (last visited April 9, 2015), available at <http://ostaustria.org/bridges-magazine/volume-11-september-28-2006/item/1464-the-austrian-passive-house-group-visits-canada-promoting-the-building-of-tomorrow>.

211. Indeed, in the EU Directive 2002/91/EC (later recast as Directive 2010/31/EU) was the first major directive, requiring all member states to introduce a general framework for setting building energy code requirements based on a “whole-building” approach. Council Directive 2010/31/EU, art. 9, 2010 O.J. (L 153) 13.

212. More information available at *Living Building Challenge*, INT’L LIVING FUTURE INST., <http://living-future.org/lbc> (last visited June 9, 2014).

213. *Living Building Challenge*, LIVING BUILDING CHALLENGE, <http://living-future.org/lbc> (last visited Spring 2015).

communities across the U.S. through public-private partnerships with financial institutions, governments, community organizations and other partners.<sup>214</sup>

But Passive house design is not just for new buildings. With respect to the retrofitting of existing buildings with Passive house standards, there are examples in both Europe and the U.S. which show its success. The A-Zero project transformed an old cow shed into a family home in the UK, renovated an American ranch home in Michigan, and a house in Sonoma, California.<sup>215</sup> Although not very numerous, these examples show that this technique is also possible in major renovations.

#### *e) Informative Measures*

An interesting example of informative measures is the Energy Efficiency Certificate (EEC) Register included in the most recent Spanish regulation (some other member states also have created them, like the UK), to comply with the requirements established by the European regulation.<sup>216</sup> The register is a statistical inventory on the EECs registered in each Autonomous Community that helps inspection and monitoring activities, and informs the public about the level of compliance with the energy efficiency objective.

#### *B. Energy Efficiency Measures Adopted In the U.S.*

Policy and programs have played an important role in reducing energy use and energy intensity in U.S. over the past 30 years. With less than 1.5% of the U.S. building stock built each year, improving existing buildings is critical to ameliorate building energy inefficiency.<sup>217</sup> As such, the Environmental Protection Agency (EPA) and the U.S. Department of Energy (DOE) have jointly created the State Energy Efficiency (SEE) Action Network to help States achieve maximum cost effective energy

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214. *Enterprise*, ENTERPRISECOMMUNITY.COM, [www.enterprisecommunity.com](http://www.enterprisecommunity.com) (last visited Dec. 10, 2014).

215. *A-Zero*, A-ZERO, [www.a-zero.co.uk](http://www.a-zero.co.uk) (last visited Dec. 10, 2014). *The New O'Neill Passive House Retrofit*, PASSIVE HOUSE ALLIANCE U.S., <http://www.phius.org/media/W1siZiIsIjIwMTIvMDUvMDQvMTFfMDZiMzJfNzc3X0NhczVfU3RlZHIiMl9PX05laWxsX1Jlc19SZXRyb2ZpdEZJTkFMLnBkZiJdXQ?sha=0843d4cd> (last visited Dec. 10, 2014).

216. Royal Decree 235/2013 on the basic procedure for the energy efficiency certification of buildings. Real Decreto 235/2013, de 5 de abril, por el que se aprueba el procedimiento básico para la certificación de la eficiencia energética de los edificios (B.O.E., 2013, 3904) (Spain). Council Directive 2010/31/EU, art. 20, 2010 O.J. (L 153) 26.

217. *31 Ways to Make Your Funeral Home More Energy Efficient*, CONNECTINGDIRECTORS.COM (Aug. 22, 2013), <http://connectingdirectors.com/articles/41621-31-ways-to-make-your-funeral-home-more-energy-efficient>.

efficiency improvements in homes, offices, buildings and industry by 2020, through energy audits and retro-commissioning practices.<sup>218</sup>

The federal government adopted a number of laws from 1975 to 1980 that established educational efforts, financial incentives, and authorized the setting of efficiency standards and also made a significant investment in energy efficiency research & development and grants over the past 30 years.<sup>219</sup> More recently, new regulations establishing minimum efficiency standards for a wide range of household appliances and major types of equipment for the commercial and industrial sectors were adopted.<sup>220</sup> Furthermore, as will be explained, many states have implemented building energy codes, utility-based energy efficiency programs, and other policies to complement these federal initiatives.<sup>221</sup>

## 1. Methods of Enforcing Energy Efficient Policies

### *a) Mandatory Regulatory Measures*

In the U.S., codes and standards developed at the state and local levels provide a range of energy, environmental, and economic benefits to states and municipalities, and can be supported by utilities by helping with their implementation, integrating them into resource planning, and advocating for the adoption of more ambitious regulation.<sup>222</sup>

Energy codes in the U.S. regulate the residential and the commercial sectors separately. States, municipalities, and tribes across the U.S. may use any existing codes and adapt them to their specific needs.<sup>223</sup> The energy code which has been adopted by most states and municipalities, and applies to most residential buildings is the International Energy

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218. *EPA and DOE Join States to Speed Energy Efficiency Progress in the United States*, DEPARTMENT OF ENERGY (Feb. 2, 2010), available at <http://energy.gov/articles/epa-and-doe-join-states-speed-energy-efficiency-progress-united-states>.

219. NATIONAL ACADEMY OF SCIENCES, *REAL PROSPECTS FOR ENERGY EFFICIENCY IN THE UNITED STATES* (2010).

220. *Id.*

221. H. Geller, P. Harrington, R. Rosenfeld, S. Tanishima & F. Unander, *Policies for Increasing Energy Efficiency: Thirty Years of Experience in OECD Countries*, 556-573 *ENERGY POLICY* 34 (2006) [hereinafter *Geller*].

222. *Building Codes for Energy Efficiency*, *supra* note 147, at 1.

223. U.S. EPA and representatives from tribal nations and federal agencies have formed the Tribal Green Building Codes Workgroup, in March 2011. Kayenta Township (Arizona) is the first tribal community in the United States to adopt an international green building code. *Tribal Green Building Codes Workgroup*, EPA, <http://www.epa.gov/region9/greenbuilding/tribal-workgroup.html> (last visited May 22, 2014). Examples of this are the 2013 Energy Efficiency standards, in California or the mandatory San Francisco existing buildings energy performance Ordinance. *San Francisco: Building Efficiency Policy*, ALLIANCE TO SAVE ENERGY, (June 26, 2012), <http://www.ase.org/resources/san-francisco-building-efficiency-policy>.

