CLIMATE CHANGE, COMING SOON TO A COURT NEAR YOU

REPORT SERIES PURPOSE AND INTRODUCTION TO CLIMATE SCIENCE

DECEMBER 2020

ASIAN DEVELOPMENT BANK

ADB

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ISBN 978-92-9262-498-9 (print); 978-92-9262-499-6 (electronic); 978-92-9262-500-9 (ebook)
Publication Stock No. TCS200346-2
DOI: http://dx.doi.org/10.22617/TCS200346-2

Notes:
In this publication, "$" refers to United States dollars.
All photos are by ADB unless otherwise specified.

Cover design by Gayle Certeza, Daniel Desembrana, and John Michael Casipe.

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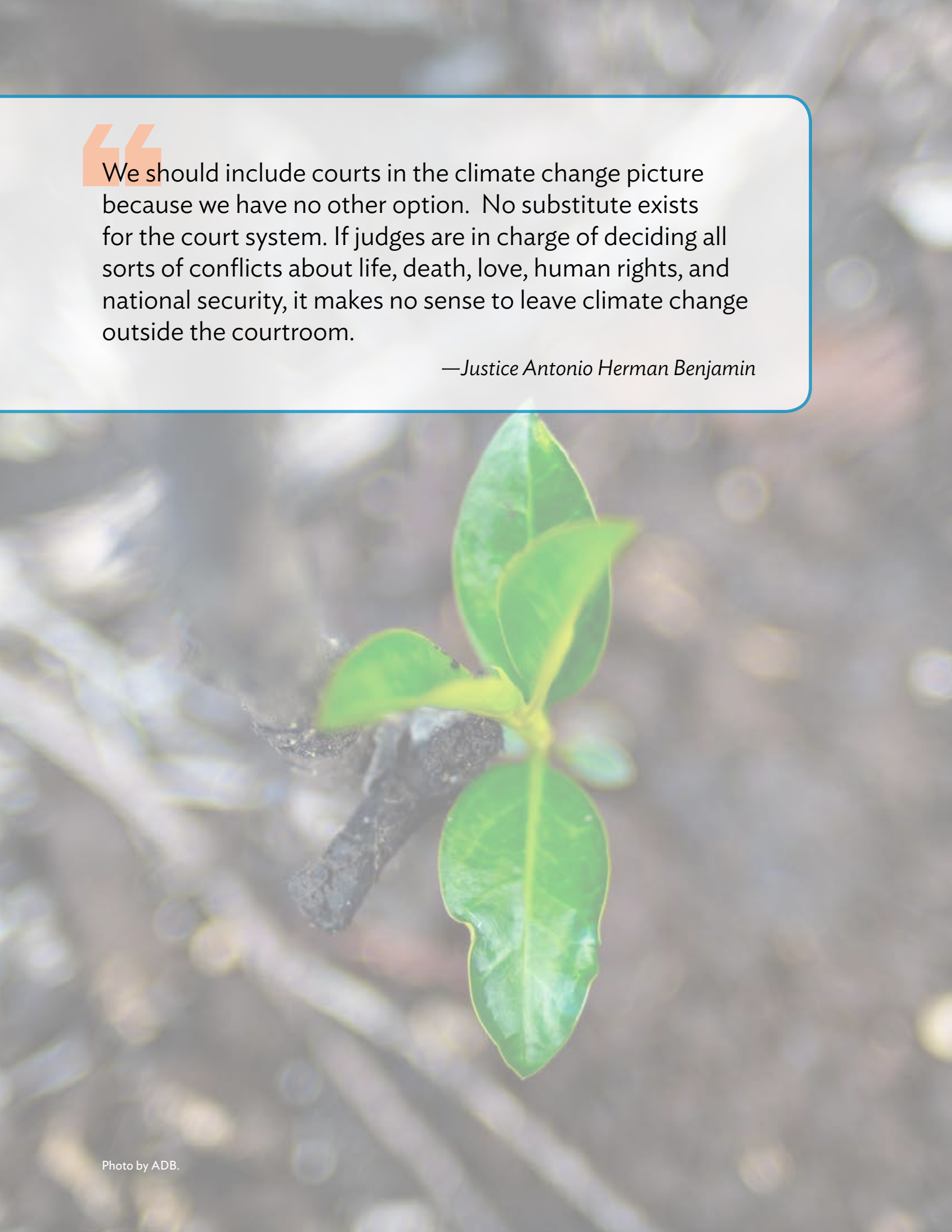


> We should include courts in the climate change picture because we have no other option. No substitute exists for the court system. If judges are in charge of deciding all sorts of conflicts about life, death, love, human rights, and national security, it makes no sense to leave climate change outside the courtroom.
>
> —*Justice Antonio Herman Benjamin*

Photo by ADB.

FOREWORD

CLIMATE CHANGE AND JUDGES

Climate change poses the most urgent existential challenge of our lifetime—not only for humanity's survival and protection of the planet's biodiversity, but also for the proper functioning of the Environmental Rule of Law. Our global climate's accelerating volatility—with its adverse impacts on ecosystems, vast landscapes, and human health and dignity—is transforming how lawyers and judges address Environmental Law's traditional principles, objectives, instruments, and institutions. From an institutional point of view, the climate crisis fundamentally affects the way we perceive the role of courts in natural resource disputes.

Judges are trained and work in boxes of legal knowledge, practical expertise, and jurisdiction. The "little world" of a judge is one of unavoidable boundaries: political and judicial arenas that fragment ecological spaces instead of respecting them.

Climate change profoundly modifies these ancient premises and rattles judges' comfort zones. Some perceive the subject matter of climate protection—the atmospheric common good, ecosystem services, and intergenerational values—as extending beyond the jurisdiction of local courts. In fact, judges may feel that climate issues reside outside the sovereign borders of national courts. Particularly in respect to the planet's climate, the material good—the atmosphere as a whole—is one that just a few decades ago, following the lessons of Roman law, was considered alien to the categories addressed by domestic legislation.

It is also disturbing to judges that, while those who need protection and would benefit from judicial measures taken to address climate change are spread across the world, only a fraction might live within their jurisdiction. The same applies to the causes of climate change—perpetrated in large part by seemingly faraway activities and actors. Even more complicated for the generalist judge is the inability to see, touch, hear, or directly know the subject of the case. Although intangible categories are not unknown in the judicial context, the more this "physicality" is weakened or dissipated, the more ordinary judges begin to think that the conflict should be decided by someone else or somewhere else.

The climate crisis poses even greater judicial complication when we realize that many countries still do not have comprehensive or effective environmental laws. In others, judges may lack jurisdiction over the whole spectrum of environmental matters. Or, worse, when they can exercise authority, judges may lack the independence, knowledge, or integrity to discharge their responsibilities properly. In other words, although the biodiversity and climate change crises are universal, environmental law and adequate access to courts and justice are not. People in developed countries with robust democratic systems take fair and effective environmental adjudication for granted. For a large portion of the world, however, fundamental access to justice cannot be assumed. Sadly, those large areas are frequently home to rich biodiversity hot spots and tropical forests in desperate need of judicial enforcement.

Therefore, we may fairly raise the question: should we expect—and trust—courts to address climate change? Despite the above difficulties, my qualified answer is yes, for at least four pragmatic, legal, ethical, and policy and/or institutional reasons.

First, the pragmatic argument. We should include courts in the climate change picture because we have no other option. No substitute exists for the court system. If judges are in charge of deciding all sorts of conflicts about life, death, love, human rights, and national security, it makes no sense to leave climate change outside the courtroom. This assumption does not mean that we do not recognize the enormous differences between climate and "regular" environmental cases. However, the lack of other or better alternatives makes courts an inevitable choice.

Second, it would not be reasonable to entrust Environmental Law to judges, as we already do globally, without including climate change. At the end of the day, many key parts of nature—biomes, ecosystems, species, and genetic diversity—and the human environment will be directly and perhaps irreversibly affected by climate change. For obvious reasons, the exclusion of climate cases would handicap and ossify environmental jurisdiction, transforming it into a body without its heart and preventing the legal system's evolution in a world of rapid transformations. Climate change is already affecting and will continue to affect not just Environmental Law. It will also impact most, if not all, legal disciplines that compose the conventional field of judicial intervention—from constitutional to tax and insurance law, from civil and administrative liability to criminal law, and from family to international and civil procedure law. In other words, if climate change is not allowed to enter the courtroom through the front door (Environmental Law), it will undoubtedly invade the judicial sanctum through the back door.

Third, except for a few areas of law (contracts, for example), judges are merely part of the solution for social problems; even then, they are not the only or even the best option. Courts do not replace the constellation of actors and measures in the climate change domain—both national and international. They complement whatever is in place. Some judges may see this role as a second-class type of judicial intervention, one filled with humility (not a widespread characteristic in the profession) as opposed to the ordinary exercise of jurisdiction in which judges have the final and most authoritative word on any complaint brought before them. That misguided but understandable sentiment fails to grasp judges' role in contemporary society as one that is not uniform for all aspects of human conflicts.

Fourth, the position of judges in climate adaptation is much less daunting than in climate mitigation. Take, for instance, the thousands of cases around the world where judges are already dealing with permits, environmental impact assessments, protected areas, deforestation, water resources, wetlands, and desertification. Is it really defensible to keep addressing those legal issues without taking into account the impacts of climate change? Can a judge decide an objection to a permit for building a hotel resort in the middle of endangered mangroves without considering sea level rise due to climate change? Or adjudicate a case of significant deforestation in a region that is already suffering from growing water stress?

None of these reasons ignore or reduce the relevance of legitimate counterarguments that advocate that climate change policy issues should be fought outside the courtroom. Climate change is not the only or the first highly technologically or economically complex issue facing the courts. Software and DNA cases are common nowadays in many countries. Climate change is no more politically charged than national security, torture, discrimination, abortion, immigration, corruption, same-sex marriage, or election disputes. Even war and peace are not entirely beyond the judicial realm.

It is also worthwhile mentioning that, in light of general or specific legislation dealing with the subject, including constitutional provisions, judges do not make climate change law. They apply (within the limits of the separation of powers) norms discussed and approved by legislative bodies or enacted by administrative authorities. Under these circumstances, it is not *judicial lawmaking,* but rather *judicial law implementation*. Once clear and detailed policies—that go much further than vague, conditional and noncommittal statements of public intentions—are legislated, they become legal policies that can and should be enforced by judges. Otherwise, what would be the purpose of legislating? Therefore we should here make a distinction between *activist environmental judges* and *activist environmental legislation* (or legislators).

Thus, with a qualified yes, I respond to the initial question I have posed. It is qualified because it comes with one major and several secondary requirements, especially if we want to have judges involved in responding to the climate change crisis adequately. Let me focus on the primary requirement only. In general, judges are still not fully aware of the existential threat that the climate crisis poses to humanity as a whole and every person on the planet, in every jurisdiction. Judges tend to ignore that environmental law regimes they use in their daily practice already include contact points that allow for easy connection to the climate change dimension. In other instances, new and specialized laws have been passed, but remain unknown to or insufficiently understood by judges and therefore endure as untouched laws in the books. Finally, bound by their training and jurisdictions, judges are prone to feel isolated as professionals—a state of mind that discourages innovation and the kind of learning from each other that greater interaction and communication could bring. From the judges' perspective, the most effective medicine for this complex set of attributes and attitudes, which impair their ability to confidently manage climate change litigation, is *judicial education*.

And judicial education has been precisely the road chosen by the Asian Development Bank (ADB) in its work with judges from this immense and diverse part of the world. It has been a most successful journey, one that developed a judicial community around Environmental Law. The present reports are testimony to such an initiative and a component of the broader series of successful ADB endeavors in the Environmental Rule of Law universe. As the first publication of its kind with a focus on judges, this report series will greatly benefit those who already know the subject. It will also particularly serve the many for whom climate change is (until now) a remote area of law.

On behalf of the *Global Judicial Institute on the Environment*, I offer my effusive congratulations to ADB's extraordinary team and the distinguished coauthors of this innovative report series.

ANTONIO HERMAN BENJAMIN
Justice, National High Court of Brazil
Lead founding member of the Global Judicial Institute on the Environment
6 November 2020

> Climate change is a global challenge. While the emphasis on the Paris Agreement is on nationally determined contributions, to be enforced by national legal measures, the problems are common to all, and we all have much to learn from each other.
>
> —*Lord Robert Carnwath*

Photo by Samir Jung Thapa/ADB.

FOREWORD

I am delighted to welcome this important series of reports on climate litigation and legal frameworks.

It was in 2002 that the Global Judges' Symposium in Johannesburg affirmed the vital role of an independent judiciary and judicial processes in interpreting and enforcing environmental laws, and called for a UNEP-led programme of judicial training and exchange of information on environmental law. Since then, as member of the UNEP judicial advisory group, I have taken part in numerous judicial conferences on environmental law in different parts of the world. Since 2010, the Asian Development Bank has taken a lead in encouraging judicial interchange and training through its Law and Policy Reform Programme, including a series of judicial conferences in the Asia and Pacific region, in which I have been honoured to participate. The cases collected in this study are testament to the richness of the contribution of judges from that part of the world.

Climate change is a global challenge. While the emphasis on the Paris Agreement is on nationally determined contributions, to be enforced by national legal measures, the problems are common to all, and we all have much to learn from each other. Two of the most significant climate change cases in recent years—the *Urgenda* case in Holland and the *Leghari* case in Pakistan—came from countries with widely differing legal systems. But the principle they established is universal—that effective action on climate change is a human right and fundamental constitutional responsibility of governments everywhere. As was said in 1993 by the Philippines' Supreme Court in the famous *Oposa* case, rights to a balanced and healthful ecology are "basic rights" which "predate all governments and constitutions" and "need not be written in the Constitution for they are assumed to exist from the inception of humankind."[a]

I congratulate the Asian Development Bank team responsible for these remarkable reports. I have no doubt that they will be of immense value to all those involved in giving legal force to the Paris commitments, whether as judges, legislators, or legal professionals.

LORD ROBERT CARNWATH
Commander of the Royal Victorian Order (CVO)
Former Justice of the Supreme Court of the United Kingdom
April 2020

[a] *Oposa v. Factoran*, G.R. No. 101083, 30 July 1993.

> This report chronicles green and climate jurisprudence that emerged over the years and is a testament to ADB's tireless effort over a decade in building a judicial coalition.
>
> —*Justice Syed Mansoor Ali Shah*

Photo by Gerhard Jörén/ADB.

FOREWORD

"I don't want you to be hopeful. I want you to panic...
and act as if the house was on fire."
—Greta Thunberg

Unbridled human desire, supported by unsustainable development over centuries, has disrupted the rhythm of nature. Defiling of the local environment slowly snowballed into a threat for the entire planet as carbon emissions sullied the atmosphere. Humanity's disruption of Earth's system is climate change.

Any remedial response to this global challenge can only be through the collective coordination of humankind. Nationalism needs to give way to global cooperation and solidarity. While nations of the world try to coalesce to combat this challenge, politics and powerful vested interests continue to hamper such a consensus. Nations have been unable to implement their international commitments to meet this most serious existential threat. Dissatisfied citizenry of the world has been compelled to consider other options to combat this challenge. Some of them have knocked at the doors of the courts of justice to fight climate change by making their governments answerable and accountable and by seeking climate justice.

Courts, unlike other limbs of government, are not elected and have no constituencies or voters or political agendas to tow. They are not swayed by politics or other vested or corporate interests, but are guided by ethos of justice and fair play. They function within the frame of constitutionalism and the rule of law. This gives the courts of the world a common language to communicate. It is, therefore, easy to build a global judicial consensus on climate justice. The Asian Development Bank (ADB) realized this and put together a judicial environmental coalition in Asia and the Pacific in 2010. Since then, "green" judges in Asia and the Pacific have met and shared ideas in a series of roundtables and knowledge-sharing events. This unique congress of judges from different jurisdictions debated and dialogued to evolve innovative and avant-garde judicial techniques to safeguard the environment. These judges put these ideas to work and produced far-reaching jurisprudence that has touched the soul of the planet.

Several judiciaries from Asia have a rich tradition in public interest litigation and enforcement of constitutional human rights and, therefore, did not take long to absorb environmentalism in its fold. The jurisprudence that evolved showcased a new judicial technique of forming judicial commissions comprising environmental scientists, experts, and members of the civil society to sit face to face with the government and evolve sustainable solutions. The overarching environmental judicial approach of this period remained inquisitorial and consensus-based.

These judges were ready with their jurisprudence and sharpened tool kit when climate change walked into their courtroom. Climate litigation brought with it a host of new issues that slowly overshadowed the erstwhile environmental litigation. Climate change cut across sectors which were not earlier part of

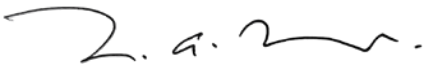
the environmental checklist. Climate litigation has to embrace multiple new dimensions like Health Security, Food Security, Energy Security, Water Security, Human Displacement, Human Trafficking, and Disasters Management. Climate Justice covers agriculture, health, food, building approvals, industrial licenses, technology, infrastructural work, human resource, human and climate trafficking, disaster preparedness, health, etc.

Most countries from Asia and the Pacific do not significantly contribute to climate change but suffer at the hands of it. Adaptation, as opposed to mitigation, has a totally different judicial response. Climate change, therefore, has a much broader meaning for the judiciaries of Asia and the Pacific. Adaptation entails issues that, facially, might not appear to be climate related but, upon deeper probe, show a causal link with climate change. The jurisprudence on climate justice emerging from the developed economies is more focused on mitigation and review of governmental decisions to curb emissions. On the whole, jurisprudence evolved by the courts has played a key role in fashioning climate governance and effectively combating climate change.