Conservation Code (IECC),<sup>224</sup> which supersedes the Model Energy Code (MEC).<sup>225</sup> The federal Energy Policy and Conservation Act (EPCA) of 1992 requires states to review and adopt the MEC (and its successor, the IECC), or submit to the Secretary of Energy its reasons for not doing so. Most energy codes for commercial buildings are based on ASHRAE/IESNA Standard 90.1, jointly developed by ASHRAE and the Illuminating Engineering Society (IES).<sup>226</sup> The EPCA requires states to adopt the most recent version of ASHRAE Standard 90.1, which the DOE has determined will save energy. Alternatively, states can follow the commercial building provisions of the IECC.<sup>227</sup>

The primary national policy instruments developed to promote green building are: a) the “National Action Plan for Energy Efficiency Vision for 2025: A Framework for Change,” 2008,<sup>228</sup> and b) the Energy Efficiency and Conservation Block Grant (EECBG) Program, funded for the first time by the American Recovery and Reinvestment Act (Recovery Act) of 2009.<sup>229</sup> In addition to these federal actions, several states, mostly those on the East Coast and California, have developed energy efficiency measures and plans. This commitment to energy efficiency targets as a unique opportunity, not only to fight climate change but also as an economic driver to improve the quality of life. Recent studies estimate that cost-effective energy efficiency improvements in the U.S. building sector have the potential to reduce annual electricity and natural gas consumption by 20% to 30% over the next 10 to 15 years, saving more than \$100 billion annually for consumers and businesses.<sup>230</sup>

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224. The International Codes are also called I-Codes. The International Code Council is a member-focused association. It is dedicated to developing model codes and standards used in the design, build and compliance process to construct safe, sustainable, affordable and resilient structures. *About ICC*, INTERNATIONAL CODE COUNCIL, <http://www.iccsafe.org/AboutICC/Pages/default.aspx> (last visited May 22, 2014).

225. This code contains a complete set of comprehensive, coordinated building safety and fire prevention codes that include other specific codes like the International Building Code, the International Energy Conservation Code, the International Existing Building Code, the International Green Construction Code, the International Private Sewage Disposal Code, and the International Zoning Code, among others. *Building Codes for Energy Efficiency*, *supra* note 147, at 4.

226. *Building Codes for Energy Efficiency*, *supra* note 147.

227. *Id.*

228. *National Action Plan for Energy Efficiency Vision for 2025: A Framework for Change*, EPA (November 2008), <http://www.epa.gov/cleanenergy/documents/suca/vision.pdf>.

229. *Energy Efficiency and Conservation Block Grant Program*, CATALOG OF FEDERAL DOMESTIC ASSISTANCE <https://www.cfda.gov/index?s=program&mode=form&tab=core&id=1fb0162365c82d9b123b52ca3a6ce43f> (last visited Mar. 30, 2015).

230. Maggie Eldridge et al., *North Carolina's Energy Future: Electricity, Water, and Transportation Efficiency*, ACEEE, (2010), <http://cleanaircarolina.org/wp-content/uploads/2013/03/ACEEE-report-2010.pdf>. Hannah Choi Granade et al., *Unlocking Energy Efficiency in the U.S. Economy*, MCKINSEY & COMPANY, July 2009, <http://www.greenbuilding>

Energy codes that are well designed, implemented, and enforced have the potential to yield benefits related to energy use, the natural environment, and the economy, as a result of: (i) savings on energy bills, reducing peak energy demand, and improving system reliability; (ii) reducing air pollution and GHG emissions; and (iii) incentivizing greater investment in energy efficient capital equipment and creating new jobs in related industries such as equipment installation and compliance. In this manner, they are the most potent of all policies in reducing energy use from heating and cooling of buildings, but to-date have primarily targeted new buildings.

Legislation passed in 1976 that called for the adoption of national building energy efficiency standards, but the building industry opposed this policy, and it was eventually converted to voluntary guidelines and design tools.<sup>231</sup> Therefore, there is not a U.S. building code at national level, but, as indicated before, codes have been developed at the state and local levels, giving rise to heterogeneous regulations.<sup>232</sup> However, model codes such as the International Energy Conservation Code, are widely followed by states and localities that bring some uniformity to building energy codes.<sup>233</sup> In 1978, California became the first state to include energy requirements in its code; and as of 2015, sixteen states have yet to adopt a statewide residential code, or the adopted code is older or undemanding.<sup>234</sup> In many states, municipalities are very active and have their own code. In fact, some states may also allow local jurisdictions to adopt more stringent code requirements, and some cities are using codes to encourage innovative building practices to pave the way for new building technology.<sup>235</sup> For example: Massachusetts, the first state to adopt an above-code appendix to its state code, where 104 cities had adopted it by 2012;<sup>236</sup> Portland's Green Building Policy (adopted in 2001), which requires new construction and major renovations of all city facilities to

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lawblog.com/uploads/file/mckinseyUS\_energy\_efficiency\_full\_report.pdf.

231. Geller, *supra* note 221, at 563.

232. *Achieving Scale in the US: A View from the Construction and Real Estate Sectors*, THE ECONOMIST, INTELLIGENT UNIT 6 (2013), [http://www.gbpn.org/sites/default/files/06.EIU\\_US\\_Case Study.pdf](http://www.gbpn.org/sites/default/files/06.EIU_US_Case Study.pdf) [hereinafter *Economist*].

233. Geller, *supra* note 221, at 563-64.

234. Those states are AK, AZ, CO, KS, ME, MO, MS, ND, OK, SD, TN, UT, WI, WT, CO, ND, SD, KS, OK, MO, WI, TN, MS, ME, AK, as well as American Samoa and N. Mariana Islands. To check the status of the State Energy Code adoption of the building codes and standards, Building Energy Codes Program, go to: <https://www.energycodes.gov/status-state-energy-code-adoption> (last visited August 13, 2014). The status of building codes and standards may be checked at this site.