This report chronicles green and climate jurisprudence that emerged over the years and is a testament to ADB's tireless effort over a decade in building a judicial coalition. The Asian Judges Network on Environment helped the judges meet, discuss, and share ideas, which contributed to developing judicial inventiveness that emerged from Asia and the Pacific. The report is an invaluable exposé of judicial innovation and a valuable source for judiciaries around the world.

As I close this foreword, the coronavirus disease (COVID-19) pandemic has stalled the wheels of human activity and has caged humans with self-isolation and global lockdown. Weeks into it, I see blues skies out of my window, greener pastures, clean air, less noise, singing of the birds, and a general sense of relief on the face of nature. I guess the lesson for humankind is to back up and learn to coexist with nature. A new world is taking shape as I write this. A world that requires us to shed our old ways and move to a new normal. This report and the rich jurisprudence it puts out on display will help us fight and defy going back to the pre-corona world of greed, avarice, mindless consumerism, and unchecked carbon emissions.

I wish this report a huge success.



SYED MANSOOR ALI SHAH
Justice
Supreme Court of Pakistan
Islamabad
20 April 2020

Photo by Gerhard Jörén/ADB.

> ADB is committed to supporting the global climate agenda, including by developing the capacity of judicial systems within Asia and the Pacific to play their vital role.
>
> —*Thomas M. Clark*

Photo by Ariel Javellana/ADB.

PREFACE

Judges are vital development partners for institutions promoting a sustainable and inclusive future, with an indispensable role to play in climate governance in Asia and the Pacific. This work is for them.

The Office of the General Counsel within the Asian Development Bank (ADB) started judicial capacity development on environmental law in 2010 as part of its Law and Policy Reform Program. ADB chose to work with judges for three principal reasons. First, judges form a distinct, independent, and critical branch of government; yet, development partners frequently overlook the benefits of judicial capacity building. Second, judges play a significant role in advancing the rule of law and as guardians of justice in Asia and the Pacific. Third, despite these critical responsibilities, judges need greater resources and opportunities for professional development, information sharing, and judicial networking.

Initially, ADB's program focused on judicial trainings on environmental protection issues, more narrowly, without inclusion of climate mitigation and adaptation. Then, over the past decade, global awareness of climate change and of the need for concerted action to address it surged. Countries expanded their domestic legal and policy frameworks to address climate impacts, and came together in global fora to coordinate this response, most notably by signing the Paris Agreement in 2015. Driven by the need to protect themselves, their children, and their environment from climate change, people turned more to litigation to address climate change, under a variety of theories. With these shifts, ADB expanded the focus of its judicial capacity building program to incorporate climate change and sustainable development.

In our work with judiciaries over the last 10 years, ADB has seen the extraordinary potential of judicial capacity building, along with the huge gaps that remain to be filled.

- Issuing judgments advancing environmental protection can see judges labeled "anti-development." This label isolates and demotivates judges and can hamper them from addressing the serious legal and constitutional issues that may be implicated by climate change. For such judges, we created the Asian Judges Network on Environment (AJNE), a platform to connect judges and legal professionals, facilitate the sharing of knowledge and legal developments on a regional and global level, and boost motivation. ADB also launched annual conferences on environmental and climate law to share best practices. We complemented that work with assisting on targeted national judicial reforms in almost all host countries.
- During the annual judicial conferences, Asian and Pacific judges debated and developed the concepts of environmental and climate justice for the region. These sessions helped develop shared judicial language and frameworks to assess climate issues, and gave impetus to the development of seminal jurisprudence across the region. Despite these successes in the region, broader global audiences are often not aware of the phenomenal work that Asia and Pacific judiciaries do for lack of international reporting.

The Law and Policy Reform Program realized that ADB could, with these reports, both provide practical support to judges facing complex climate litigation as well as showcase climate jurisprudence from Asia and the Pacific to a broader audience.

In service of these overarching objectives, this report series seeks to (i) share environmental and climate jurisprudence from Asia and the Pacific, contributing to global knowledge on regional climate law and litigation; (ii) provide a comprehensive benchbook and tool kit for judges, especially those from Asia and the Pacific, to facilitate decision-making in this ever-evolving field of law; (iii) capture the results of ADB's judicial capacity development work—the legacy of ADB's work to date; and finally, (iv) acknowledge the prodigious work done by the judiciaries of Asia and the Pacific—ADB applauds their dedication and progress.

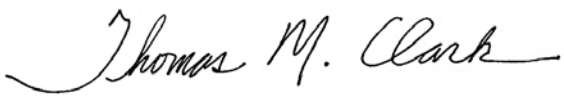
ADB was pleased to collaborate with the Sabin Center for Climate Change Law on this project. Michael Burger, Ama Francis, and the team at Sabin provided extraordinary support for ADB, contributing authoritatively on climate litigation around the world in Report Two, supplementing ADB's own research, and drafting the national legal frameworks report.

With pleasure, I acknowledge and introduce ADB's young and extraordinarily smart team of researchers and authors. Seventeen researchers gathered laws and cases from the 32 countries covered by these reports. Gregorio Rafael P. Bueta and Francesse Joy J. Cordon-Navarro contributed to and assisted with reviewing the reports. Maria Cecilia T. Sicangco wrote the report on international climate change legal frameworks and assisted with reviewing and editing these reports.

Many thanks to Irum Ahsan who led this initiative. Irum headed the Law and Policy Reform team between 2017 and 2020, under the guidance of ADB's former Deputy General Counsel Ramit Nagpal. Her energy, drive, and creativity have created a flagship program for ADB. I thank Briony Eales, who steered this initiative tirelessly over the last 3 years, working with researchers and authors, and juggling work with a young child. She worked with the researchers; wrote about climate science, climate litigation, and climate laws; and created a synthesized and cohesive series of reports.

The team diligently works on strengthening the rule of law, a key driver for robust and sustainable economic development. This will be vital work over the coming years. The global efforts to mitigate climate change and address its harmful impacts must only intensify in the near future, especially in Asia and the Pacific. The region is too large, diverse, and globally significant not to be at the center of these efforts. ADB is committed to supporting the global climate agenda, including by developing the capacity of judicial systems within Asia and the Pacific to play their vital role.

We look forward to our continued work with the region's judiciaries to strengthen climate justice and the rule of law.



THOMAS M. CLARK
General Counsel
Office of the General Counsel
Asian Development Bank

ACKNOWLEDGMENTS

Climate Change, Coming Soon to a Court Near You is a flagship publication series of the Law and Policy Reform Program under the Office of the General Counsel of the Asian Development Bank (ADB). The reports would not have been possible without the vision and leadership of Irum Ahsan, project team leader, and currently advisor, Office of the Compliance Review Panel.

Briony Eales researched and wrote Report One, *Report Series Purpose and Introduction to Climate Science.* For their input on the report, we thank Michael Burger and Ama Francis of the Sabin Center for Climate Change Law. Gregorio Rafael P. Bueta and Maria Cecilia T. Sicangco provided valuable support with the publishing process.

Tara Mitchell and Hammed Bolotaolo gave instrumental editorial advice on this report. Judy T. Yñiguez handled typesetting and graphics generation. The cover artwork was designed by Gayle Certeza, Daniel Desembrana, and John Michael Casipe, guided by Anthony Victoria. Corazon Desuasido and Jess Alfonso Macasaet proofed the draft layout.

Support for printing and publishing the report was provided by the Printing Services Unit of the ADB Office of Administrative Services and by the ADB Department of Communications' publications and web teams. We are grateful to Anna Sherwood and colleagues in the Department of Communications for their guidance on design and publishing. Noren Jose advised on ADB style.

We express gratitude to former ADB General Counsel Christopher Stephens and former Deputy General Counsel Ramit Nagpal for supporting these reports from their inception. We also thank the present General Counsel Thomas M. Clark for his support in completing this publication.

Photo by Narendra Shrestha/ADB.

ABBREVIATIONS

ADB	Asian Development Bank
cm	centimeter
CO_2	carbon dioxide
CO_2eq	carbon dioxide equivalent
COVID-19	coronavirus disease
DMC	developing member country
GHG	greenhouse gas
GMSL	global mean sea level
$GtCO_2e$	gigatonne of CO_2 equivalent
IPCC	Intergovernmental Panel on Climate Change
m	meter
NASA	National Aeronautics and Space Administration
NCEI	National Centers for Environmental Information
NDC	nationally determined contribution
NOAA	National Oceanic and Atmosphere Administration
PgC	petagram of carbon
PPM	parts per million
RCP	representative concentration pathway
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
US EPA	United States Environmental Protection Agency

Climate protests in California. Around the world, people are marching for climate action. A growing number of lawsuits reference climate justice and argue that climate change threatens fundamental human rights (photo by Li-An Lim).

EXECUTIVE SUMMARY

Climate Change: A Clarion Call for Judges

It is 2020 and the world is at a crossroads on climate change.

The Paris Agreement aims to limit global warming to 1.5°C–2°C above preindustrial temperatures. Current international climate responses will not meet these targets. Thus, urgent and widespread action is indispensable. Recent Intergovernmental Panel on Climate Change reports showed a significant difference in the degree of impact between 1.5°C and 2°C of warming. Indeed, the 1.5°C goal is the safest for most of Asia and the Pacific.

And then the coronavirus disease (COVID-19) pandemic entered the equation, shutting down economies and claiming almost 1,163,459 lives by 28 October 2020. Its devastating impacts leave the world struggling to rebuild. After COVID-19, the world must choose the path toward a safer, inclusive, dignified, and resilient future.

Frustrated by government inaction and threatened by climate change impacts on their lives and human rights, global citizens are taking the fight for climate justice to the courts. Climate litigation is demanding that judges play a role in climate governance.

Asian courts have issued groundbreaking climate decisions. Their approaches diversify the global discourse on climate jurisprudence and are worth sharing. For other judges in Asia and the Pacific, climate change is coming soon to your courts.

The Asian Development Bank (ADB) has worked with courts in Asia and the Pacific for over 10 years to build networks and support judges with environmental and now climate change decision-making. This report series captures the wisdom gained over the last 10 years and provides resources for judges, decision-makers, and lawyers involved in climate litigation.

Why These Reports?

Climate Change, Coming Soon to a Court Near You is a series of four reports on climate law, policy, and litigation. Climate litigation is growing in Asia and the Pacific, so judges and quasi-judicial decision-makers must have access to climate law resources.

Cases from high-income countries dominate global literature about climate litigation. These countries have different mindsets, legal and policy frameworks, and climate change challenges. Although judges from Asia and the Pacific have much to gain from reading this literature, they also need perspectives and approaches closer to home from peers working with similar challenges.

Most Asia and the Pacific countries have low emissions and are incredibly susceptible to climate change. The region therefore focuses on climate adaptation and resilience—activities supported by ecosystem resilience and biodiversity.

Unfortunately, weak environmental governance is common in Asia and the Pacific, creating cascading effects in this era of climate change. Frail ecosystems and biodiversity offer communities less protection from the impacts of climate change, e.g., healthy mangrove forests protect humans and other species from storm surges. Ecosystems are also more easily damaged by climate change. Unchecked environmental degradation leaves indigenous, agrarian, and island communities even more vulnerable to death, homelessness, and displacement. Judiciaries in the region benefit from understanding the role of ecosystem protection, biodiversity, and sustainable development in boosting local climate resilience. Hence, these reports outline links between environmental protection, biodiversity, and climate change.

Prioritizing environmental protection and low-emission development is challenging in Asia and the Pacific, a region dominated by low to lower middle-income countries with development objectives. Judges who do that are often labeled "anti-development," isolating them from their peers. Judges need access to resources and networks that boost their knowledge, and to information that proves that balanced and appropriate environmental and climate protection makes business sense and aligns with national climate commitments.

Judicial knowledge about climate change, legal frameworks, and relevant legal principles are fundamental to a strong rule of law. Many core principles in climate law stem from environmental law, a field that a few judges in Asia and the Pacific have studied or practiced.

Resource limitations, ad hoc publication of laws, and language barriers in Asia and the Pacific also make it difficult for judges to maintain current knowledge about climate law, climate science, and local climate change impacts, diminishing judicial effectiveness. These reports seek to overcome some of these barriers by synthesizing climate information and achievements and weaving a regional perspective into the global discourse on climate law.

Report Series Structure

Within this series are four reports:

- ***Report Series Purpose and Introduction to Climate Science:*** a brief introduction to climate change and climate science
- ***Climate Litigation in Asia and the Pacific and Beyond:*** a comparative analysis of climate litigation in Asia and the Pacific and the rest of the world
- ***National Climate Change Legal Frameworks in Asia and the Pacific:*** analyses of the national climate change policy and legal frameworks in ADB developing member countries in South Asia, Southeast Asia, and the Pacific and the People's Republic of China, with tables to highlight constitutional provisions relevant to climate change and a discussion of trends in climate law
- ***International Climate Change Legal Frameworks:*** a ready reference to key international climate change instruments and soft law, with tables showing treaty commitments by country

ADB has specifically designed these reports for judges, quasi-judicial decision-makers, lawyers from Asia and the Pacific, and those interested in Asian and Pacific climate law.

Key Takeaways

Litigation

Climate litigation is growing—in Asia and the Pacific and around the world. Most climate lawsuits in Asia target government respondents, seeking climate action or challenging decisions with climate impacts. The number of cases against governments based on treaty obligations, particularly the Paris Agreement, is increasing, and so is litigation against private entities.

Litigation preferences reflect domestic legal frameworks, with litigants looking for appropriate hooks to support their claims. Of the countries surveyed in this report, 25% have adopted framework climate legislation—economy-wide framework climate change law. The other states use climate policies and existing laws to achieve their goals. Unclear or incomplete legal and policy frameworks combined with weak enforcement frequently lead litigants to sue for violations of constitutional rights.

Petitioners in Asia favor constitutional litigation because it (i) has been used successfully in environmental litigation, (ii) allows direct access to superior courts, (iii) provides a legal basis for a claim where the existing legal and policy framework is incomplete, and (iv) is easier for petitioners to demonstrate standing where a constitutional right has been breached. The preference for rights-based litigation

reflects a global trend. Roughly one-third of all climate litigation outside the United States hinges on fundamental, human, and constitutional rights.

Most lawsuits target climate mitigation—the reduction of greenhouse gas emissions. However, litigation seeking climate change adaptation is growing and frequently emerges as a silent issue in Asian environmental lawsuits. In various cases, neither the parties nor the court identified climate change as an issue, but the case outcomes had co-benefits for climate resilience and, therefore, adaptation. These reports treat such cases as climate cases.

Climate litigation in Pacific courts remains rare, which does not reflect the existential nature of the climate threat in the Pacific.

Pacific islanders are more likely to rely on customary dispute resolution to resolve local conflicts, reducing the likelihood of litigation. Pacific nations know that their contribution to climate change is negligible. Lawsuits against national governments are also counterproductive if the state has limited resources to respond. Therefore, Pacific islanders are more likely to pursue human rights petitions in United Nations bodies or engage in transnational litigation, e.g., the climate migration cases filed in Australia and New Zealand.

Women, children, indigenous communities, and older adults—people who are particularly vulnerable to climate change—have also been active in domestic and international climate litigation.

National Legal and Policy Frameworks

Legal and policy frameworks are growing in Asia and the Pacific as governments plan for low-emission and resilient growth and ramp up climate responses in line with the Paris Agreement.

National legal and policy frameworks help drive global climate action. The period preceding the Paris Agreement (2009–2015) saw the most intense adoption of domestic laws and policies globally. This factor underscores the relationship between bolstering national climate action and driving forward the global agenda. Only collaborative, widespread, and urgent local responses can limit climate change, requiring quality national legal and policy frameworks backed up by well-informed judiciaries supporting implementation.

Legal and policy commitments need strengthening across the region. Most procedures for environmental impact assessments do not expressly require consideration of climate change. Laws requiring proponents to account for climate effects on a project and incorporate climate durability into its design are rare, undermining climate-resilient development. A few laws cover climate change and oceans.

Climate impacts, the Paris Agreement, technology, and markets will shape domestic climate laws and policies, as governments seek to keep up with changes.

Courts in Asia and the Pacific are shaping national legal and policy frameworks with their decisions. Further, given the existential crisis presented by climate change, courts have been willing to assess whether national laws and policies meet international climate commitments.

International Legal and Policy Frameworks

COVID-19 put much of 2020 on hold, including meetings central to the Paris Agreement implementation. The 26th Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change was postponed until 2021, delaying agreement on a carbon trading mechanism, common time frames for reporting under the agreement, and ramping up climate finance and technology transfers.

The Paris Agreement is mainly silent on oceans and aviation. However, the adoption of domestic laws and policies in the 6 years leading up to the Paris Agreement showed the power of national legal frameworks to shape global action.

Judges Can Contribute to Better Climate Outcomes

Judges' role in government makes them gatekeepers, even climate emergency managers. Judges are central to

- holding governments accountable for meeting policy commitments and complying with legal obligations on climate change, the environment, and sustainable development, and thereby shaping legal and policy frameworks;
- admitting relevant and credible scientific evidence for climate change in courtrooms and making judicial findings of fact about climate change, which can elevate the national discourse on climate change (indeed, courts have successfully incorporated international scientific consensus, synthesized by the Intergovernmental Panel on Climate Change, into domestic legal common ground, ensuring that advancements in climate science filter into local law); and
- balancing outcomes and protecting citizens' fundamental, constitutional, and other legal rights, frequently closing the gaps through which people and ecosystems fall.

These functions demonstrate that judges have a vital role in climate governance in Asia and the Pacific. Supporting judges to respond to climate litigation contributes to better quality climate governance.

Moving Forward

Today's judges are being asked to decide on the burning issue of our generation—climate change. It is a challenge that threatens to eclipse all others in modern history.