235. Levine, *supra* note 107.

236. *Id.* at 14-15.



meet the Certified level of LEED;<sup>237</sup> Austin's commitment to a zero-energy target for all new homes by 2015; and San Francisco's mandatory Green Building Code for new construction projects (adopted in 2008), which established strict guidelines for residential and commercial buildings.<sup>238</sup> Yet, among many states with codes, compliance levels still lag behind expectations.<sup>239</sup>

While most states in the U.S. have energy codes which apply to new buildings, not all apply such regulations to retrofits of existing buildings. This shortage of coherent regulation, combined with the lack of harmonization across states creates reluctance among investors in energy efficiency retrofiting.<sup>240</sup> Aware of the regulation's spread in this matter, the federal government's Climate Action Plan of July 2013 contemplated the formalization of a memorandum entitled "Implementation of Energy Savings Projects and Performance-Based Contracting for Energy Savings," inviting federal agencies, in support of the Better Buildings Challenge, to work together to synchronize building codes, leveraging those policies to improve the efficiency of federally owned and supported building stock.<sup>241</sup>

According to the 2014 International Energy Efficiency Scorecard of the ACEEE, the federal government should update national model building codes and provide technical assistance to states implementing and adopting energy efficiency building codes,<sup>242</sup> in both, new and existing building (when going through major renovation).

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237. *City of Portland – Green Building Policy and LEED Certification*, U.S. DEP'T OF ENERGY, <http://energy.gov/savings/city-portland-green-building-policy-and-leed-certification> (last visited June 11, 2014).

238. San Francisco's Green Building Ordinance inspired California's Building Standards Commission, which subsequently developed Title 24 Part 11, the California Green Building Standards Code, or "CALGreen." The Green Building Ordinance was updated in 2010 to combine the mandatory elements of the Standards Code with stricter local requirements, and merge them in Chapter 13C of the San Francisco Building Code, which requires green building standards to be met by: all newly constructed buildings (of any size or occupancy), and renovations to areas over 25,000 sq. ft. in existing buildings that are undergoing major structural upgrades and mechanical, electrical or plumbing upgrades. *Green Building Ordinance*, CITY AND CNTY OF SAN FRANCISCO, <http://sfdbi.org/green-building-ordinance> (last visited June 11, 2014).

239. *Levine*, *supra* note 107, at 11.

240. *Economist*, *supra* note 232, at 10.

241. *The President's Climate Action Plan*, EXEC. OFFICE OF THE PRESIDENT 11 (July 2013), <https://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf>, archived at <http://perma.cc/YP2C-97TQ>.

242. *Executive Summary: The 2014 International Energy Efficiency Scorecard*, ACEEE, (July 2014), <http://aceee.org/files/pdf/summary/e1402-summary.pdf>.

*b) Economic Instruments Building Energy Labeling*

U.S. rating and disclosure policy<sup>243</sup> is less expansive than in Europe. In fact there is not yet a mandatory energy label for buildings in the U.S., but research based on the voluntary rating and disclosure of U.S. buildings suggest that the U.S. marketplace is already factoring energy efficiency into its real estate decision-making.<sup>244</sup> Indeed, some labels that have been introduced in the market are yielding important results, like the Home Energy Rating System, ENERGY STAR for homes, and the U.S. DOE Home Energy Score. Also, commercial buildings have their own rating system with ENERGY STAR, ASHRAE, and green building ratings.

The **Home Energy Rating System (HERS)** is the most common home rating system in the U.S. and it is required for a home to qualify for an energy efficiency mortgage, for ENERGY STAR labeling, or for many other energy efficiency programs. As of today, more than one million U.S. homes have received a HERS score, many in conjunction with ENERGY STAR and federal new home tax incentives.<sup>245</sup>

The **ENERGY STAR for homes**<sup>246</sup> voluntary program helps businesses and individuals save money and protect the climate through superior energy efficiency. Any home, new or existing, that can be field verified to meet all EPA requirements for ENERGY STAR Certified Homes can earn the label. In 2010, 25% of single-family homes built in the U.S. earned the ENERGY STAR rating and in 2012, more than 101,000 new homes were added,<sup>247</sup> and 7,000 more in 2013.<sup>248</sup> The state

243. Residential energy rating and disclosure policies are a relatively new strategy in the U.S. for reducing energy consumption. Therefore, the language that is being used in order to explain its components is not yet very clearly established. According to the Earth Advantage Institute, energy rating and disclosure refers to the strategy that utilities and state and local governments are implementing to encourage an emphasis on energy efficiency and allow for the financial valuation of energy efficiency in the building sector – both residential and commercial. *Energy Rating & Disclosure for Pacific Northwest Homes*, EARTH ADVANTAGE INSTITUTE 5 (April 2013), [http://www.earthadvantage.org/assets/documents/Regional\\_Energy\\_Rating\\_26\\_Disclosure\\_-\\_130502\\_FNL.pdf](http://www.earthadvantage.org/assets/documents/Regional_Energy_Rating_26_Disclosure_-_130502_FNL.pdf).

244. Andrew Burr, Cliff Majersik, & Nick Zigelbaum, *The Future of Building Energy Rating and Disclosure Mandates: What Europe can Learn from the United States*, INSTITUTE FOR MARKET TRANSFORMATION 1 (2010), <http://www.imt.org/resources/detail/the-future-of-building-energy-rating-and-disclosure-mandates-what-europe-ca>.

245. *What is the HERS Index?*, RESIDENTIAL ENERGY SERVICES NETWORK, <http://www.resnet.us/hers-index> (last visited June 6, 2014).

246. *About ENERGY STAR*, ENERGY STAR, <http://www.energystar.gov/about/> (last visited June 6, 2014).

247. *Benefits of an Energy Star Home*, ESURANCE, <https://www.esurance.com/info/home-owners/benefits-of-an-energy-star-home> (last visited March 30, 2015).

248. *Which Cities Have the Most ENERGY STAR Certified Buildings?*, GREEN ECONOME (Apr. 24, 2014), <http://www.greeneconome.com/which-cities-have-the-most-energy-star-certified-buildings/>.

with the most certified new homes in 2012 was Texas, with 21,351 homes,<sup>249</sup> and the city with the highest number was Los Angeles, with a total of 443 certified buildings.<sup>250</sup> **ENERGY STAR Portfolio Manager**<sup>251</sup> and **ENERGY STAR Buildings & Plants**<sup>252</sup> are specific tools for commercial buildings. The first one is the most widely used benchmarking tool<sup>253</sup> in the U.S. It is the tool of choice among cities such as New York, Seattle, and Boston that have passed mandatory benchmarking laws, and it is used by the Canadian Government as the platform for their national energy-benchmarking program for existing commercial and institutional buildings. The **DOE Home Energy Score** allows homeowners to compare the energy performance of their homes to other homes nationwide, while providing homeowners with suggestions on how to improve their homes' efficiency. As of June 2014, 11,372 home energy scores have been completed in the U.S.<sup>254</sup>

**ASHRAE Building Energy Quotient (EQ)**<sup>255</sup> is a voluntary certification program for buildings that compares the building with an energy label to other buildings based on energy use intensity per square foot. The "in operation" EQ rating provides information about the energy use of an existing building to provide valuable insight into how the building performs and opportunities for improvement.<sup>256</sup> The **Green Building Rating** is a type of rating and labeling that is growing its presence in the U.S. with different programs. The most important one is Leadership in Energy and Environmental Design (LEED), administered by the U.S. Green Building Council (USGBC). It has 9 different

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249. 2013 *Energy Star Certified New Homes Market Share*, ENERGY STAR, <http://www.energystar.gov/index.cfm?fuseaction=qhmi.showhomesmarketindex> (last visited June 6, 2014).

250. 2015 *Energy Star Top Cities*, ENERGY STAR, <http://www.energystar.gov/buildings/topcities> (last visited June 6, 2014).

251. *PortfolioManager*, ENERGY STAR, <http://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager> (last visited Mar. 30, 2015) [hereinafter *PortfolioManager*].

252. *Building and Plants*, ENERGY STAR, <http://www.energystar.gov/buildings> (last visited Mar. 30, 2015).

253. Benchmarking is the process of comparing the energy performance of a building or building type to similar buildings or building types (see subsection IV.A of this Article).

254. *Home Energy Score*, U.S. DEPT. OF ENERGY, <http://energy.gov/eere/buildings/home-energy-score> (last visited June 6, 2014).

255. What is *BEQ*?, BUILDING ENERGY QUOTIENT, <http://buildingenergyquotient.org/what-is-beq.html> (last visited June 6, 2014).

256. ASHRAE BUILDING ENERGY LABELING PROGRAM, IMPLEMENTATION REPORT, BUILDING ENERGY QUOTIENT: PROMOTING THE VALUE OF ENERGY EFFICIENCY IN THE REAL ESTATE MARKET (June 2009), available at [http://www.unep.org/sbci/pdfs/Paris-ASHRAE\\_briefing.pdf](http://www.unep.org/sbci/pdfs/Paris-ASHRAE_briefing.pdf).

categories,<sup>257</sup> and one of them is the LEED for Existing Buildings: Operations & Maintenance (LEED-EB). There are around 7,500 LEED-EB certified buildings in the U.S.<sup>258</sup>

Interestingly, according to the USGBC, approximately 61% of all construction projects are retrofit projects, and the market share of retrofit projects that are green is expected to rise to 20-30% in 2014. By 2015, approximately 61% of all construction projects are expected to be retrofit projects and the green share of the largest non-residential retrofit and renovation activity is expected to more than triple that figure.<sup>259</sup> Furthermore, LEED is also becoming international. In 2013, approximately 42% of square footage pursuing LEED certification existed outside the U.S. Indeed, as of April 2013, the number of registered and certified LEED projects in the world was significant: 44,998 (North America), 1,704 (Latin America), 1,706 (EU), and 1,297 (Middle East and North Africa). Of these regions, ten countries have the most registered and certified LEED projects: U.S. (44,270), Canada (4,212), China (1,156), United Arab Emirates (808), Brazil (638), India (405), Mexico (322), Germany (299), Turkey (194), and Republic of Korea (188).<sup>260</sup>

Also, several major U.S. cities are currently implementing building benchmarking and disclosure policies including: NYC, Washington, D.C., Seattle, San Francisco, Austin, Philadelphia, and Chicago, as well as some states like California, New York, and Washington. In NYC, the Greener, Greater Buildings Plan (GGBP)<sup>261</sup> requires owners of large buildings to annually measure their energy consumption. Local Law 84<sup>262</sup> standardizes this process and captures information using the U.S. EPA online benchmarking tool known as the PortfolioManager.<sup>263</sup> In the U.S., the top

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257. New construction (LEED-NC); Existing Buildings (LEED-EB); Commercial Interiors (LEED-CI); Core & Shell (LEED-CS); Schools (LEED for Schools); Retail (LEED-NC Retail); Health care (LEED-HC); Homes (new construction, LEED for homes); and Neighborhood Development (LEED-ND).

258. *Projects*, U.S. GREEN BLDG. COUNCIL, <http://www.usgbc.org/projects/existing-buildings> (last visited June 7, 2014).

259. *Green Building Facts*, U.S. GREEN BLDG. COUNCIL (Feb. 23, 2015), <http://www.usgbc.org/articles/green-building-facts> (last visited June 7, 2014) [hereinafter *Green Building Facts*].

260. *Top 10 Countries for LEED*, U.S. GREEN BLDG. COUNCIL (May 5, 2014), <http://www.usgbc.org/articles/top-10-countries-leed>.

261. *Greener, Greater Buildings Plan*, PLAN NYC, GREEN BUILDINGS & ENERGY EFFICIENCY, <http://www.nyc.gov/html/gbee/html/plan/plan.shtml> (last visited June 13, 2014).

262. *LL84: Benchmarking*, PLAN NYC, GREEN BUILDINGS & ENERGY EFFICIENCY, <http://www.nyc.gov/html/gbee/html/plan/ll84.shtml> (last visited May 22, 2014).

263. PortfolioManager is the industry-leading, no-cost online tool that lets benchmark, track, and manage energy and water consumption and greenhouse gas emissions against national averages. *PortfolioManager*, *supra* note 251.