As Albert Einstein once said, "We cannot solve our problems with the same thinking we used when we created them." Significant judicial advancements have often rested on the shoulders of jurists who were willing to apply new consciousness and imagination to existing principles to resolve society's pressing problems. We need new perspectives to create climate justice. Justice will only be fair if it considers diverse perspectives and rights—those of women, children, elders, indigenous peoples, the differently abled, and future generations, as well as those of the traditional power structures.

These reports are for those who must adjudicate climate litigation in Asia and the Pacific. ADB lauds the advancements that Asia and the Pacific judiciaries have made in environmental and climate justice and sustainable development. The authors hope that this jurisprudence brings diversity and a fresh perspective to the global discourse on climate law.

As for climate justice, more work is needed. Emissions continue to rise, and global commitments do not yet have the world on track to limit global warming to well below 2°C above preindustrial temperatures. Gaps persist in climate change legal and policy frameworks, allowing action to stagnate. To promote climate justice in Asia and the Pacific, judges can assess these gaps. They can ask, do these frameworks support the overarching 1.5°C–2°C temperature goal under the Paris Agreement?

These reports encourage judiciaries to equip themselves with knowledge about climate science and law because litigation demands that judges take part in reckoning climate justice. The future rests heavily on each of us. Those able to make powerful decisions must choose action. This work is in the service of judges and decision-makers. We hope it lights the way, a little.

Photo by Lorie Shaull.

Destruction after Typhoon Haiyan. The typhoon battered Leyte in the Philippines in November 2013, leaving more than 6,000 people dead, affecting 12 million other people, and causing $8 billion in damages. It remains one of the strongest storms on record to make landfall (photo by Ariel Javellana/ADB).

PART ONE

REPORT SERIES RATIONALE

I. An Existential Threat in the 21st Century

"Climate change is, quite simply, an existential threat for most life on the planet—including, and especially, the life of humankind."[1] And humans are causing it.

In its 4.5-billion-year history, Earth has been far hotter than it is now.[2] But humans did not exist in the age of dinosaurs, and neither did most of the species living around us. While climate change will not end our planet, it risks making Earth unrecognizable and inhospitable to current life. Our civilization and ecosystems emerged during the Holocene, which started around 11,700 years ago when Earth warmed after the last glacial maximum and the ice sheets covering North America and Europe retreated.[3] The average temperature and stability of the Holocene allowed modern civilization to flourish.[4] In short, modern civilization and agriculture are adapted to the Holocene climate.[5]

The Industrial Revolution's steam engines hailed the beginning of large-scale fossil fuel use. Unfortunately, the by-product of burning fossil fuels for energy production—especially coal, oil, and gas—are greenhouse gas (GHG) emissions.[6] GHGs occur naturally in Earth's atmosphere and are essential for regulating the global climate.[7] But artificially increasing atmospheric GHG concentrations by burning fossil fuels is warming Earth.[8] (This report discusses climate science further in Part Two: Introduction to Climate Change.)

1 A. Guterres. 2018. Keynote Address. Speech given at the R20 Austrian World Summit. Vienna. 15 May.

2 In the Cretaceous period (145–66 million years ago), Earth was around 35°C, and there were no ice caps covering the magnetic poles. During 1961–1990, the average global temperature was around 14°C. See National Aeronautics and Space Administration (NASA) Earth Observatory. World of Change: Global Temperatures; and Goethe-Universität Frankfurt am Main. 2015. Extreme Global Warming of Cretaceous Period Punctuated with Significant Global Cooling. *ScienceDaily*. 28 May.

3 The last glacial maximum refers to the last time Earth's glaciers were at their greatest extent. See P.U. Clark et al. 2009. The Last Glacial Maximum. *Science*. 325 (5941). pp. 710–714.

4 J. Hansen. 2018. *Climate Change in a Nutshell: The Gathering Storm*. New York: Climate Science, Awareness and Solutions Program, Columbia University. p. 12.

5 Footnote 4, pp. 12 and 40.

6 H. Ritchie and M. Roser. Fossil Fuels. OurWorldInData.org (accessed 6 April 2020).

7 United States (US) Environmental Protection Agency (EPA). 2012. *Climate Change Indicators in the United States, 2012 (2nd ed.)*. Washington, DC. p. 3.

8 Intergovernmental Panel on Climate Change (IPCC). 2014. *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Geneva: IPCC. p. 2, SPM 1 and p.4, SPM 1.2.

Contemporary global discussion about climate change focuses on human-caused global warming, which is elevating temperatures compared with the preindustrial temperature average of the Holocene—anthropogenic climate change. Preindustrial temperatures refer to global temperatures before large-scale industrial activity around 1750.[9] However, the Intergovernmental Panel on Climate Change (IPCC) uses the 1850–1900 period as its preindustrial temperature baseline.[10]

A warming planet sets in motion chain reactions that will change and destabilize the climate in which humans evolved to thrive.[11] Humans cannot separate themselves from Earth's natural environment. We are innately connected to it, relying on Earth for air, water, food, and energy—the fundamental necessities of life. Climate change threatens our capacity to access these necessities and, therefore, undermines our enjoyment of human rights.[12] Indeed, climate change is such a threat to humanity that the Bulletin of the Atomic Scientists lists it as one of the two existential dangers to humanity—the other is nuclear war.[13]

II. Climate Change Impacts in 2020

Climate change is not a future event—we live with it now. Human activity has already caused a 1°C warming above the preindustrial mean temperature.[14] This 1°C shift has triggered increasingly frequent and intense extreme weather events, rising sea levels, and diminishing Arctic sea ice.[15] Across Asia and the Pacific, populations endure severe weather, heat stress, flooding, droughts, and sea level rise.[16] Impacts are sudden onset (severe weather events) or slow onset (rising sea levels and melting glaciers).

9 See the definitions of "pre-industrial" and "industrial revolution" in footnote 8, pp. 124 and 126.

10 IPCC. 2018. Summary for Policymakers. In V. Masson-Delmotte et al., eds. *Global Warming of 1.5°C. An IPCC Special Report*. In press. p. 24, Box SPM.1. The IPCC also used the 1850–1900 temperature baseline in its Fifth Assessment Report (AR5). See footnote 8.

11 The IPCC describes the ranges of impacts, forcings, and tipping points ensuing from different levels of warming and atmospheric concentration of carbon dioxide (CO_2). See footnote 8, pp. 77–79, Part 3.2; and IPCC. 2018. Summary for Policymakers. In V. Masson-Delmotte et al., eds. *Global Warming of 1.5°C. An IPCC Special Report*. In press. pp. 7–10, Part B. Projected Climate Change, Potential Impacts and Associated Risks.

12 For a discussion on the links between climate change and human rights, see UN Environment Programme (UNEP) and Sabin Center for Climate Change Law. 2015. *Climate Change and Human Rights.* Nairobi: UNEP.

13 J. Mecklin, ed. 2020. Closer than Ever: It Is 100 Seconds to Midnight—2020 Doomsday Clock Statement. *Bulletin of the Atomic Scientists*. News release. 23 January.

14 IPCC. 2018. Summary for Policymakers. In V. Masson-Delmotte et al., eds. *Global Warming of 1.5°C. An IPCC Special Report*. In press.

15 IPCC. 2018. Summary for Policymakers of IPCC Special Report on Global Warming of 1.5°C Approved by Governments. News release. 8 October.

16 Y. Hijioka et al. 2014. Asia. In V.R. Barros et al., eds. *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects*. Cambridge, United Kingdom and New York, NY, United States: Cambridge University Press. pp. 1327–1370; L.A. Nurse et al. 2014. Small Islands. In V.R. Barros et al., eds. *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects*. Cambridge, United Kingdom and New York, NY, United States: Cambridge University Press. pp. 1613–1654; and J. Aucan. 2018. Effects of Climate Change on Sea Levels and Inundation Relevant to the Pacific Islands. *Pacific Marine Climate Change Report Card: Science Review 2018*. pp. 43–49.

The IPCC has warned that based on current emissions and pledges, global temperatures will increase to 1.5°C above preindustrial temperatures between 2030 and 2052, bringing more intense impacts (footnote 14). Around 30% of people currently live with deadly heat events.[17] By 2100, lethal heat waves will affect up to 75% of the world's population. (This report summarizes the impacts of 1.5°C and 2°C of warming in Table 4: Summary of Projected Risks at 1.5°C and 2°C.)

Climate change shapes health in various ways. Beyond the obvious impacts of extreme weather events, factors such as heat, air quality, food and water security, and vector distribution (diseases) impair health.[18] Conflict- and climate-induced migration also harm physical and mental health. The World Health Organization (WHO) estimates that climate change causes 150,000 deaths annually, including deaths from extreme weather.[19] By 2030, WHO anticipates that climate change-associated heat, malaria and dengue fever, coastal flooding, and undernutrition will kill 250,000 people annually.[20] More recent studies label this estimate conservative because it does not account for deaths from climate-sensitive health outcomes or disrupted health services (footnote 18). For example, less food could contribute to around 529,000 deaths by 2050 (footnote 18). The more startling fact is that air pollution—significantly contributed to by fossil fuels—kills around 7 million annually in 2020.[21] Four million of these pollution-related deaths occur in Asia and the Pacific.[22]

III. Climate Change and the Coronavirus Disease

In 2020, the world grappled with the devastating impacts of the coronavirus disease (COVID-19). By 28 October 2020, there were around 43.8 million confirmed COVID-19 infections and more than 1 million deaths.[23] Millions more had suffered from hunger and economic devastation as the world ground to a halt to contain infections and keep people safe. Widespread and sudden community lockdowns were akin to "war-time" responses.[24]

17 C. Mora et al. 2017. Global Risk of Deadly Heat. *Nature Climate Change*. 7 (7). pp. 501–506.
18 A. Haines and K. Ebi. 2019. The Imperative for Climate Action to Protect Health. *New England Journal of Medicine*. 380 (3). pp. 263–273.
19 The Health and Environment Linkages Initiative. Climate Change.
20 S. Hales et al., eds. 2014. *Quantitative Risk Assessment of the Effects of Climate Change on Selected Causes of Death, 2030s and 2050s*. Geneva: World Health Organization. p. 1.
21 WHO. 2018. 9 Out of 10 People Worldwide Breathe Polluted Air, But More Countries Are Taking Action. News release. 2 May.
22 WHO. Air Pollution—The Silent Killer.
23 WHO. WHO Coronavirus Disease (COVID-19) Dashboard (accessed 28 October 2020).
24 *UN News*. 2020. First Person: COVID-19 Is Not a Silver Lining for the Climate, Says UN Environment Chief. 5 April.

Many initially lauded the cleaner environment resulting from the COVID-19 global economic shutdown. Social media feeds filled with news that Delhi's air had cleared and that satellites recorded lower atmospheric concentrations of pollutants.[25] History, however, teaches us that these gains may not be sustained. The COVID-19 pandemic is not the first time that an economic downturn has shrunk fossil fuel emissions. Reduced fossil fuel and cement production during the 2009 global financial crisis saw carbon dioxide (CO_2) emissions drop by 1.4%.[26] By 2010, however, global CO_2 emissions were growing faster than ever (footnote 26). A boom in fossil fuel emissions during recovery from an economic crash is not limited to the 2009 financial crisis. *The Economist* tracked emission spikes after the oil crises of the 1970s, the fall of the Union of Soviet Socialist Republics, and the Asian financial crisis (footnote 26).

COVID-19 is also affecting climate action and green energy expansion. The Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC) has postponed the 26th Session of the Conference of the Parties scheduled for late 2020 and the midyear meetings leading up to it. COVID-19 has also slowed down the installation of solar and wind energy in 2020.[27]

When the COVID-19 pandemic passes, governments will redirect their attention to rebuilding their economies. Their choice of investments will be critical to the planet's future. Rather than investing in high-emitting industries, governments could turn their focus to supporting green options. Governments might also opt to learn from the current crisis and see that their constituents are willing to contribute to global action because this issue affects every living thing.

Without urgent action, the effects of climate change will intensify over the next 30–50 years and beyond.[28] As Earth's climate evolves, the pace of climate change will get faster, threatening to outstrip the current response to climate change.[29] Put simply, "climate change is a defining challenge of our time."[30]

Recognizing the unique challenges and opportunities created by the COVID-19 crisis, the World Economic Forum launched The Great Reset initiative in June 2020.[31] The Great Reset commits to creating a fairer, more sustainable, and resilient

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25 S. Biswas. 2020. India Coronavirus: Can the Covid-19 Lockdown Spark a Clean Air Movement? *BBC*. 21 April; and *The Economist*. 2020. The Epidemic Provides a Chance to Do Good by the Climate. 26 March.

26 *The Economist*. 2020. The Epidemic Provides a Chance to Do Good by the Climate. 26 March.

27 Footnote 26; and *BloombergNEF*. 2020. Covid-19 Wreaks Havoc on the Wind Industry. 1 April.

28 Footnote 14; and ADB. 2017. Climate Change and Disasters in Asia and the Pacific. Infographic. 28 November. See *Impacts will be Costly*.

29 Three factors affect climate change: (i) forcings—origins of climate change; (ii) climate feedbacks—processes that can amplify or lessen climate change; and (iii) tipping points—when these points are reached, there is an abrupt shift in Earth's climate. See NASA. The Study of Earth as an Integrated System.

30 *Leghari v. Federation of Pakistan*, PLD 2018 Lahore 364, para. 11.

31 C. Alessi. 2020. 'A golden opportunity'—HRH the Prince of Wales and Other Leaders on the Forum's Great Reset. World Economic Forum news release. 3 June.

global economic and social system that builds "a new social contract that honours the dignity of every human being."[32] The initiative specifically recognizes the threat of failing to take climate action in a post-COVID-19 world. During the initiative's launch, Kristalina Georgieva (managing director of the International Monetary Fund) observed, "the best memorial we can build for those who lost their lives to the pandemic is a greener, smarter, fairer world."[33]

In September 2020, the Government of Japan launch the Platform for Redesign 2020, an online platform on Sustainable and Resilient Recovery from COVID-19.[34]

IV. Purpose of ADB's Reports on Climate Law and Litigation

In 2015, the world's governments famously adopted the Paris Agreement. Parties agreed to hold the "increase in the global average temperature to well below 2°C above pre-industrial levels" and to pursue "efforts to limit the temperature increase to 1.5°C above pre-industrial levels."[35] The temperature goal sought to minimize the risks and impacts of climate change.

Buoyed by the world's unity surrounding the agreement, global hopes for coherent international climate action were initially high. However, current government pledges and actions are not on track to limit global warming to 1.5°C.[36] Recent data predict a 1.5°C warming by 2035, a 2°C warming by 2053, and a 3.2°C warming by 2100 (footnote 36).

Frustrated by government inaction on climate change, citizens around the world are turning to their courts, commissions, and tribunals, unleashing lawsuits across the globe. The number of cases is growing and will likely grow exponentially as climate impacts intensify. Typically, national climate impacts and circumstances shape domestic litigation. These cases look for action; climate justice and sustainable development; and protection of rights, review of decisions, and compensation. Climate change is coming soon to a courtroom near you.

Judges and members of specialized tribunals will need resources to respond to climate litigation. In this series of reports, ADB has two overarching objectives:

(i) **Supporting judiciaries and legal professionals by sharing knowledge and ideas.** Although this report uses the term "judges," many other legal

[32] World Economic Forum. The Great Reset: A Unique Twin Summit to Begin 2021; and World Economic Forum. The Great Reset.
[33] "The World Economic Forum: The Great Reset." Soundcloud podcast, 6:55, speech given by Kristalina Georgieva, managing director of the International Monetary Fund, at The Great Reset launch on 4 June 2020, posted by World Economic Forum.
[34] Government of Japan. Platform for Redesign 2020.
[35] *Paris Agreement*, Paris, 12 December 2015, *United Nations Treaty Series*, No. 54113. art. 2(1)(a).
[36] Climate Action Tracker. 2019. *The World Is Not on Track to Meet 1.5°C*.

professionals are sitting in tribunals and commissions throughout Asia and the Pacific who need information about climate change. While these tribunals and commissions may be limited to exercising quasi-judicial powers, they are important components of their national legal systems. These tribunals and commissions apply similar standards of rigor to evidence and procedure as courts, and their findings have valuable impacts on climate change regulation.

(ii) **Showcasing climate and environmental jurisprudence from Asia and the Pacific.** We believe this sharing of information can enrich the global discourse on climate litigation and regulation.

A. Supporting Judiciaries and Legal Professionals by Sharing Knowledge and Ideas

If the global community wants to build better responses to climate change, we need to share information about best practices, especially with judges and legal practitioners.

Judiciaries form a distinct and independent branch of government. They are central to protecting the rule of law and fundamental rights. They clarify legislation and referee executive action. They also interpret domestic constitutions and protect individual rights. When it comes to climate change, judiciaries are bound to consider facts and law with impartiality. Climate change cannot be dismissed as a rumor. Their role in protecting rights and reviewing the lawfulness of executive decisions or actions means that judiciaries are crucial in regulating national responses to climate change.

ADB's support for Asian judges started in 2010, under the Law and Policy Reform Program of the Office of the General Counsel. At ADB, we believe that well-equipped judiciaries sensitized to climate change-related issues are pivotal to upholding the environmental rule of law. Judiciaries are an essential pillar of the government and a key development partner. ADB's work with judiciaries has led to the establishment of "green" benches—courts specializing in environmental law and with special rules of procedure for environmental cases—and seminal jurisprudence on the environment and climate change. ADB's involvement has also resulted in collaboration among Asian judiciaries through the Asian Judges Network on Environment.

In the course of ADB's work with judges on environmental and climate change law, judiciaries from Asia and the Pacific expressed deep concern about climate change. In particular, many wondered how they might better understand climate science and what the relevant legal considerations are for this emerging field of disputes, especially in Asia and the Pacific.

Information about climate change law and litigation in Asia and the Pacific has been lacking.[37] Many judges across this region work with funding constraints and

[37] See J. Peel and J. Lin. 2019. Transnational Climate Litigation: The Contribution of the Global South. *American Journal of International Law*. 113 (3). pp. 679–726.

limited resources, making it challenging for them to obtain current legal materials. In extreme cases, judges cannot access national and international legal and policy frameworks or jurisprudence from comparative jurisdictions. They also cannot access up-to-date climate change data. This information gap impairs judicial capacity to deliver timely justice. Sharing information is, therefore, a fundamental rationale of this report.

This series of reports represents the most ambitious and comprehensive review of climate law and litigation across Asia and the Pacific to date in report format.[38] At ADB, we see the value in publishing current information on climate laws and litigation to support judiciaries in our developing member countries (DMCs).

B. Showcasing Climate and Environmental Jurisprudence from Asia and the Pacific

There are two good reasons for showcasing climate and environmental jurisprudence from Asia and the Pacific:

(i) Judges in Asia and the Pacific face unique challenges and operate in culturally distinct legal systems. They will benefit from having access to comparative jurisprudence from complementary countries.

(ii) Judges from Asia and the Pacific have ideas that are worth sharing and will contribute to the global discourse on climate litigation.

North America, Europe, and Australia see the largest volume of climate litigation, and most litigation analyses focus on them.[39] There is much to learn from the litigation outcomes in these economies. Judges from Asia and the Pacific, however, face different challenges. Further, with a growing body of climate change jurisprudence in Asia and the Pacific, it is time to survey regional climate cases.

Asia and the Pacific is home to some of the most climate-vulnerable countries globally.[40] Countries in Asia and the Pacific have historically been low carbon emitters. Hence, the majority of these countries are heavily focused on climate

[38] ADB worked closely with the Sabin Center for Climate Change Law (Sabin Center) in the production of these reports. The Sabin Center maintains the Climate Change Litigation Databases, with one focused on climate litigation globally and another in the US. ADB provided the Sabin Center with research on climate litigation in Asia and the Pacific. ADB also provided research on climate law and policy in Asia and the Pacific to the Climate Change Laws of the World database, jointly maintained by the Sabin Center and the Grantham Research Institute on Climate Change and the Environment. ADB also acknowledges ECOLEX and FAOLEX, UN databases that provide extensive information on environmental law and food, agriculture, and natural resources management.

[39] J. Setzer and R. Byrnes. 2019. *Global Trends in Climate Change Litigation: 2019 Snapshot*. London: Grantham Research Institute on Climate Change and the Environment and Centre for Climate Change Economics and Policy, London School of Economics and Political Science. p. 3.

[40] D. Eckstein et al. 2019. Global Climate Risk Index 2020: Who Suffers Most from Extreme Weather Events? Weather-Related Loss Events in 2018 and 1999 to 2018. Berlin: Germanwatch e.V.; and ADB. 2017. Climate Change in Asia and the Pacific. Infographic. 28 November.

change adaptation. This focus will likely flavor climate litigation in Asia and the Pacific. However, Asia and the Pacific's profile as passive recipients of climate change is changing. Without change, the region will emit 48% of the world's share of carbon emissions by 2030.[41] Countries in Asia and the Pacific must now plan for and work toward sustainable, low-emission growth.

The varied litigation approaches across South Asia, Southeast Asia, and the Pacific reflect the rich diversity within their legal systems. Across the region, common law systems are more prevalent than civil law systems. Twenty-two countries combine common law with sharia or customary law, or both.[42] Nine countries are predominantly civil law systems.[43] Except for Indonesia, Nepal, and the Philippines, the common law systems have produced the richest array of environmental and climate litigation. Within the existing jurisprudence, factors such as national rights and laws, legal system personality, and citizen behaviors shape Asia and the Pacific jurisprudence.

In Asia and the Pacific, climate litigation presents more frequently under the guise of another kind of dispute. In the review of local litigation, climate change popped up—either explicitly or implicitly—in disputes relating to forestry, water rights, air pollution, urban planning, and environmental permits. While the plaintiffs and courts may not have raised climate change explicitly as an issue, we have treated a case as being relevant to climate change if the outcomes had real implications for climate change. For example, climate change will likely make 341 million people in Asia vulnerable to flooding by 2025.[44] Therefore, any cases protecting natural drainage systems are essential contributions to climate adaptation because they boost resilience to climate change. The litigation report, therefore, dedicates a section to adaptation cases and encourages judges to apply a climate lens to environmental disputes.

Climate litigation in Asia is also more likely to occur as public interest litigation, founded on a constitutional or statutory right. South Asia boasts excellent examples of environmental constitutionalism—rights-based environmental litigation. In such cases, courts take a more liberal approach to standing because petitioners can hinge their petitions on constitutional rights to life or the environment. It helps that many jurisdictions across Asia and the Pacific have modern constitutions that embed rights. (Report Three surveys constitutional rights across the region.)

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41 Collectively, the People's Republic of China, India, and Indonesia will emit 89% of Asia and the Pacific's GHG emissions by 2030. See ADB. 2017. Climate Change in Asia and the Pacific. Infographic. 28 November.

42 The following countries have predominantly common law systems: Bangladesh, Bhutan, the Cook Islands, the Federated States of Micronesia, Fiji, India, Kiribati, Malaysia, Maldives, the Marshall Islands, Myanmar, Nauru, Pakistan, Palau, Papua New Guinea, Samoa, Singapore, Solomon Islands, Sri Lanka, Tonga, Tuvalu, and Vanuatu.

43 The following countries have predominantly civil law systems: Afghanistan, Cambodia, Indonesia, the Lao People's Democratic Republic, Nepal, the Philippines, Thailand, Timor-Leste, and Viet Nam. The Philippines gravitated to a mixed civil and common law system in the 20th century.

44 ADB. 2015. *Climate Change Resilience in Asia's Cities*. Infographic. 6 May.

In our view, judicial approaches and principles applied in environmental constitutionalism can also be applied in the climate change context because climate change threatens natural rights, including the right to life.[45] As natural rights exist regardless of constitutional and legal gaps, judicial reliance on them could prove fruitful, and Asian jurisprudence has much to say on this topic. For example, in 1993, the Philippine Supreme Court declared that the right to a balanced and healthful ecology "concerns nothing less than self-preservation and self-perpetuation."[46] Such rights, therefore, "need not even be written in the Constitution for they are assumed to exist from the inception of humankind" (footnote 45).

V. Countries Covered by the Report Series

The series focuses on judiciaries in ADB's DMCs in South Asia, Southeast Asia, and the Pacific (Table 1). To help build capacity for judicial decision-making on climate change and sustainable development, we also discuss global jurisprudence.

Table 1: Countries Covered by the Report Series

South Asian Countries	Southeast Asian Countries	Pacific Countries
Afghanistan	Cambodia	Cook Islands
Bangladesh	Indonesia	Federated States of Micronesia
Bhutan	Lao People's Democratic Republic	Fiji
India	Malaysia	Kiribati
Maldives	Myanmar	Marshall Islands
Nepal	Philippines	Nauru
Pakistan	Singapore	Palau
Sri Lanka	Thailand	Papua New Guinea
	Viet Nam	Samoa
		Solomon Islands
		Timor-Leste
		Tonga
		Tuvalu
		Vanuatu

Source: Authors.

[45] In 1689, John Locke defined natural rights as God-given rights that cannot be taken or given away and to include the rights to life, liberty, and possessions. See Constitutional Rights Foundation. Natural Rights: The Declaration of Independence and Natural Rights.

[46] *Oposa v. Factoran*, G.R. No. 101083, 30 July 1993.

VI. Report Series Structure

ADB partnered with the Sabin Center for Climate Change Law to write this four-part series covering

(i) climate science,
(ii) climate litigation,
(iii) national climate change legal frameworks, and
(iv) international climate change legal frameworks.

A. Report One on Climate Science

Part Two of this report contains a brief discussion of the science of climate change. The purpose of this summary is to introduce judges to the key causes and impacts of climate change. The authors from ADB hope that this summary will function as a starting point for judges to know more about climate change.

B. Report Two on Climate Litigation

Given its capacity to disrupt and destroy, climate change will result in an explosion of litigation, inspiring the title of this report series—*Climate Change, Coming Soon to a Court Near You*.

The climate litigation report provides a comparative assessment of climate litigation, broken down into key topics. It explores climate litigation across Asia and the Pacific and contrasts approaches with those taken by judiciaries in other parts of the world. The report looks at litigation approaches in the following areas:

(i) holding governments accountable,
(ii) permitting and judicial review,
(iii) cases against private parties,
(iv) adaptation cases, and
(v) impacts on people who are vulnerable to climate change.

Report Two does not feature cases from every country covered under the study. Rather, it features cases that are relevant to climate change governance in Asia and the Pacific.

C. Report Three on National Climate Change Legal Frameworks

Domestic legal and policy frameworks are critical drivers of national climate responses. Judges play an important role in clarifying and enforcing national laws. Report Three discusses the legal and policy climate change frameworks of 31 countries in South Asia, Southeast Asia, and the Pacific, plus the People's

Republic of China. It summarizes national legal and policy approaches to climate change and contains tables of constitutional provisions that frequently underpin right-based climate litigation across the region. Report Three also explores trends in climate law and policy.

D. Report Four on International Climate Change Legal Frameworks

Report Four provides judges with a ready reference to treaties and international legal agreements entered into by their respective countries. It also summarizes essential instruments within the global legal framework.

Giant clams at Aitutaki Island, the Cook Islands. According to the Intergovernmental Panel on Climate Change, if global warming reaches 2°C above preindustrial temperatures, 99% of the world's coral reefs will decline. Increased ocean acidity will also make it harder for clams like these to build their shells (photo by Eric Sales/ADB).

PART TWO

INTRODUCTION TO CLIMATE CHANGE

Climate change presents courts with emerging evidentiary and legal challenges. As with any matter that comes before them, judges need to understand the fundamentals—the who, when, where, how, and why of the issue. Judges will also assess the relevance of information and inquire into expert credibility. Thus, it is useful for judges to understand where to locate credible sources of information on climate science.

While their application of domestic law and responses to lawsuits vary across the world, judges have consistently accepted the basic tenet of climate change—human GHG emissions are causing it. This judicial consensus on climate change is unsurprising. Courts are concerned with facts and will, therefore, be guided by the overwhelming consensus within the scientific community.

Climate science can be difficult to follow. The Intergovernmental Panel on Climate Change (IPCC) reports are detailed and discuss "the assessed likelihood of an outcome."[1] The reports describe the scientists' level of confidence in the findings, with levels of confidence ranging from very low to very high. How does a court make sense of statistical probabilities within the legal context, which emphasizes the balance of probabilities in civil cases?

A simplified discussion about climate science and the impacts of climate change could prove useful for judges in understanding some of the key concepts and terms in climate science. As such, this discussion may function as a starting point for judges facing a climate change case.

The authors of this ADB report defer to the writings and opinions of climate scientists, particularly the IPCC. Therefore, judges should treat the information contained in the IPCC reports as authoritative. If there are inconsistencies between this discussion and the IPCC reports, the opinion of the IPCC prevails.

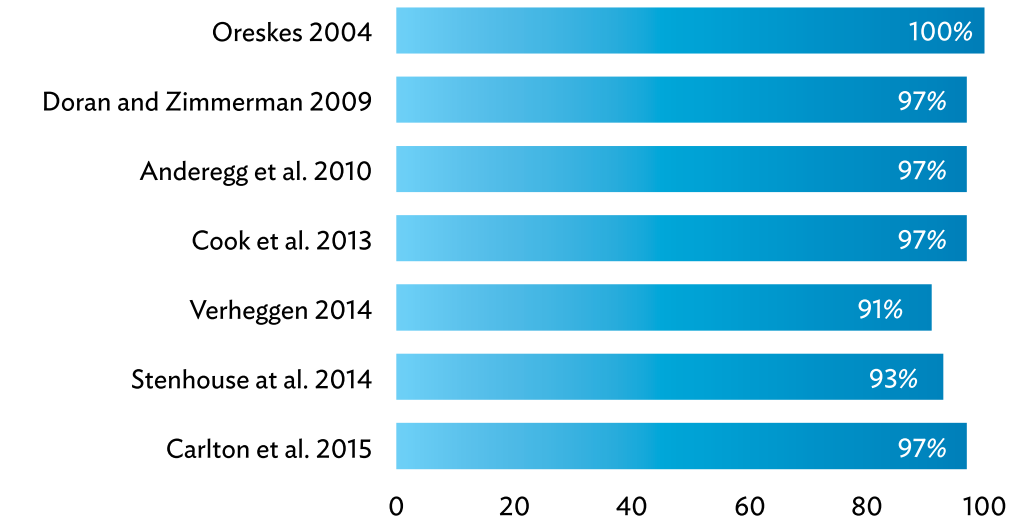
[1] IPCC. 2018. Summary for Policymakers. In V. Masson-Delmotte et al., eds. *Global Warming of 1.5°C. An IPCC Special Report*. In press. p. 4.

I. Scientific and Global Consensus on Anthropogenic Climate Change

Climate change continually grabs global headlines. And yet the media—especially in developed economies—is frequently divided over its facts and causes.[2] These divergent opinions create confusion, making it appear that the scientific community is split on the science. That is not the case.

Between 90% and 100% of actively publishing climate scientists agree that humans are causing global warming.[3] A 2016 study, after reviewing independent studies on climate science consensus that had collectively analyzed almost 12,000 abstracts, concluded that there was a 97% consensus among climate scientists.[4] Figure 1 shows the results of that study.

Figure 1: Studies into Scientific Agreement on Human-Caused Global Warming



Source: J. Cook et al. 2016. Consensus on Consensus: A Synthesis of Consensus Estimates on Human-Caused Global Warming. *Environ. Res. Lett.* 11 (2016) 048002.

[2] M.T. Boykoff and J.T. Roberts. 2007. *Fighting Climate Change: Human Solidarity in a Divided World: Human Development Report 2007/2008*. New York: United Nations Development Programme.

[3] N. Oreskes. 2004. The Scientific Consensus on Climate Change. *Science.* 306 (5702). p. 1686, correction published on 21 January 2005; J. Cook et al. 2016. Consensus on Consensus: A Synthesis of Consensus Estimates on Human-Caused Global Warming. *Environ. Res. Lett.* 11 (2016) 048002 (The study reviewed papers published between 1991 and 2011); and NASA. Do Scientists Agree on Climate Change?

[4] J. Cook et al. 2016. Consensus on Consensus: A Synthesis of Consensus Estimates on Human-Caused Global Warming. *Environ. Res. Lett.* 11 (2016) 048002.

Scientific research on Earth's climate is not new. In 1856, Eunice Foote discovered the cause of global warming and published a paper hypothesizing that atmospheric CO_2 could increase global temperatures.[5] Three years later, John Tyndall showed that CO_2 and other GHGs absorb heat and act like a blanket around the Earth—the greenhouse effect.[6] In the 1890s, Svante Arrhenius showed that CO_2 produced by factories and machines would increase global temperatures.[7] American scientist Charles Keeling began measuring atmospheric CO_2 in 1958, providing hard data that atmospheric CO_2 levels were increasing.[8]

Since then, scientists have researched and debated the cause and facts of climate change extensively, and the United Nations established the IPCC.[9] Technological advancements have given scientists better tools, methods, models, and data to make more accurate conclusions. Nearly 200 scientific organizations around the world concur that human activity has caused current climate change.[10] Moreover, numerous national science academies agree that climate change is real and caused by human action.[11]

In 2014, the IPCC stated that "human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history."[12] Further, the IPCC considered that the level of warming was "unprecedented over decades to millennia" (footnote 12).

Despite political rhetoric in parts of the world, the global community has also reached a consensus on climate change. At the time of writing, all countries are party to the United Nations Framework Convention on Climate Change

5 K. Wilkinson. 2019. The Woman Who Discovered the Cause of Global Warming Was Long Overlooked. Her Story Is a Reminder to Champion All Women Leading on Climate. *Time*. 17 July; and E. Foote. 1856. *On the Heat in the Sun's Rays*. Paper read before the American Association for the Advancement of Science. 23 August.

6 R.M. Baum Sr. 2016. Future Calculations: The First Climate Change Believer. *Distillations*. Science History Institute. 18 July; and J. Hansen. "Why I Must Speak Out about Climate Change." Filmed February 2012. TED video, 17:23.

7 R.M. Baum Sr. 2016. Future Calculations: The First Climate Change Believer. *Distillations*. Science History Institute. 18 July.

8 H. Shaftel. 2018. The Scientific Method and Climate Change: How Scientists Know. NASA's Jet Propulsion Laboratory. News release. 6 June.

9 General Assembly Resolution 43/53, *Protection of Global Climate for Present and Future Generations of Mankind*, A/RES/43/53 (6 December 1988).

10 Government of the US, State of California, Governor's Office of Planning and Research. List of Worldwide Scientific Organizations.

11 Editorial. 2001. The Science of Climate Change: Joint Statement. *Science*. 292 (5520). p. 1261; National Academies of Sciences, Engineering, and Medicine. 2008. Joint Science Academies' Statement: Climate Change Adaptation and the Transition to a Low Carbon Economy; and National Academies of Sciences, Engineering, and Medicine. 2009. G8+5 Academies' Joint Statement: Climate Change and the Transformation of Energy Technologies for a Low Carbon Future.