10 states for LEED, as of February 2014, were California, Texas, New York, Florida, Pennsylvania, Illinois, Virginia, Maryland, Georgia, and Washington, in that order.

The Institute for Market Transformation conducted three interesting benchmarking case studies that led to significant energy use reduction, using the EPA's PortfolioManager tool: i) Mercer Court in Capitol Hill, Seattle, in which 40% lower energy use in one year was observed; ii) Ten Penn Center Downtown in Philadelphia, in which the buildings tenants saved more than \$300,000 on electricity costs in 2011; and iii) Franklin Square Downtown in Washington, D.C., in which, thanks to benchmarking, the real estate company was able to bring down energy consumption in the building by 6 million kilowatts per hour per year, and push its ENERGY STAR score from 77 up to 89.<sup>264</sup>

By industry, the three sectors with the highest penetration of Green Building ratings are: 1) education, 2) health care, and 3) office.<sup>265</sup>

The **Federal Energy Management Program** (FEMP) is operated by the U.S. government to improve energy efficiency in federal facilities. Some Executive Orders beginning in 1991 instructed federal agencies to reduce their energy use per square foot or floor space<sup>266</sup>. In order to accomplish this, the FEMP provides technical assistance, training, and help with innovative approaches, such as ESCOs and performance contracts, to project financing and implementation.<sup>267</sup>

### *c) Financial Instruments and Incentives*

Direct payments and incentives (mostly tax credits and rebates) or low-cost financing play a key role in driving homeowners and businesses in the U.S. to invest in energy efficiency. There are several common instruments used in the U.S. for that purpose.

**Utility and ratepayer-funded programs** account for the bulk of incentives for improved building energy performance in the U.S.<sup>268</sup> Moreover, the investment in efficiency programs has more than tripled since 1998, mainly targeting residential and commercial buildings, which

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264. *Energy Benchmarking: Case Studies*, INST. FOR MKT. TRANSFORMATION, <http://www.imt.org/policy/building-energy-performance-policy/case-studies> (last visited June 3, 2014).

265. *Green Building Facts*, *supra* note 259.

266. *Real Prospects for Energy Efficiency in the United States*, AMERICA'S ENERGY FUTURE ENERGY EFFICIENCY TECHNOLOGIES SUBCOMMITTEE, available at [http://www.nap.edu/openbook.php?record\\_id=12621&page=277](http://www.nap.edu/openbook.php?record_id=12621&page=277)

267. *Geller*, *supra* note 221, at 566.

268. *Levine*, *supra* note 107, at 32.

received the largest share of program funds.<sup>269</sup> Much of the increase of these programs is attributed to the proliferation of state-level regulatory commitments to energy efficiency, especially through the “energy-efficiency resource standard” (EERS or EEO) that is in place in the majority of U.S. states. It establishes specific, long-term targets for energy savings that utilities or non-utility program administrators<sup>270</sup> must meet through customer energy efficiency programs. An EERS can apply to either electricity or natural gas utilities, or both, depending on the state, and can be adopted through either legislation or regulation.<sup>271</sup>

Also, **rebates** are commonly used to reduce the initial cost of energy-efficiency investment, encouraging higher levels of investments in the market. At first, these programs focused on high efficiency appliances and equipment, but now they are targeting a comprehensive approach seeking better building performance.

In the residential sector, the U.S. EPA has developed **ENERGY STAR utility programs incentive structures** for new and existing home retrofit markets, such as tiered incentives, equipment incentives, rating incentives, and homeowner discounts. Specifically for existing homes, the ENERGY STAR Home Performance (HPWES), offers whole-house solutions to high-energy bills and homes with comfort problems. The assessment includes the heating and cooling systems, windows, insulation, flow of air into and out of the house, as well as a safety check of gas appliances.<sup>272</sup> Since 2002, over 330,000 homeowners have improved their homes’ efficiency with whole house solutions to improve comfort and indoor air quality while reducing energy bills.<sup>273</sup>

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269. The consortium for Energy Efficiency report indicated that electricity program budgets were split among commercial and industrial efficiency programs by 39%, residential efficiency programs by 23% and low-income programs by 8%. In the case of gas programs, 41% of the budget was directed to the residential sector followed by low-income with 27% and then the commercial and industrial sectors, with a share of 24%. *Levine, supra* note 107, at 28.

270. Leading States identified in the American Council for an Energy Efficient Economy’s (ACEEE) State Energy Efficiency Scorecard have incorporated energy efficiency into their utility sector and/or public benefits programs, including robust spending on efficiency, high levels of energy savings, aggressive energy savings targets, and supporting policies to remove disincentives to utilities and to reward utilities for meeting goals. These states are: Vermont, credited in February 2014 by President Obama as “a National energy-efficiency model”; “California and Massachusetts, *Incentivizing Utility-Led Efficiency Programs*, ACEEE, <http://aceee.org/sector/state-policy/toolkit/utility-programs> (last visited June 7, 2014).

271. *Energy Efficiency Topics*, ACEEE, <http://aceee.org/topics/eers> (last visited June 7, 2014).

272. *About Home Performance with Energy Star*, ENERGY STAR, [http://www.energystar.gov/index.cfm?c=home\\_improvement.hpwes\\_sponsors\\_about](http://www.energystar.gov/index.cfm?c=home_improvement.hpwes_sponsors_about) (last visited June 7, 2014).

273. *Home Performance with Energy Star*, ENERGY STAR, [https://www.energystar.gov/v/index.cfm?fuseaction=hpwes\\_profiles.showsplash](https://www.energystar.gov/v/index.cfm?fuseaction=hpwes_profiles.showsplash) (last visited June 7, 2014).