12 IPCC. 2014. *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Geneva: IPCC. p. 2, SPM 1.

(UNFCCC), and there are 189 parties to the Paris Agreement.[13] All of ADB's DMCs in South Asia, Southeast Asia, and the Pacific are parties to the UNFCCC and the Paris Agreement. Further, in late 2019, the Association of Southeast Asian Nations issued a joint statement affirming their commitment to the UNFCCC and the Paris Agreement.[14]

The UNFCCC and the Paris Agreement are founded on science. They acknowledge that human activities have been substantially increasing atmospheric concentrations of GHGs, increasing the natural greenhouse effect that results in additional warming. Both agreements ask their parties to act to limit and adapt to climate change.

ADB has also committed to "tackling climate change, building climate and disaster resilience, and enhancing environmental sustainability."[15] On a 3-year rolling average, 75% of ADB's committed operations—both sovereign and nonsovereign—will support climate change mitigation (reducing emissions) and adaptation (adjusting to impacts) by 2030. "Climate finance from ADB's own resources will reach $80 billion cumulatively from 2019 to 2030" (footnote 15).

II. A Brief Introduction to Climate Change

A. The Greenhouse Effect

The IPCC's reports do not identify an absolute temperature—a number—when they discuss variations in the global mean temperature.[16] This practice makes it challenging for lawyers to understand what the current global mean temperature is and how it is changing. Temperature anomalies are more reliable indicators of changes to the global mean temperature than absolute temperature because they describe variations from a baseline temperature record, which is calculated over 30 years or longer.[17] The UNFCCC and the Paris Agreement refer to the preindustrial era, which describes the period before 1750. However, the IPCC uses the reference period 1850–1900 to approximate the preindustrial global

[13] *United Nations Framework Convention on Climate Change*, New York, 9 May 1992, *United Nations Treaty Series*, Vol. 1771, No. 30822, p. 107. Information on the status of the UNFCCC and Paris Agreement may be found at United Nations Treaty Collection. United Nations Framework Convention on Climate Change; and United Nations Treaty Collection. Paris Agreement Status. The United States has notified the Secretary-General of its decision to withdraw from the Paris Agreement, which shall take effect on 4 November 2020.

[14] Association of Southeast Asian Nations. 2019. ASEAN Joint Statement on Climate Change to the 25th Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC COP25). 2 November.

[15] ADB. 2018. *Strategy 2030: Achieving a Prosperous, Inclusive, Resilient, and Sustainable Asia and the Pacific*. Manila. p. vi.

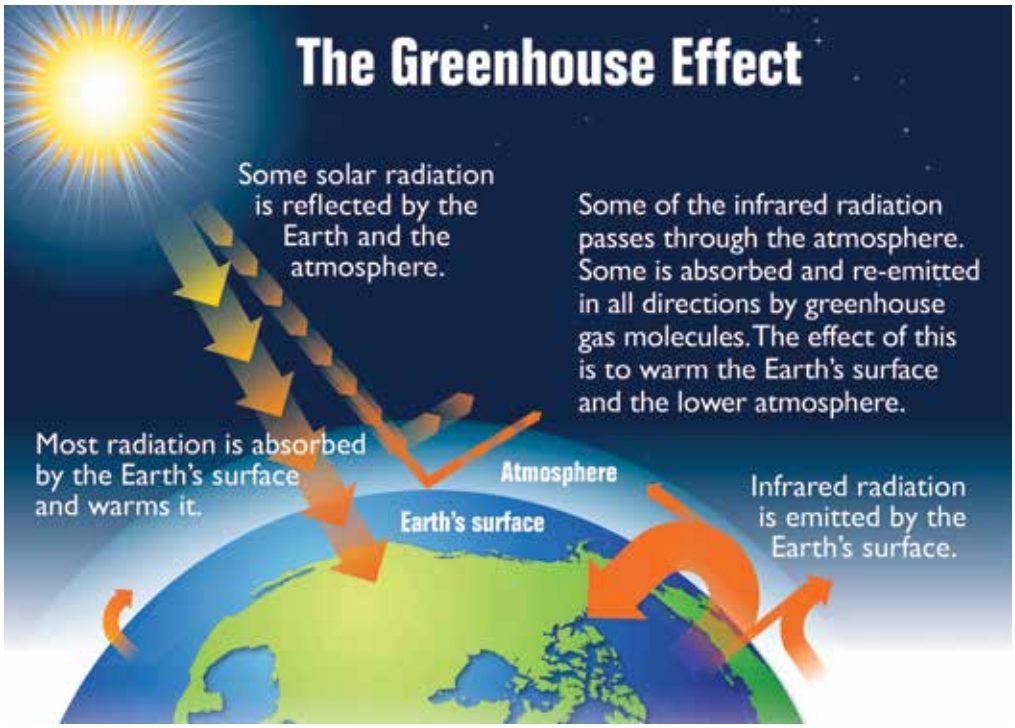
[16] The Goddard Institute for Space Studies within NASA notes that the "most trusted models produce a value of roughly 14°C, i.e. 57.2°F." See NASA. GISS Surface Temperature Analysis.

[17] National Oceanic and Atmosphere Administration (NOAA) National Centers for Environmental Information (NCEI). Anomalies vs. Temperature.

mean surface temperature because it is the earliest period with near-global temperature observations.[18]

GHGs are critical in regulating Earth's climate. These gases occur naturally in Earth's atmosphere and function like a blanket to slow down the loss of heat.[19] Figure 2 shows the operation of the greenhouse effect.

Figure 2: The Greenhouse Effect



Source: United States Environmental Protection Agency. 2012. Climate Change Indicators in the United States, 2012 (2nd ed.). Washington, DC. p. 3.

The IPCC defines GHGs to include water vapor (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), and ozone (O_3).[20]

[18] M.R. Allen et al. 2018. Framing and Context. In V. Masson-Delmotte et al., eds. *Global Warming of 1.5°C. An IPCC Special Report*. In press. p. 81. The IPCC also uses 1850–1900 as its temperature baseline in IPCC. 2013. *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, United Kingdom and New York, NY, United States: Cambridge University Press.

[19] "Glacier Change and Sea Level Rise (live public talk)," YouTube video, 1:11:57, from a presentation given by Alex Gardner at the 2017 von Kármán Lecture Series streamed live on 9 February 2017, posted by NASA Jet Propulsion Laboratory.

[20] IPCC. 2018. Annex I: Glossary. In V. Masson-Delmotte et al., eds. *Global Warming of 1.5°C. An IPCC Special Report*. In press. pp. 550–551.

The IPCC also includes human-made substances in its definition of GHGs, including halocarbons, chlorine- and bromine-containing substances, sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs). Each of these gases has a life span in the atmosphere and a different capacity for warming, known as their global warming potential.[21] As CO_2 is naturally occurring and the main long-lived gas in the atmosphere, it is the reference against which other GHGs are measured.[22]

Naturally occurring GHGs have been the dominant force in controlling Earth's climate for at least 800,000 years.[23] They are Earth's radiator. Without them, liquid water and, therefore, life on Earth would not be possible. Among the GHGs, CO_2 plays a crucial role in regulating temperatures.[24] In his address at the National Academy of Sciences, esteemed paleoclimatologist Richard Alley explained that throughout Earth's recorded history, "It is not the case that warmth made CO_2 high, it is the case that CO_2 made warmth. . . . What you see is . . . the climate history looking like the CO_2 history."[25] In summary, the more CO_2 in the atmosphere, the stronger the greenhouse effect and the warmer Earth becomes.[26]

B. The Carbon Cycle

The carbon cycle is an essential component of Earth's natural thermostat. By balancing the levels of atmospheric carbon with stored carbon, it stabilizes the global climate over the long term.[27] The carbon cycle prevents all of Earth's carbon from entering into the atmosphere simultaneously by gradually converting carbon from one form into another—by drawing carbon down from the atmosphere into rocks, soil, plants, or the ocean. The carbon cycle explains why Earth does not have a Venus-like climate—an atmosphere dominated by CO_2 and planetary temperature exceeding 400°C.

The process of drawing down CO_2 from the atmosphere and storing it in a carbon sink is called carbon sequestration.[28] The carbon cycle works slowly—over a few hundred thousand years. Hence, rapid alterations to atmospheric CO_2 can beat the climate system, causing short-term climactic shifts. While the carbon cycle would gradually rebalance global carbon, that process would likely take hundreds of thousands of years.[29]

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21 Greenhouse Gas Protocol. Global Warming Potential Values.

22 Footnote 20, p. 544; and NASA. 2008. Tracking Earth's Most Abundant Greenhouse Gas. News release. 30 October.

23 "Richard Alley—4.6 Billion Years of Earth's Climate History: The Role of CO_2," YouTube video, 24:07, from the Symposium—Earths, Moons, Mars & Stars at the National Academy of Sciences 152nd Annual Meeting, posted by National Academy of Sciences, 1 June 2015.

24 A.A. Lacis et al. 2010. Atmospheric CO_2: Principal Control Knob Governing Earth's Temperature. *Science*. 330 (6002). pp. 356–359, as corrected on 18 March 2011.

25 Footnote 23, at 15:25.

26 Footnote 19, at 6:45.

27 H. Riebeek. 2011. The Carbon Cycle. *Earth Observatory*. 16 June.

28 Footnote 12, p. 127.

29 Footnote 23, at 10:59; and footnote 12, p. 16, SPM 2.4.

C. Baseline Measurements of Atmospheric Greenhouse Gases and Temperature

Scientists have accurately measured atmospheric GHG levels and Earth's mean temperature for over 800,000 years using "proxy" data[30] from ice core samples.[31] Understanding the last million years of Earth's climate history is especially relevant to modern humans because we evolved in this environment around 200,000–300,000 years ago in Africa.[32]

Ice core samples reveal that levels of atmospheric CO_2 have fluctuated between 170 and 300 parts per million (ppm) for over 800,000 years.[33] New testing methods on older ice core samples have also confirmed that atmospheric CO_2 has not exceeded 300 ppm for 3 million years.[34] Fluctuations in CO_2 levels align with the pattern of cooling and warming during glacial–interglacial cycles—ice ages followed by warm interludes without ice sheets.[35] Earth has cycled between glacial and interglacial periods for the last 2.6 million years.[36] The data also show that fluctuations in global temperatures have mirrored fluctuations in atmospheric CO_2 for at least 800,000 years.[37] Hence, when atmospheric CO_2 increases or decreases, global temperatures follow (Figure 3) (footnotes 19 and 23).

D. Recent Changes in Atmospheric Greenhouse Gas Concentrations

In 1850, atmospheric CO_2 measured 285 ppm.[38] This level sat within the "normal" range of atmospheric CO_2 concentrations for the last 2 million years. Since the 1800s, humans have pumped CO_2 into the atmosphere by burning fossil fuels,

[30] Data generated from matter such as ice cores, coral, fossil pollen, ocean sediments, tree rings, and historical data are called "proxy" data. See NOAA NCEI. What Are "Proxy" Data?

[31] Scientists can measure atmospheric CO_2, methane, and other GHGs from gas bubbles trapped in ice core samples. See M. Kelly. 2019. Two Million-Year-Old Ice Cores Provide First Direct Observations of an Ancient Climate. Princeton University. News. 21 November; Frozen water isotopes enable scientists to measure past temperatures. See R. Mulvaney. 2004. How Are Past Temperatures Determined from an Ice Core? *Scientific American*. 20 September.

[32] J. Organ. 2018. Top 6 Human Evolution Discoveries of 2018. *PLOS BLOGS*. 11 December.

[33] D. Lüthi et al. 2008. High-Resolution Carbon Dioxide Concentration Record 650,000–800,000 Years Before Present. *Nature*. 453 (7193). pp. 379–382. See also footnotes 19 and 23.

[34] Scientists used the boron isotope proxy to test atmospheric CO_2 on a 2.7-million-year-old ice core sample. See G. Foster. 2018. 410 ppm CO_2 for April 2018 - First Time in Millions of Years.... *The Foster Lab (blog)*. 6 May; and P. Voosen. 2017. Record-Shattering 2.7-Million-Year-Old Ice Core Reveals Start of the Ice Ages. *Science*. 15 August.

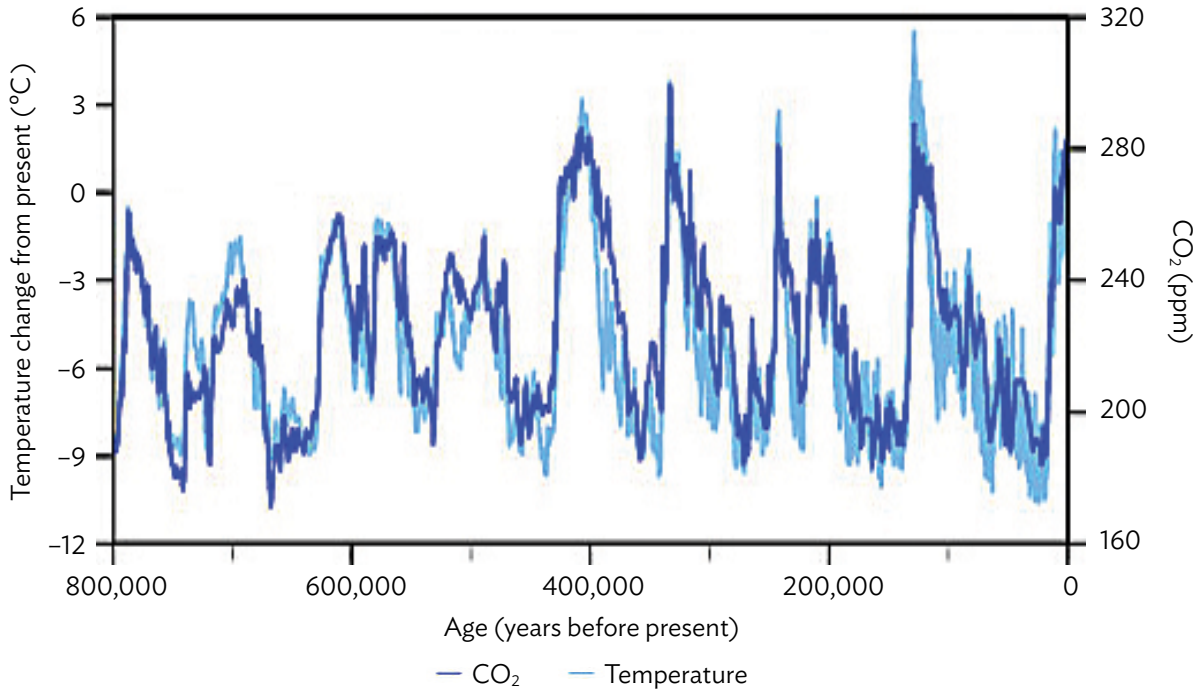
[35] Footnotes 19 and 23; and NOAA NCEI. Glacial–Interglacial Cycles.

[36] NOAA NCEI. Glacial–Interglacial Cycles.

[37] J. Jouzel et al. 2007. Orbital and Millennial Antarctic Climate Variability over the Past 800,000 Years. *Science*. 317 (5839). pp. 793–796; and footnotes 19 and 23.

[38] NASA. Global Mean CO_2 Mixing Ratios (ppm): Observations.

Figure 3: 800,000 Years of Carbon Dioxide and Temperature



C = Celsius, CO_2 = carbon dioxide, ppm = parts per million.

Notes: Light blue shows temperature changes, and dark blue shows CO_2 changes. The "present" age (bottom axis) shows the levels of atmospheric CO_2 in the mid-19th century.

Source: National Oceanic and Atmosphere Administration, National Centers for Environmental Information. Temperature Change and Carbon Dioxide Change.

with emissions rising sharply since 1970.[39] In 1958, C. David Keeling started measuring atmospheric CO_2, which had risen to 315 ppm.[40]

In March 2020, the atmospheric global CO_2 levels exceeded 413 ppm, higher than any CO_2 levels for at least 3 million years.[41] The last time CO_2 exceeded 450 ppm was around 16 million years ago.[42] Figure 4 shows the contrast between present-day atmospheric CO_2 levels and historical Antarctic temperature levels

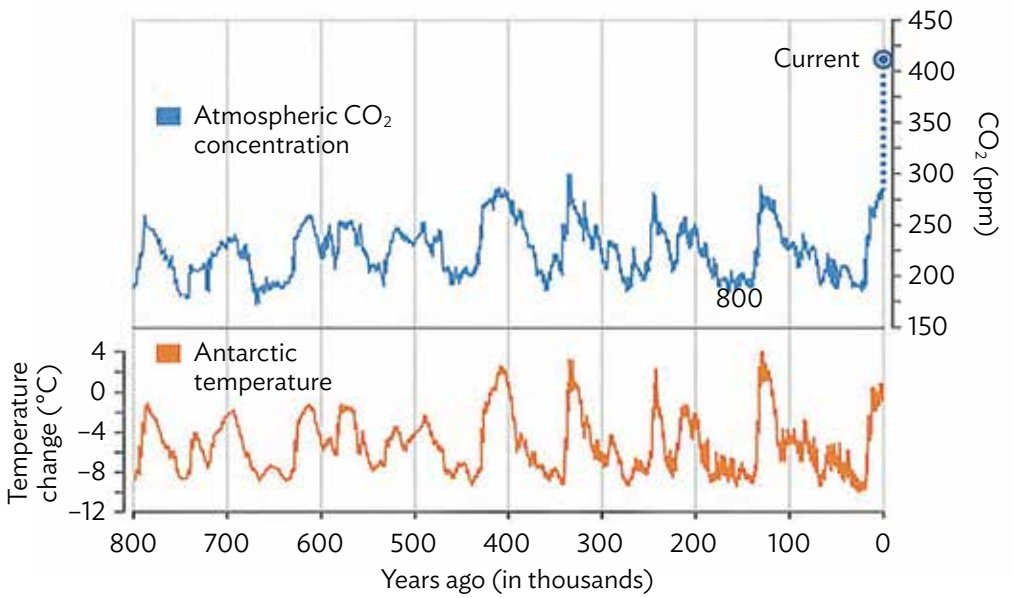
[39] Footnote 12, p. 3, Figure SPM.1(d) and p. 5, Figure SPM.2; and Union of Concerned Scientists. 2009. Why Does CO_2 Get Most of the Attention When There Are So Many Other Heat-Trapping Gases? Explainers. 6 June (updated 3 August 2017).