In the commercial sector, ENERGY STAR has recently launched a Building Performance program (BPwES). It is designed to help utilities and energy efficiency program sponsors engage their business customers and local trade allies in an ongoing relationship centered on strategic energy management and a path to help businesses meet efficiency program goals through persistent savings in commercial buildings.<sup>274</sup>

Owners and designers of new and existing energy-efficient residential and commercial buildings may seek **tax incentives** and qualify for tax deductions under the Energy Policy Act of 2005. Non-tax rebates for energy efficiency measures are more common in the U.S. than tax incentives. However, federal tax incentives are considered to be especially successful for energy efficient appliances in both commercial and residential sectors. Residential retrofitting accounted for most of the credits in windows, insulation, and exterior doors. For commercial buildings, most credits were granted for deductions in energy use for lighting.<sup>275</sup>

Up-front costs continue to be high even with the incentives, which have proven to be sufficient to meet the needs for building retrofitting. Therefore, **innovative financial mechanisms** are essential to overcome the energy improvement costs while complementing the incentives with other programs. During the last decades, some innovative energy-efficiency financing programs have emerged helping reduce the up-front costs of improvements. The most prevalent mechanisms in the U.S. are as follows:<sup>276</sup>

- *EPCt implemented by an ESCO*: With the traditional ESCO using an EPCt (a partnership between a federal agency and an ESCO), the initial cost of the investment (e.g. equipment) has to be funded by the host customer; especially if it is in the MUSH market, as they have easier access to funding.<sup>277</sup> During its first stages in the U.S., EPCts were popular in the MUSH market, and in recent years it has expanded to federal projects, though it remains less common in the

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274. *Building Performance with Energy Star*, ENERGY STAR, [http://www.energystar.gov/index.cfm?c=eeps\\_guidebook.eeps\\_building\\_performance](http://www.energystar.gov/index.cfm?c=eeps_guidebook.eeps_building_performance) (last visited June 7, 2014).

275. Karsten Neuhoﬀ et al., *Financial Incentives for Energy Efficiency Retrofits in Buildings*, ACEEE SUMMER STUDY ON ENERGY EFFICIENCY IN BUILDINGS 8-238 (2012), available at <http://aceee.org/files/proceedings/2012/data/papers/0193-000422.pdf>.

276. Charlotte Kim et al., *Innovations and Opportunities in Energy Efficiency Finance*, WILSON SONSINI GOODRICH & ROSATI 4-10 (May 2012), <https://www.wsgr.com/publications/PDFSe arch/WSGR-EE-Finance-White-Paper.pdf> [hereinafter *Kim*].

277. *Energy Savings Performance Contracts*, U.S. DEPT. OF ENERGY, <http://energy.gov/eere /femp/energy-savings-performance-contracts> (last visited June 11, 2014).

private building sector.<sup>278</sup> The ESCO guarantees that the improvements will generate energy cost savings over the term of the contract (up to twenty-five years). After the contract ends, all additional cost savings will correspond to the agency.<sup>279</sup>

- *Energy Services Agreement (ESA) and Managed Energy Services Agreement (MESA) models*: With these mechanisms, the customer does not have to pay up-front the cost of the project, and instead, the customer enters into an ESA or a MESA with an energy service provider that will finance 100% of the improvement. The service provider owns the energy efficiency improvement, which is progressively paid through the energy service. The building owner, hence, can avoid the expensive initial payment of the project.<sup>280</sup> These models are particularly suited for larger energy efficiency projects rather than small-scale ones.
- *On-bill financing & repayment models (OBF/OBR)*: They are programs in which the customer pays the utility's improvement through a monthly energy bill, usually serviced by a utility company. The programs can be tailored to the industrial, commercial or residential sector. As of December 2011, at least twenty states in the U.S. are home to utilities that have implemented or are about to implement on-bill financing programs, many of which have legislation in place that support or require its adoption.<sup>281</sup> Advantages of on-bill programs include: the convenience of a single bill for customer; the perception of a secure investment; the capacity to leverage a unique relationship between the utility and the customer, allowing easier ways to pay back the cost of the energy efficiency improvements; and creating potential for customers to gain access to financing through modified underwriting that takes bill payment history into account. However, they still face some challenges, like upfront costs to utilities, risk on payments of the finance charge,

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278. Somik Ghosh, Deborah Young-Corbett, & Suchismita Bhattacharjee, *Barriers to the Use of ESPC in the Private Building Sector: Perception of the A/E/C Commune*, ASSOCIATED SCHOOLS OF CONSTRUCTION 1-3 (2011), <http://ascpro.ascweb.org/chair/paper/CPGT299002011.pdf>.

279. *The FDIC's Compliance with Energy Management Requirements, Office of Audits and Evaluations Report No. EVAL-13-003*, OFFICE OF INSPECTOR GENERAL 17 (2013), <http://www.fdic.gov/reports13%5C13-003EV.pdf>

280. Kim, *supra* note 276.

281. Catherine Casey J. Bell, Steven Nadel, & Sara Hayes, *On-Bill Financing for Energy Efficiency Improvements: A Review of Current Program, Challenges, Opportunities, and Best Practices*, ACEE iii (Dec. 8, 2011), available at <http://aceee.org/research-report/e118>.



handling the transfer of property, finding capital, and addressing non-utility fuels.<sup>282</sup>

- *Property-assessed Clean Energy Financing (PACE)*: It is a local government and community voluntary initiative that allows property owners to fund energy efficiency, water efficiency, and renewable energy projects with little or no up-front costs through an assessment on their property tax bills for up to twenty years.<sup>283</sup> It eliminates up-front costs, providing low-cost, long-term financing and making it easy for building owners to transfer repayment obligations to a new owner upon sale, thereby overcoming challenges that have hindered adoption on energy efficiency projects in buildings. This mechanism has been used nationwide for decades since its introduction in pilot programs in 2008. As of 2014, 31 states and the District of Columbia have adopted legislation that enables local governments to offer PACE benefits to building owners.<sup>284</sup>

## 2. Summary and Conclusions

Given the amount of information provided, a summary at this point could be helpful to draw some conclusions that reveal possible improvements to U.S. energy efficiency measures. Ultimately, the intention of this article is to find new ways to advance the U.S. experience based on best practices in the EU and create a list of recommendations (depicted in section VI) aimed at improving the energy efficiency of the U.S. existing building stock.

**First, there is great potential for energy saving in the existing building stock.** There is a particularly cost-effective market for energy efficiency measures to be implemented in buildings, but the building industry is just starting to become conscious of the real economic and environmental opportunities. Energy efficiency measures are currently designed and implemented primarily for new buildings, even though most of the potential is in the existing building stock as most buildings in cities are more than fifty years old. Transforming the built environment into a more efficient one is perceived as being very demanding, complex, and costly. However, the building industry is evolving to recognize the economic and environmental capabilities of the built environment.