[40] Earth System Research Laboratories, NOAA. Trends in Atmospheric Carbon Dioxide: Monthly Average Mauna Loa CO_2 (accessed 9 June 2020).

[41] Footnote 40; G. Foster. 2018. 410 ppm CO_2 for April 2018 - First Time in Millions of Years.... *The Foster Lab (blog)*. 6 May; M. Kelly. 2019. Two Million-Year-Old Ice Cores Provide First Direct Observations of an Ancient Climate. Princeton University. News. 21 November; Y. Yan et al. 2019. Two-Million-Year-Old Snapshots of Atmospheric Gases from Antarctic Ice. *Nature*. 574 (7780). pp. 663–666; and P. Voosen. 2017. Record-Shattering 2.7-Million-Year-Old Ice Core Reveals Start of the Ice Ages. *Science*. 15 August.

[42] G. Foster. 2018. 410 ppm CO_2 for April 2018 - First Time in Millions of Years.... *The Foster Lab (blog)*. 6 May.

Figure 4: 800,000 Years of Carbon Dioxide and Temperature Compared with 2020



C = Celsius, CO_2 = carbon dioxide, ppm = parts per million.
Source: The Royal Society. 2020. Is the Current Level of Atmospheric CO_2 Concentration Unprecedented in Earth's History?

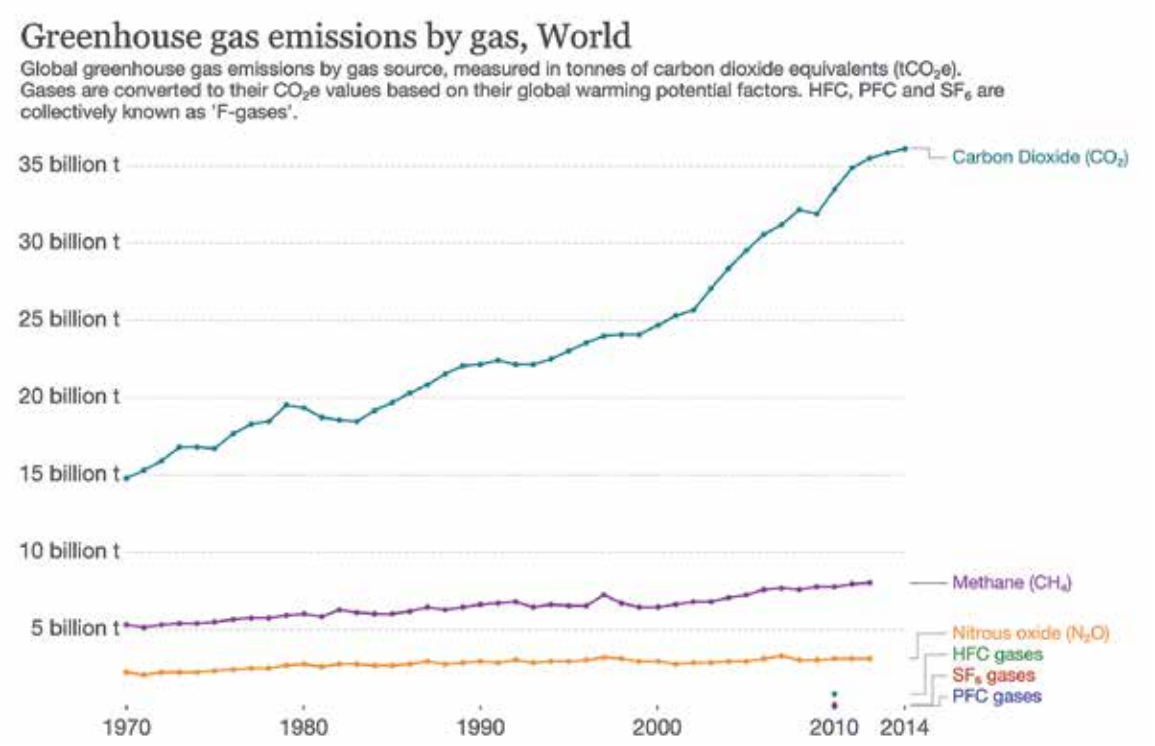
over the last 800,000 years. It shows that Antarctic temperature fluctuations correlate with cooling and warming during glacial–interglacial cycles. Antarctic weather patterns feed into global weather patterns and so are relevant for tracking historical temperature records.[43]

Atmospheric concentrations of CO_2 are so high as a result of anthropogenic emissions. Roughly half of the cumulative anthropogenic emissions between 1750 and 2011 occurred after 1974.[44] From 1970 to 2010, anthropogenic GHG emissions increased by about 90% (footnote 44). CO_2 emissions—from fossil fuel combustion and industrial processes—composed 78% of those emissions (footnote 44). In 2014, the IPCC stated that "cumulative emissions of CO_2 largely determine global mean surface warming by the late 21st century and beyond."[45] Updated figures demonstrate that global emissions of CO_2 still dominate total GHG emissions (Figure 5).

Methane and nitrous oxide atmospheric concentrations are also "unprecedented in at least 800,000 years."[46] Emissions to date have caused an uptake of energy by the climate system, driving climate change (footnote 46).

[43] Norwegian Polar Institute. Global Climate Change.
[44] Footnote 12, pp. 4 and 45.
[45] Footnote 12, p. 56.
[46] Footnote 12, p. 44.

Figure 5: Global Greenhouse Gas Emissions by Gas



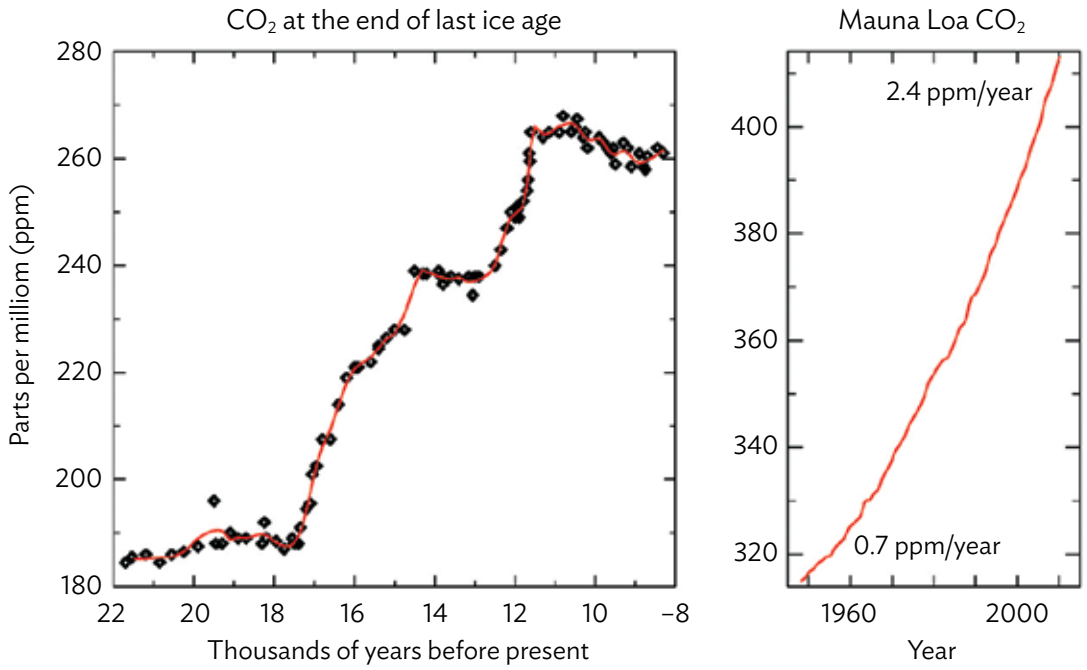
HFC = hydrofluorocarbon, PFC = perfluorocarbon, SF6 = sulfur hexafluoride, t = tonnes.
Note: Our World in Data sourced these data from the (i) Carbon Dioxide Information Analysis Center, Environmental Sciences Division, Oak Ridge National Laboratory, Tennessee, United States; and (ii) European Commission, Joint Research Centre (JRC)/ Netherlands Environmental Assessment Agency (PBL), and Emission Database for Global Atmospheric Research (EDGAR).
Source: H. Ritchie and M. Roser. 2017. CO_2 and Greenhouse Gas Emissions. Our World in Data (last revised December 2019).

E. Rates of Warming

The current rates of warming are also unprecedented. During the past million years, a warming of 4°C–7°C took around 5,000 years on average.[47] Following the last glacial maximum, it took around 6,000 years for atmospheric CO_2 to increase by around 75 ppm, causing Earth to warm to a Holocene climate.[48] Human activity is currently causing CO_2 to increase by 2.4 ppm per year (Figure 6).[49] At current rates of CO_2 emissions, what previously took 6,000 years through natural processes has taken just over 31 years.

[47] NASA Earth Observatory. How Is Today's Warming Different from the Past?
[48] E. Monnin et al. 2001. Atmospheric CO_2 Concentrations over the Last Glacial Termination. *Science*. 291 (5501). pp. 112–114.
[49] Earth System Research Laboratories, NOAA. Monthly Average Mauna Loa CO_2. Trends in Atmospheric Carbon Dioxide: Annual Mean Global Carbon Dioxide Growth Rates; and Figure 6.

Figure 6: Carbon Dioxide Increases Following Last Age vs. Modern Carbon Dioxide Increases



CO_2 = carbon dioxide, ppm = parts per million.
Source: Earth System Research Laboratories, NOAA and Scripps Institution of Oceanography.

F. Temperature Goal vs. Temperature Projections

Future warming depends on how quickly the world reduces GHG emissions and by how much. To understand the various trajectories for warming in the 21st century, the IPCC modeled different emissions pathways called representative concentration pathways (RCPs).

The RCPs map the levels of warming associated with atmospheric GHG concentrations. They include (i) a stringent mitigation scenario that would aim to likely keep global warming below 2°C (RCP2.6), (ii) two intermediate scenarios (RCP4.5 and RCP6.0), and (iii) a very high GHG emission scenario—a worst-case scenario (RCP8.5).[50] Table 2.1 (Carbon Dioxide Equivalent Concentrations and Warming in 2100) shows the warming projections of the RCPs.[51]

[50] Footnote 12, pp. 8–9 (SPM 2.1) and 56; and Z. Hausfather. 2019. Explainer: The High-Emissions 'RCP8.5' Global Warming Scenario. *Carbon Brief*. 21 August.

[51] See IPCC. 2014. Summary for Policymakers. In R.K. Pachauri et al. *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Geneva: IPCC. p. 9, Figure SPM.5(a), and p. 22, Table 3.1 in SPM.1.

Table 2.1: Carbon Dioxide Equivalent Concentrations and Warming Relative to 1850–1900

RCP Scenario or Equivalent	Carbon Dioxide Equivalent Concentrations in 2100 (ppm CO_2eq)[a]	Projected Warming in 2031–2050 above 1850–1900 Levels (°C)	Projected Warming in 2081–2100 above 1850–1900 Levels (°C)	Likely Level of Warming in 2081–2100 above 1850–1900 Levels (°C)[b]
RCP2.6	430–480	1.1–2.0	0.9–2.4	2.0°C
RCP4.5	580–720	1.3–2.2	1.7–3.3	3.0°C
RCP6.0	720–1,000	1.2–2.0	2.0–3.8	4.0°C
RCP8.5	>1,000	1.5–2.4	3.2–5.4	>4.0°C

C = Celsius, CO_2eq = carbon dioxide equivalent, ppm = parts per million, RCP = representative concentration pathway.

[a] This column lists the total concentration of all greenhouse gases (GHGs) in 2100, expressed as ppm in CO_2eq, which measures the total atmospheric concentration of all GHGs, including cooling aerosols. CO_2eq is a standard unit for measuring carbon footprints.

[b] The Intergovernmental Panel on Climate Change (IPCC) defines "likely" as a 66%–100% chance.

Sources: IPCC. 2014. Summary for Policymakers. In R.K. Pachauri et al. *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* Geneva: IPCC. p. 9, Figure SPM.5(a) and p. 22, Table 3.1 in SPM.1; and IPCC. 2019. Summary for Policymakers. In H.-O. Pörtner et al., eds. *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate*. In press. p. 8, Table SPM.1.

Under these IPCC models, only RCP2.6 has a reasonable chance of limiting temperature increase to 2°C in 2100.[52]

Analysis of the RCPs confirmed that temperatures throughout this century would directly respond to cumulative levels of CO_2 emissions.[53] Hence, the more CO_2 the world emits, the hotter it will get. The IPCC stressed that stabilizing the global temperature increase to 1.5°C–2°C above preindustrial temperatures by 2100 requires an "urgent and fundamental departure from business as usual" and reaching net zero CO_2 emissions by 2050.[54]

The global community can meet these objectives by setting and meeting a carbon budget—capping cumulative net global anthropogenic CO_2 emissions from the preindustrial period to limit global warming, to 1.5°C–2°C for example.[55] Scientists estimate that the total budget, including past and present emissions, is around

[52] The IPCC clarifies that if emissions never exceed 530 ppm CO_2eq, it is more likely than not (>50%–100%) that temperatures could stay at 2°C under the 480–530 ppm CO_2eq emission scenario. See footnote 51, p. 22, Table 3.1 in SPM.1.

[53] Footnote 51, p. 9, Figure SPM.5 and p. 22, Table 3.1 in SPM.1.

[54] Footnote 12, p. v. Net zero CO_2 emissions are achieved when "anthropogenic CO_2 emissions are balanced globally by anthropogenic CO_2 removals over a specified period." See footnote 1, p. 24.

[55] L. Sussam. 2018. Carbon Budgets Explained. *Carbon Tracker (blogs)*. 6 February.

1 trillion tonnes of carbon (or 1,000 PgC).[56] In 2018, the IPCC described the remaining carbon budget as follows:

(i) 420 gigatonnes of CO_2 ($GtCO_2$) for a 66% chance of limiting warming to 1.5°C—the safer bet, or
(ii) 580 $GtCO_2$ for a 50% chance of limiting warming to 1.5°C.[57]

Table 2.2 summarizes the annual emissions compatible with meeting the Paris Agreement goals with no temperature overshoot, "temporary exceedance of a specified level of global warming."[58]

Table 2.2: Estimated Annual Benchmark Emissions Compatible with Paris Agreement Temperature Goals

Target Year	1.5°C ($GtCO_2e\ yr^{-1}$)[a]	2°C ($GtCO_2e\ yr^{-1}$)	NDC Pledges ($GtCO_2e\ yr^{-1}$)[b]
2025	40	46	51–54
2030	25–30 Global net anthropogenic CO_2 emissions must decline by about 45% from 2010 levels by 2030	38 Global net anthropogenic CO_2 emissions must decline by about 25% by 2030	52–58
2050	Net zero CO_2 + deep reductions in non-CO_2 emissions		–
2070		Net zero	–

CO_2 = carbon dioxide, $GtCO_2e\ yr^{-1}$ = gigatonne of CO_2 equivalent per year, NDC = nationally determined contributions.

[a] $GtCO_2e\ yr^{-1}$ measures the total atmospheric concentration of all greenhouse gases, including cooling aerosols. CO_2 equivalent is a standard measurement for carbon footprints.

[b] This column describes the unconditional estimated emissions contained in the NDC pledges.

Sources: J. Rogelj et al. 2018. Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development. In IPCC. *Global Warming of 1.5°C. An IPCC Special Report*. In press. pp. 95 and 126; and Climate Action Tracker. CAT Emissions Gaps.

[56] World Resources Institute. Infographic: The Global Carbon Budget.
[57] J. Rogelj et al. 2018. Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development. In V. Masson-Delmotte et al., eds. *Global Warming of 1.5°C. An IPCC Special Report*. In press. p. 96.
[58] Footnote 1, p. 24.

III. Global Progress with Emissions Reduction Pledges Post-Paris Agreement

In 2015–2016, countries submitted their first nationally determined contributions (NDCs) in accordance with the Paris Agreement. Report Three in this series discusses the national legal frameworks as well as the NDCs submitted by ADB's DMCs in South Asia, Southeast Asia, and the Pacific.