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282. *Id.*

283. *Property Assessed Clean Energy (PACE) Programs*, CENTER FOR SUSTAINABLE ENERGY, <http://energycenter.org/policy/property-assessed-clean-energy-pace> (last visited June 7, 2014).

284. *What is PACE Financing?*, PACENOW FINANCING FOR THE FUTURE, <http://www.pacenow.org/about-pace/> (last visited June 7, 2014).

Second, energy efficiency measures should be aimed at any or all of the following subjects.

- To improve exterior construction characteristics, the buildings, whatever their specific characteristics, should make them more adequate for their specific climate and even energy self-sufficient. These measures usually need to be accompanied by changes in the zoning regulations, in order to remove impediments to retrofitting.
- To improve interior energy efficiency, measures should be aimed at the advancement of the energy performance of the building equipment (mainly for heating, cooling, lighting, and appliances).
- Tenants and/or owners should make improvements in appliance use and should work toward overcoming obstacles to action, mainly knowledge of the problems and the split incentive problem, with informative measures.
- Interested third parties should promote measures aimed at involvement and collaboration of both the public and private sectors. The government may use its full authority to encourage energy efficiency improvements in the building stock. It is the duty of the public sector to take the lead. Meanwhile, civil associations can mobilize local people through consciousness campaigns and by demanding a stronger commitment to the climate change fight from public authorities.

**Third, there are some difficulties to the development of the energy efficiency measures.** Energy efficiency targets are established by governments (either at international, regional, national or local levels), but implementation is only possible with the collaboration of the public and private sectors. The private sector still finds some market barriers towards energy efficiency investment. Additionally, deep renovation is not the only a technical challenge. The real obstacles are financial, legal and political. Indeed, one of the most complex problems is the so-called “split incentive” problem, in which a person who invests in energy efficiency does not perceive the energy savings. Well-targeted policy packages with clear information about the financial benefits for each of the parties involved should be put in place.

Most governments develop energy efficiency measures targeting specific problems of buildings and undertaking just a partial energy

renovation. A more structured and comprehensive approach is more economically and environmentally efficient. There is a need to combine the different instruments and adapt them to the national or regional specificities and needs of the different market segments.

None of the measures implemented by the public sector can achieve energy efficiency targets themselves. Incentives are limited resources and cannot be sustained indefinitely; also, they do not solve the problem of financial credibility. Additionally, they are a partial leverage for a project, as it also needs to accomplish other issues such as technical assistance. Therefore, public/private collaboration is the only way to green the existing building stock.

There is not one effective solution for the energy efficiency challenge. Instead, an array of instruments, defined by public and private initiative, need to be addressed and combined when adapting to the particular needs of the stakeholders and specific problems of the built environment. The prevalence of some measures over others will be conditioned by the specificities of the nation/city (climatic, economic, political, cultural, and even individual behavior) as well as by the particular characteristics of the building. Therefore, the benchmark study is essential in order to arrive at the most effective package of measures.

**Fourth, more information on the existing measures, especially regulatory, and more stringent compliance are necessary to improve the energy performance of the existing building stock.** There are four main energy efficiency policy instruments: regulatory, economic, financial and informative/voluntary. Their distribution between the two studied regions (U.S. and EU) is diverse, but both need all four policy instruments to achieve their respective energy efficiency targets. Therefore, successful targets depend on the most convenient combination of measures in each particular case.

#### a) Regulatory Instruments

*Regulatory instruments* (energy codes and standards) are very effective if they are enforced and controlled. Strengthening building code requirements for energy performance, together with other policies to encourage efficiency, has already contributed to total building energy use trends stabilizing or even slowing down.

**In Europe**, almost all member states have building codes, but more than half lack specific regulation on technical issues regarding the existing building stock, and, if existent, they apply to a specific scope or refer to a particular requirement. Also, compliance is consistent among member states. However, the most important regulations in the EU for the built

environment have been established with Directives, although implementation varies among countries. New standards like the EEO are helping fill the gap created by building code regulation, but they are used in the U.S. more frequently than in the EU. More common in the EU are EPCs, which are used as a mandatory performance label that allows comparison among buildings in member states.

Energy efficiency regulation **in the U.S.** is patchy, confusing, and inconsistent. Building codes and other policies differ between states, and sometimes even within them. This leads to suboptimal situations, as most companies have to manage the adoption of energy efficiency measures at the building level rather than at the portfolio level, which would be much more productive. This is despite the benefit that some building codes are yielding in cities that are committed to climate change action like San Francisco or New York City.

#### b) Economic Instruments

*Economic instruments*, mainly labels in the EU, such as legislative or informative measures like EPCs or comparative performance labels, have been used to harmonize information about the energy performance of a building among member states. However, given the responsibility of member states with regard to their implementation and effectiveness, the results among them are very heterogeneous. In all, the building energy labeling instrument in Europe needs to be, first, strengthened; and second, complemented with other measures in order to achieve the energy efficiency 2020 target. Flexibility in its implementation, where needed, along with an increasing participation by the main stake-holders in the process, has brought good results in the EU.

There is not yet a mandatory label in the U.S., but rating labeling programs are generating a high level of interest and are viewed as trusted sources of information. They are, hence, increasingly influencing purchase and retrofitting decisions. Labeling programs are essential in the commercial sector and are a growing presence in the residential sector, particularly in new homes. However, some labels created in the U.S., like LEED, are widely used and are becoming a hallmark of energy efficiency in buildings all around the world.

#### c) Financial Instruments

*Financial instruments* are very effective when high capital costs limit energy efficiency investments. In the EU, loans and tax incentives are the most common. Less common are white certificates (EEO), audits, third-party financing (through ESCOs), and Fits (for integration of renewables).

White certificates tend to incentivize low cost, mass-market measures rather than deep retrofits; therefore, this approach may not be best suited to future policy objectives.

In the U.S., the most common instruments developed at all levels are the utility and ratepayer funded programs and the rebates. In both regions, innovative mechanisms are being developed with great interest and success, like PACE in the U.S., or different types of grants and subsidies, like tax credits in the EU.