The pledges in the first NDCs are not on track for stabilizing global warming to 1.5°C above preindustrial temperatures. Emissions will reach 52–58 $GtCO_2e\ yr^{-1}$ by 2030 (or 50–54 $GtCO_2e\ yr^{-1}$ if conditional pledges are implemented), exhausting the 1.5°C carbon budget by 2030.[59] These emission pathways are consistent with a warming of up to 3.2°C by 2100, with continued warming in the next century.[60] Modest national starting points in first NDC pledges were a by-product of the Paris Agreement's design. In line with the Paris Agreement's ambition mechanism, countries should enhance their climate pledges every 5-year NDC cycle.[61]

Reversing a temperature overshoot of 0.2°C or more would require a sharp drop in emissions plus swift and large-scale deployment of CO_2 removal technology after 2030.[62] The IPCC describes this option as risky because CO_2 removal technology is unproven and "might not be achievable given considerable implementation challenges."[63] Thus, limiting warming to 1.5°C without overshoot and reliance upon large-scale CO_2 removal relies upon decreasing CO_2 emissions well before 2030.[64]

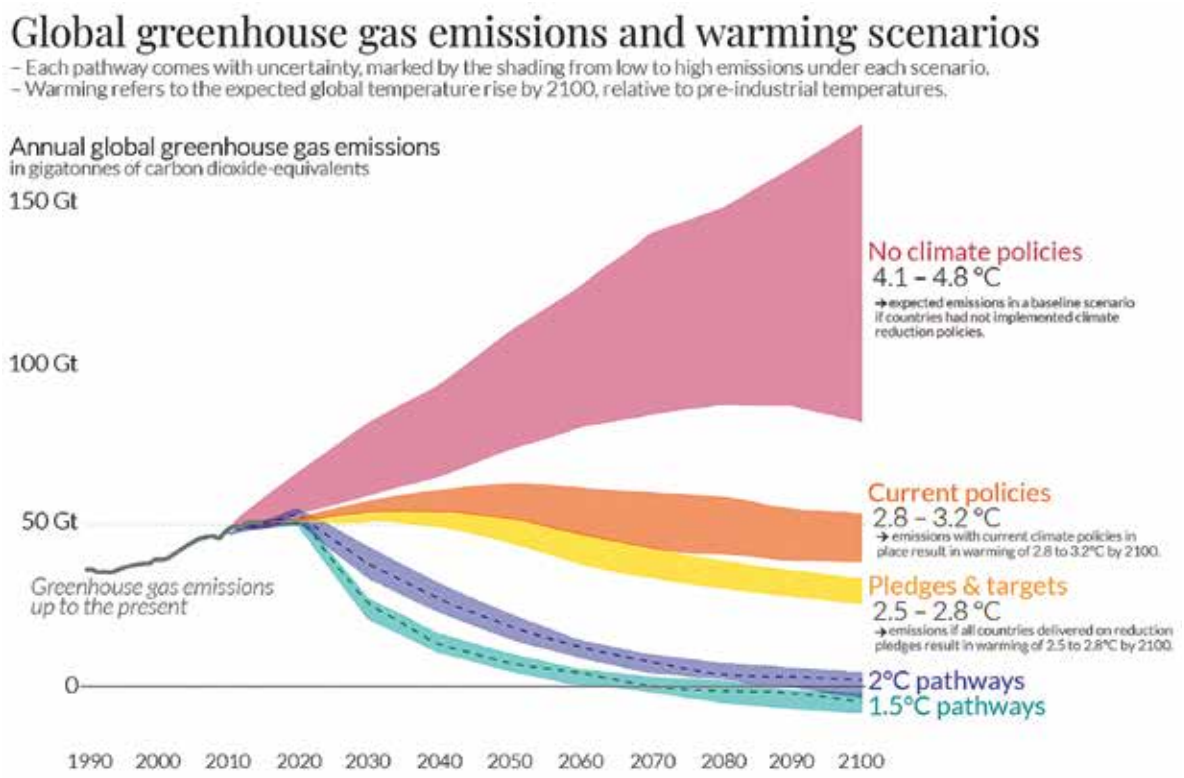
Figure 7 shows how the current NDC pledges compare with emission pathways required to limit warming to 1.5°C or 2°C above preindustrial temperatures.

There is good news.

The world has not yet exhausted the carbon budget. So cumulative anthropogenic GHG emissions until 2018 are unlikely to cause a warming of over 1.5°C in the next 20–100 years.[65] Ideally, then, this century's 20s could roar to life with climate action and sustainable growth. "However, lack of global cooperation,

[59] The first NDC pledges will result in 400–560 $GtCO_2$ of emissions by 2030. See footnote 57, p. 126.
[60] Climate Action Tracker. Addressing Global Warming; United Nations Environment Programme. 2019. *Emissions Gap Report 2019*. Nairobi. p. xix. In its report on the impacts of a 1.5°C warming, the IPCC considered that the first NDCs would result in a warming of up to 3°C. See footnote 1, p. 18.
[61] C. Revill. 2016. The Paris Agreement Ambition Mechanism. E3G. Commentary. 16 May; and S. Yeo. 2015. Explainer: The 'Ratchet Mechanism' within the Paris Climate Deal. *Carbon Brief*. 3 December.
[62] Footnote 57, pp. 126–127, section 2.3.5.
[63] Footnote 57, p. 96; and footnote 1, p. 18, para. D.1.2.
[64] Footnote 1, p. 18, part D.1.
[65] Footnote 1, p. 5, para. A.2.1.

Figure 7: Global Greenhouse Gas Emission Scenarios vs. Temperature Goals



C = Celsius, $GtCO_2e$ = gigatonnes of carbon dioxide equivalents.
Source: Our World in Data. CO_2 and Greenhouse Gas Emissions, Future Emissions Scenarios.

lack of governance of the required energy and land transformation, and increases in resource-intensive consumption are key impediments to achieving 1.5°C pathways."[66] Thus, limiting emissions and supporting low emissions now—in post-COVID-19 economic recovery—is critical.

Sustaining net zero global anthropogenic emissions after 2100 will be needed to prevent further warming, reverse ocean acidification, and limit sea level rise.[67] This is because long-lived GHGs can continue to cause warming in the atmosphere.[68] Additionally, the oceans will continue to absorb and release heat, and vegetation changes due to deforestation and land degradation may release emissions (footnote 68). Deforestation has contributed to 77% of the emissions from land

[66] Footnote 57, p. 95.
[67] Footnote 1, p. 5, para. A.2.2.
[68] Nitrous oxide has a 100-year lifetime, and around 15%–40% of a CO_2 emission pulse will remain in the atmosphere for 1,000 years. See M. Collins et al. 2013. Long-Term Climate Change: Projections, Commitments and Irreversibility. In T.F. Stocker et al., eds. *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, United Kingdom and New York, NY, United States: Cambridge University Press. pp. 1106–1107, FAQ 12.3.

use and land cover change since 1850.[69] Future emissions from land use and land cover change will depend on practices and conservation effort.

IV. The Ocean and Cryosphere

In late 2019, the IPCC released a report considering the impact of climate change on the ocean and Earth's cryosphere:

> All people on Earth depend directly or indirectly on the ocean and cryosphere. The global ocean covers 71% of the Earth surface and contains about 97% of the Earth's water. The cryosphere refers to frozen components of the Earth system. Around 10% of Earth's land area is covered by glaciers or ice sheets. The ocean and cryosphere support unique habitats, and are interconnected with other components of the climate system through global exchange of water, energy and carbon. The projected responses of the ocean and cryosphere to past and current human-induced greenhouse gas emissions and ongoing global warming include climate feedbacks, changes over decades to millennia that cannot be avoided, thresholds of abrupt change, and irreversibility.[70]

Oceans play a significant role in the carbon cycle by absorbing heat and carbon. The ocean's absorption of heat and carbon has, however, affected sea levels and acidity.

A. Sea Levels

Proxy data shows that for at least 800,000 years, sea levels have gone up and down in correlation with global mean temperature (Figure 8).[71] Because atmospheric CO_2 drives global mean temperature changes, it also drives sea level change (see Figure 8).[72]

Global sea levels have varied by more than 100 meters (m) over the last few million years as Earth fluctuated between glacial and interglacial periods. Sea levels increased in the first half of the Holocene but then stabilized, with the global mean sea level (GMSL) elevating about 1 m over the last 4,000 years.[73] The GMSL started rising faster during 1905–1945, increasing by around 20 centimeters (cm) since 1880.[74]

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69 L. Olsson et al. 2019. Land Degradation. In P.R. Shukla et al., eds. *Climate Change and Land: An IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems*. In press. p. 368. See also International Union for Conservation of Nature. 2015. Land Degradation and Climate Change. *Issues Brief*. Gland, Switzerland.

70 IPCC. 2019. Summary for Policymakers. In H.-O. Pörtner et al., eds. *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate*. In press. p. 5.

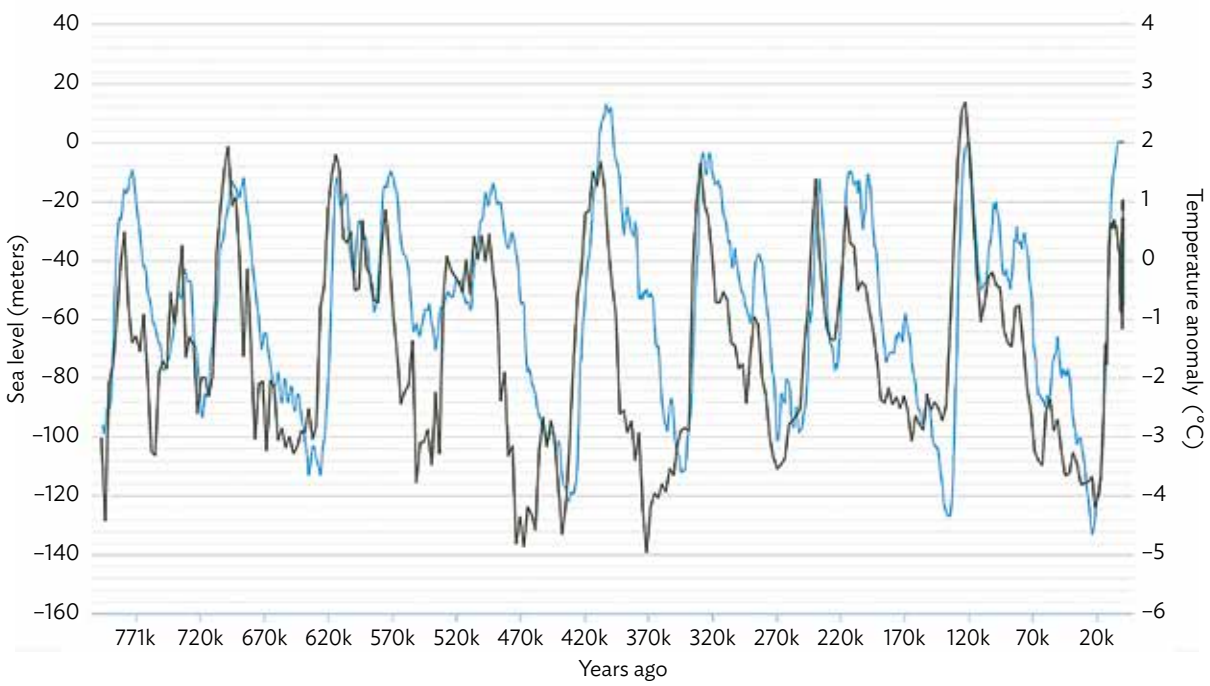
71 J. Hansen et al. 2007. Climate Change and Trace Gases. *Phil. Trans. R. Soc. A*. 365 (1856). pp. 1925–1954.

72 Footnote 19 and footnote 23.

73 K. Lambeck et al. 2014. Sea Level and Global Ice Volumes from the Last Glacial Maximum to the Holocene. *Proceedings of the National Academy of Sciences*. 111 (43). pp. 15296–15303.

74 EPA. Sea Level. The IPCC reported that total GMSL rise for 1902–2015 was 16 cm. Footnote 70, p. 10, para A.3.1.

Figure 8: Temperature and Sea Level for 770,000 Years



C = Celsius, k = thousand.

Notes: 1. Blue shows temperature fluctuations, and black shows fluctuations in the sea levels.

2. 2 Degrees Institute sourced sea level data from different sources that modeled sea levels from (i) 800,000–3,000 years ago, (ii) from 3,000 years ago to 1890, (iii) 1890–1993, and (iv) 1993–2020.

Source: 2 Degrees institute. Global Sea Levels Graph.

The rate of sea level rise has doubled since 1992.[75] The National Aeronautics and Space Administration (NASA) reported that the GMSL has grown almost 10 cm since 1993, roughly 0.33 cm per year.[76] The IPCC described the rates of sea level rise of 3.1–4.1 millimeters per year during 2006–2015 as unprecedented over the last century.[77] Sea levels are now higher than at any stage during human civilization.

Thermal expansion and melting land ice (glaciers and ice sheets) are the dominant causes of recent GMSL rise.[78] Oceans have absorbed 90% of the excess heat in the climate system since 1970, causing water to expand.[79] During 2006–2015, melting glaciers and ice sheets was the main cause of sea level rise as meltwater flowed into the oceans (footnote 77).

[75] EPA. Sea Level; and Climate Nexus. Sea Level Rise.

[76] NASA. Global Mean Sea Level (accessed 3 June 2020); and EPA. Sea Level.

[77] Footnote 70, p. 10.

[78] J.A. Church et al. 2013. Sea Level Change. In T.F. Stocker et al., eds. *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, United Kingdom and New York, NY, United States: Cambridge University Press. p. 1139.

[79] Footnote 70, p. 9; and L. Dahlman and R. Lindsey. 2020. Climate Change: Ocean Heat Content. *Climate.gov*. 13 February.

Sea levels in 2100 will depend on the extent of global warming. In 2019, the IPCC released updated projections based on improved modeling and knowledge about land ice contribution to GMSL. Based on the RCPs, sea levels could increase by 0.51 m if global temperatures rise 1.5°C above preindustrial averages (see Table 2.3).

Table 2.3: Projected Global Mean Sea Level Rise

RCP Scenario or Equivalent	IPCC Estimate of Likely Level of Warming in 2081–2100 Relative to 1850–1900 Average (°C)	Projected GMSL Rise in 2081–2100 Relative to 1986–2005 (m) mean [range]	Projected GMSL Rise in 2100 Relative to 1986–2005 (m) mean [range]
1.5[a]	1.5°C	–	0.51 [0.26–0.77]
RCP2.6[b]	2.0°C	0.39 [0.26–0.53]	0.43 [0.29–0.59]
2.0[a]	2.0°C	–	0.64 [0.35–0.93]
RCP4.5[c]	3.0°C	0.47 [0.32–0.63]	0.53 [0.36–0.71]
RCP6.0[c]	4.0°C	0.48 [0.33–0.63]	0.55 [0.38–0.73]
RCP8.5[b]	>4.0°C	0.71 [0.51–0.92]	0.84 [0.61–1.10]

C = Celsius, GMSL = global mean sea level, IPCC = Intergovernmental Panel on Climate Change, m = meter, RCP = representative concentration pathway.
Note: The IPCC defines "likely" as a 66%–100% chance.

Sources:

[a] O. Hoegh-Guldberg et al. 2018. Impacts of 1.5°C Global Warming on Natural and Human Systems. In V. Masson-Delmotte et al., eds. *Global Warming of 1.5°C. An IPCC Special Report*. In press. p. 207

[b] IPCC. 2019. Summary for Policymakers. In H.-O. Pörtner et al., eds. *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate*. In press. p. 20.

[c] J.A. Church et al. 2013. Sea Level Change. In T.F. Stocker et al., eds. *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge, United Kingdom and New York, NY, United States: Cambridge University Press. p. 1182, Table 13.5.

The GMSL will continue to rise after 2100 due to thermal expansion and ice sheet melt. The IPCC noted that "irreversible loss of the West Antarctic ice sheet and marine ice sheet instability is estimated to lie between 1.5°C and 2°C."[80] Either event—a tipping point—might cause 1–2 m of sea level rise over 200 years, causing a major shift in the climate system (footnote 80). Continued ice sheet melt will also decrease the reflectiveness of the polar ice caps (albedo), meaning the oceans will absorb solar energy as heat rather than ice reflecting the energy, creating a positive climate change feedback loop—exacerbating warming.[81] The extent of future sea level rise thus depends on future cumulative emissions and the impact of positive feedback loops.[82]

[80] O. Hoegh-Guldberg et al. 2018. Impacts of 1.5°C Global Warming on Natural and Human Systems. In V. Masson-Delmotte et al., eds. *Global Warming of 1.5°C. An IPCC Special Report*. In press. p. 257, 3.5.2.5: RFC 5—Large-Scale Singular Events.

[81] Footnote 80, p. 262.

[82] Footnote 78, p. 1140.

There is evidence of how sea levels react to 2°C warming. During the last interglacial period (116,000–129,000 years ago), the global mean temperature was 2°C warmer than preindustrial levels. Paleo sea records have established that the GMSL was 5–10 m higher than the present day.[83]

Regional sea level change is relevant for Asia and the Pacific. The IPCC forecasts that regional differences could be ±30% of the GMSL rise due to "land ice loss and variations in ocean warming and circulation."[84] During 1993–2012, sea levels in the western Pacific Ocean increased three times more than the GMSL rise.[85] NASA also predicts that sea levels in the tropics will be 20% higher.[86]

Sea level rise will have devastating consequences globally, especially for people in Asia and the Pacific.[87] From 2050, many low-lying megacities and small island developing states will experience more extreme sea level events that previously only occurred once per century—historical centennial events.[88] Globally, around 680 million people live in low-lying coastal zones, less than 10 m above sea level (footnote 70). By 2050, this number will swell to 1 billion people. Small island developing states are home to around 65 million people. Excluding Papua New Guinea, 97% of Pacific Islanders live within 10 kilometers of the coast.[89] Combined with increases in tropical storm intensity, extreme waves, and salinity intrusion, sea level rise threatens their homes and water sources. Across the Pacific, rising seas threaten to swallow islands and land, undermining the viability of islands and countries, and creating an existential threat for those peoples.[90]

B. Ocean Acidification

Oceans also play an essential role in absorbing and storing carbon. They contain 60 times more carbon than the atmosphere.[91] During 2002–2011, oceans absorbed 26% of all CO_2 emissions.[92] Once drawn down into the oceans, CO_2 dissolves and produces carbonic acid, changing the ocean's acid level—its pH. The ocean's surface pH has dropped from 8.21 to 8.10 since the preindustrial era, causing a 30% increase in the ocean's acidity—"faster than any known change

[83] Footnote 78, p. 1146.
[84] Footnote 70, p. 10, para. A.3.4.
[85] Footnote 78, p. 1148.
[86] NASA. Understanding Sea Level: Water Mass Change.
[87] For an analysis of sea level rise impacts in the Pacific, see R.C. Asuncion and M. Lee. 2017. Impacts of Sea Level Rise on Economic Growth in Developing Asia. *ADB Economics Working Paper Series. No. 507*. Manila: ADB.
[88] Footnote 70, p. 20, para. B.3.4.
[89] N.L. Andrew et al. 2019. Coastal Proximity of Populations in 22 Pacific Island Countries and Territories. *PLOS One*. 30 September.
[90] T. Law. 2019. The Climate Crisis Is Global, but These 6 Places Face the Most Severe Consequences. *Time*. 30 September; A. Klein. 2017. Eight Low-Lying Pacific Islands Swallowed Whole by Rising Seas. *NewScientist*. 7 September; and E.A. Roy. 2019. 'One Day We'll Disappear': Tuvalu's Sinking Islands. *The Guardian*. 16 May.
[91] NOAA NCEI. Temperature Change and Carbon Dioxide Change.
[92] R. Monroe. 2013. How Much CO_2 Can the Oceans Take Up? *Scripps Institution of Oceanography*. 3 July.

in ocean chemistry in the last 50 million years."[93] More than half of that acidity change occurred in the last 30 years.[94] Ocean acidity in 2100 will depend on emission levels this century.