*d) Voluntary Actions and Information*

*Voluntary actions and information* can be effective when regulations are difficult to enforce. In any case, they are aimed at supporting other policies. Communication and organizational instruments are clearly supporting tools, but, nevertheless, are necessary to address knowledge and implementation barriers. Energy performance disclosure, which is especially important for existing buildings, should be mandatory to help achieve widespread market transparency. Also essential for institutional investors to participate in energy efficiency projects is the standardization of existing data on the energy and financial performance of projects.

Policy Instrument		GOOD PRACTICE	BAD PRACTICE
<b>Regulatory</b>	US	At state level	Consequence: heterogeneous/inconsistent regulation among states
	EU	Homogeneous regulation among member states due to Directives	Heterogeneous implementation and control
<b>Labels</b>	US	Voluntary programs are very effective: LEED is an energy efficiency worldwide hallmark	Not mandatory
	EU	Minimum requirements among member states by Ecodesign Directive	Heterogeneous implementation and control
<b>Incentives</b>	US	Utility programs & rebates Innovative PACE & EEOs	Centered in single elements of the building
	EU	Grants & Tax incentives	ESCO heterogeneous use among member states
<b>Voluntary actions</b>	US	State and local actions	Energy performance disclosure not mandatory
	EU	Homogeneous regulation among member states by EPBD	Heterogeneous implementation and control

The review on energy efficiency measures developed in both the EU and the U.S. presented here may help arrive at specific conclusions in order to better define the necessary actions for the improvement of those already carried out in the U.S. This is assessed below.

#### VI. GENERAL RECOMMENDATIONS FOR THE ENERGY IMPROVEMENT OF THE U.S. EXISTING BUILDING STOCK

The interesting and sometimes very effective measures have been conducted in the US for the energy improvement of its building stock. However, there is always room for betterment. EU practice, as shown by the previous analysis, propose the following improvements on the US performance.

**First**, strengthening national model building codes, assuring more homogeneity in the regulatory package, and establishing a general framework setting out minimum requirements for energy efficiency measures in the existing building stock might assist market incumbents in their respective tasks.

Making regulations more effective should include rigorous updating of standards to promote the development, and use of new and efficient technology; announcing new codes and standards early so industry can prepare for more stringent codes; increasing training; demonstrating the feasibility of constructing progressively more efficient buildings that are cost effective; developing consistent mandatory regulation with increasing and effective penalties for those who do not comply with it, to help the energy efficiency market investment; and setting up accurate and accessible information, as well as rigorous compliance. This way, the energy efficiency process will become more mechanical, hence, easier to establishing a program of action and simpler, resulting in lower costs and easier for compliance.

**Second**, energy labels for home appliances have been very effective and appreciated by the general public as they are easily recognizable. The next clear step in the U.S. is to move towards a labeling requirement. The labels should be mandatory, the phase for voluntary labels has been overcome; clear, reflecting homogeneous information and easy to understand for the general public); flexible, which could be accomplished with gradual energy efficiency indicators (e.g. A+, A++, A+++, etc.); and strengthened, the label should need to be updated according to technological improvements.

**Third**, there are a great variety of financial mechanisms and alternative measures to reduce end-use energy consumption. Opting for one or the other, or for a specific combination of them, is conditioned by

the particularities of each region or nation. The key here is, therefore, to find the best combination of measures to suit each idiosyncrasy (e.g. any type of tax will be subject of controversy in most U.S. states whereas in Europe, they are more common and widely accepted). Here are some recommendations.

A combination of different financial instruments (subsidies, EEOs, Fits, etc.) appropriate to each culture should be used to offset the high capital cost of projects. A carbon tax should be imposed on the use of carbon-based energy by households, according to income levels. Other financial instruments, such as grants, subsidies, deferred payments (or any other innovative instrument that might eventually arise) should be considered in order to help overcome the added operational and maintaining costs of the building, especially for low-income households. Additionally, subsidies for investment in cleaner energy technologies should be put in place (Fit measures).

**Fourth**, informative actions include several options. Informative measures need to complement the mandatory ones. Furthermore, educational campaigns are necessary to guide the behavior of stakeholders, especially tenants, since they use the home appliances; and a mandatory Energy Efficiency Certificate Register could help the general public and technical experts understand buildings' level of compliance. The public sector should take the lead.

**Fifth**, voluntary actions must be deployed to complement other measures, but clear informative campaigns are required to be effective.

**Sixth**, public-private sector collaboration is necessary. The public sector, again, must set the standards.

**Finally**, all measures should be complementary. Enforcement of existing thermal regulations (switching to cleaner fuels), and implementation of subsidies and economic instruments like the Energy Performance Certificate for homes and for appliances have been proven very effective. Improvement in space cooling could be achieved with a mandatory energy label and helped by the use of vernacular buildings refurbishment like lowering heat loads by using shading devices or improving the insulation of roofs and ventilation systems (which are better if natural). Enforcement of existing regulations for appliances and lighting is key to accomplishing energy efficiency goals and buildings and their energy infrastructure need to be designed, built, and used taking into account culture, norms, and occupant behavior. Technology can improve vernacular designs.

Ultimately, the analysis of the experiences that are being developed in Europe regarding the energy improvement of the existing building

stock, in particular in the residential sector, indicates that some recommendations could be addressed to enhance that policy. Those proposals can be summarized in a table, as follows:

Type of Measure	Recommendation
<b>Regulation</b>	Linked to technological improvements Clear and accessible to general public Enforced and controlled
<b>Economic instruments</b>	Mandatory Clear (homogeneous information and easy to understand) Flexible Followed-up according to technological improvements
<b>Financial measures</b>	Carbon tax on the use of carbon-based energy by households, according to income levels Other measures to help overcome the added costs (subsidies, etc.) Subsidies for investment in clear energy technology
<b>Informative actions</b>	Educational campaigns A mandatory energy efficiency certificate Register
<b>Voluntary actions</b>	Passive House standards for major renovations Informative measures are key for voluntary actions
<b>For all measures</b>	A combinations for different measures is necessary All measures should be complementary
<b>Public-private collaboration</b>	The public sector should take the lead