The IPCC considers it "virtually certain" that open ocean surface pH will decline by around 0.039 pH units by 2081–2100 under the RCP2.6 scenario compared with the 2006–2015 baseline. This outcome would stabilize ocean surface pH at above 8.0. In contrast, the RCP8.5 scenario will drop ocean surface pH by 0.3 pH units relative to 2006–2015, causing ocean pH to dip below 8.0, which means greater acidity.[95]

The acidity levels under the RCP8.5 scenario would very likely result in the Arctic and Southern oceans, and the North Pacific and Northwestern Atlantic oceans becoming "corrosive for the major mineral forms of calcium carbonate."[96] Higher levels of ocean acidity make it harder for shellfish and corals "to extract calcium from the water to build their shells and skeletons."[97] Their shells grow slower and become thinner, eventually causing death, or the water simply dissolves the shell.

Acidification and oxygen loss in oceans alter ecosystems and can cause extinction events. During the Cretaceous–Paleogene extinction event 66 million years ago, killing 75% of marine life, ocean pH dropped by 0.25 pH units following the Chicxulub meteorite impact.[98] Scientists contend that it was ocean acidification that caused the mass extinction of marine life (footnote 98). Seemingly small shifts in ocean pH, therefore, can have enormous consequences. A 2019 study estimated that ocean pH could drop by 0.4 pH units by 2100 if carbon emissions do not abate—the RCP8.5 scenario.[99] The same study predicted that keeping global warming to a 2°C rise would limit the drop in the ocean's pH level to 0.15 pH units by 2100 (footnote 99). The susceptibility of marine ecosystems to ocean acidification further supports the need to meet the global carbon budget.

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93 The Ocean Portal Team. 2018. Ocean Acidification. Smithsonian Institution. See also R. Lindsey. 2020. Climate Change: Atmospheric Carbon Dioxide. *Climate.gov*. 20 February; and EPA. Understanding the Science of Ocean and Coastal Acidification.

94 Since the late 1980s, the ocean's surface pH has declined by 0.017–0.027 pH units per decade. See footnote 70, p. 9, para. A.2.5.

95 IPCC. 2019. Technical Summary. In H.-O. Pörtner et al., eds. *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate*. In press. p. 62; and footnote 70, p. 7, Figure SPM.1 and p. 19, para. B.2.3.

96 IPCC. 2019. Technical Summary. In H.-O. Pörtner et al., eds. *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate*. In press. p. 62.

97 R. Lindsey. 2020. Climate Change: Atmospheric Carbon Dioxide. *Climate.gov*. 20 February.

98 D. Carrington. 2019. Ocean Acidification Can Cause Mass Extinctions, Fossils Reveal. *The Guardian*. 21 October; and M.J. Henehan et al. 2019. Rapid Ocean Acidification and Protracted Earth System Recovery Followed the End-Cretaceous Chicxulub Impact. *Proceedings of the National Academy of Sciences*. 116 (45). pp. 22500–22504.

99 D. Carrington. 2019. Ocean Acidification Can Cause Mass Extinctions, Fossils Reveal. *The Guardian*. 21 October.

V. Understanding the Impacts of a 1.5°C Warming

In October 2018, the IPCC released a special report, Global Warming of 1.5 °C.[100] Prepared at the request of the Conference of the Parties of the UNFCCC, the report (i) outlines the impacts of global warming of 1.5°C above preindustrial levels, and (ii) describes emission pathways to strengthen global responses to climate change.

A. Impacts of Global Warming of 1.5°C

"For some people, this is a life or death situation, without a doubt."[101]

Climate impacts of 2°C warming will be much worse than we previously understood. The report stresses that limiting global warming to 1.5°C is not safe for everyone but will significantly lessen the environmental impacts of climate change. "Every extra bit of warming matters, especially since warming of 1.5°C or higher increases the risk associated with long-lasting or irreversible changes, such as the loss of some ecosystems," said Hans-Otto Pörtner, co-chair of IPCC Working Group II.[102] Further, lessening the impacts of climate change will have co-benefits for building more sustainable and equitable futures.

The report clarifies that 1.5°C is a much safer temperature goal. Table 2.4 summarizes some of the key findings of this comprehensive report.

B. Pathways to 1.5°C

"The good news is that some of the kinds of actions that would be needed to limit global warming to 1.5°C are already underway around the world, but they would need to accelerate," said Valerie Masson-Delmotte, co-chair of Working Group I (footnote 102).

Limiting global warming to 1.5°C above preindustrial temperatures is possible. Global communities have commenced actions to limit global warming, but these actions must accelerate.[103] "Pathways limiting global warming to 1.5°C with no or limited overshoot would require rapid and far-reaching transitions in energy,

[100] IPCC. Special Report: Global Warming of 1.5°C. There were 133 contributing authors, who cited over 6,000 scientific references. The 91 lead authors came from 44 countries. See IPCC. 2018. Summary for Policymakers of IPCC Special Report on Global Warming of 1.5°C Approved by Governments. News release. 8 October.

[101] Natalie Mahowald, author of the Summary for Policymakers in *Global Warming of 1.5°C*. Quoted in Climate Nexus. IPCC 1.5°C Report: Planet Nearing Tipping Point.

[102] IPCC. 2018. Summary for Policymakers of IPCC Special Report on Global Warming of 1.5°C Approved by Governments. News release. 8 October.

[103] United Nations. 2018. Special Climate Report: 1.5°C Is Possible But Requires Unprecedented and Urgent Action. *Sustainable Development Goals (blog)*. 8 October.

Table 2.4: Summary of Projected Risks of Global Warming of 1.5°C and 2°C

SECTOR	RISK	1.5°C RISKS	2°C RISKS	RISK DIFFERENCE: 1.5°C vs. 2°C
PEOPLE	**Heat waves**	**Widespread** extreme heat waves in the tropics	**1.7 billion** more people exposed to severe heat waves **420 million** more people exposed to extreme heat waves **65 million** more people exposed to exceptional heat waves	**2x** severe heat waves
	Small island developing states (SIDS)	**Several atoll islands inhabitable** from decreased fresh water and increased sea levels and wave heights	**Marine systems** and associated livelihoods in SIDS face higher risks	**Increased** risk
	Agriculture and **crop yields**	**Reductions** in net yields of maize, rice, wheat	**Higher reductions** in net yields of maize, rice, wheat **7%–10% loss** of rangeland livestock	**Increased** risk
FRESH WATER	**Water stress**	**50%** fewer people exposed to water stress compared with 2°C risks	Around **492 million people** exposed to new or aggravated water scarcity[a]	**2x**
	Fluvial flood	**100%** more people affected than in 1976–2005	**170%** more people affected than in 1976–2005	**70%** worse
	Drought	Up to **350.2 million** people affected	Up to **410.7 million** people affected	**15%** worse
LAND ECOSYSTEMS	**Species** losing more than 50% of their range	**6%** of insects, **4%** of vertebrates, **8%** of plants	**18%** of insects, **8%** of vertebrates, **16%** of plants	**2x–3x**

SECTOR	RISK	1.5°C RISKS	2°C RISKS	RISK DIFFERENCE: 1.5°C vs. 2°C
OCEAN	**Sea level rise**	**0.51 meter**	**0.64 meter**	**0.10 meter** 10.4 million more people exposed Slower sea level rise affords more opportunities for adaptation
	Coral reef decline	**70%–90%**	**99%**	**29%** worse
	Arctic free of sea ice	At least **once every 100 years**	At least **once every 10 years**	**10 times** worse
	Ice sheet instability (Antarctica and Greenland)		**Irreversible loss of ice sheets possible,** potentially triggering multimeter sea level rise	**Potentially** large risk increase
	Mangroves impacted	**Medium**	**Medium**	**Uncertain** and depends on other human activities
	Marine fisheries decline	**1.5 million** tonnes	**3 million** tonnes	**2x**
	Coastal ecosystem losses from storms, precipitation, and sea level rise	**High**	**High–Very High**	**Large** risk increase
COASTAL	**Area exposed**	**562–575 thousand km²**	**590–613 thousand km²**	**25–38** when temperatures first reached and **10–17** in 2100
	People exposed	**128–143 million**	**141–151 million** (+ 0–6 million) in 2100	**5%–9%** worse
	People at risk	**2–28 million**	**15–53 million**	**Risk increases** but depends on adaptation
	Coastal structure loss and livelihood impacts	**High**	**High–Very High**	**Large** risk increase

[a] The IPCC reports that an "additional 8% of the world population at 2000" would be exposed to water stress. The global population in 2000 was around 6.15 billion. See Worldometer. World Population by Year.

Source: O. Hoegh-Guldberg et al. 2018. Impacts of 1.5.C Global Warming on Natural and Human Systems. In V. Masson-Delmotte et al., eds. *Global Warming of 1.5°C. An IPCC Special Report*. In press. Chapter 3, pp. 213, 247–250, 257, and Table 3.5.

land, urban and infrastructure (including transport and buildings), and industrial systems."[104] These transitions are unprecedented in scale.

Governments can reduce national emissions by implementing different mitigation portfolios that balance energy reductions and resource intensity, decarbonization rates, and CO_2 removal. Broadly, there are two options for limiting global warming to 1.5°C by 2100: (i) keeping global warming to 1.5°C or allowing a limited overshoot, which is later reversed; or (ii) allowing a higher overshoot and then reversing the excess. Both options, however, require the global community to reach net zero emissions of CO_2 by 2050. Emissions of other GHGs—methane, black carbon, and nitrous oxide in particular—must also be reduced. That said, the IPCC models do not rely on the non-CO_2 emissions reaching net zero.

1. Illustrative Pathways for Limiting Global Warming

Given the variability in limiting global warming, the IPCC modeled four illustrative pathways, shown in Table 2.5.

Scenarios for P1 and P2 are those that would see no or limited overshoot. As highlighted earlier, the IPCC regards CO_2 removal as a risky option because it would require governments to upscale and deploy CO_2 removal technologies "at rates and volumes that might not be achievable given considerable implementation challenges."[105] Delayed action also comes with the risks of escalating costs, investments locked into "carbon-emitting infrastructure, stranded assets, and reduced flexibility in future response options" (footnote 105).

Table 2.5: Four Illustrative Pathways for Limiting Global Warming to 1.5°C in 2100

Pathway	Scenario Description
P1	Low energy demand up to 2050 with downsized energy systems that enable rapid decarbonization of energy supply Afforestation is the only CO_2 removal option under the P1 pathway
P2	Sustainability-oriented scenario with sustainable consumption patterns, low-carbon technology innovation, and well-managed land systems with limited Bioenergy with Carbon Capture and Storage (BECCS) plus afforestation for CO_2 removal
P3	Middle-of-the-road scenario that achieves emissions reductions by changing the way energy is produced, with less emphasis on reducing energy demand Greater reliance on BECCS and CO_2 removal
P4	Fossil-fuel intensive and high energy demand scenario in which emissions reductions are achieved with technology Strong reliance on CO_2 removal with BECCS

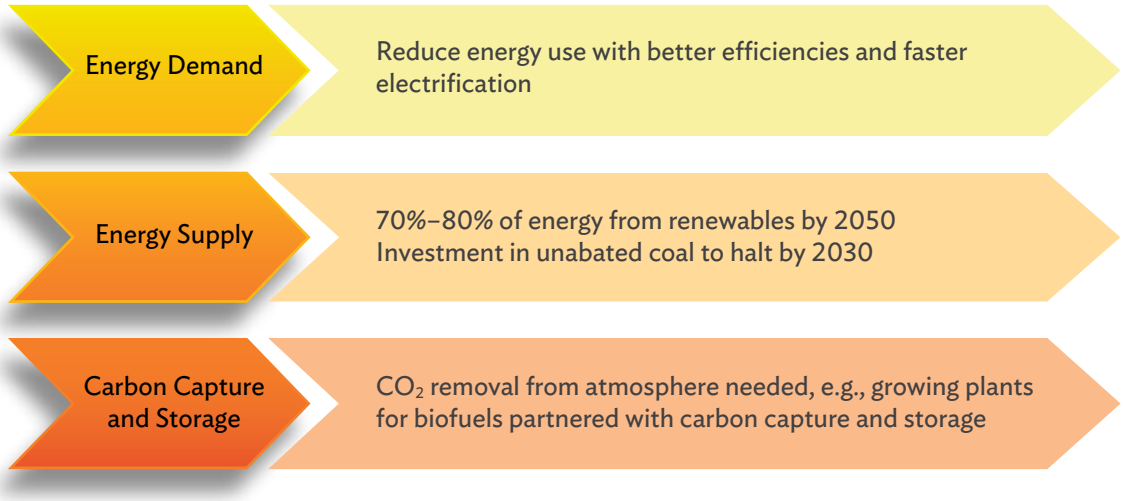
CO_2 = carbon dioxide.
Source: IPCC. 2018. Summary for Policymakers. In V. Masson-Delmotte et al., eds. *Global Warming of 1.5°C. An IPCC Special Report.* In press. p. 14.

[104] Footnote 1, p. 15. para. C.2.
[105] Footnote 1, p. 18, para. D.1.2.

2. Mitigation Pathways to 1.5°C

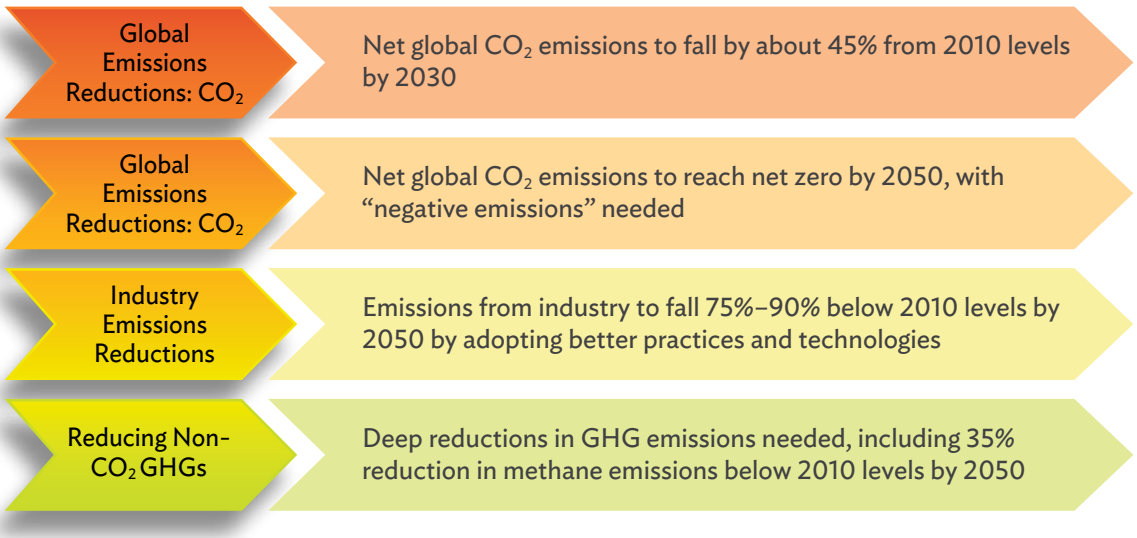
The range of recommended options for mitigation—emissions reductions—within the IPCC's report is comprehensive. Figures 9 and 10 summarize the major energy pathways and emissions reductions needed.

Figure 9: Energy Pathways and Carbon Capture



CO_2 = carbon dioxide.
Source: IPCC. 2018. Summary for Policymakers. In V. Masson-Delmotte et al., eds. *Global Warming of 1.5°C. An IPCC Special Report*. In press.

Figure 10: Emissions Reductions



CO_2 = carbon dioxide, GHG = greenhouse gas.
Source: IPCC. 2018. Summary for Policymakers. In V. Masson-Delmotte et al., eds. *Global Warming of 1.5°C. An IPCC Special Report*. In press.

C. Adapting to a 1.5°C Warmer World

Adaptation needs will generally be lower if global warming is limited to 1.5°C compared with 2°C.[106] The IPCC promotes top–down adaptation policies that integrate individual adaptation initiatives, including indigenous- and community-led adaptation priorities. Adaptation options vary by sector and community and can reduce risks

(i) to natural and managed ecosystems by using ecosystem-based adaptation, ecosystem restoration, biodiversity management, sustainable aquaculture, and local and indigenous knowledge;
(ii) of sea level rise by using coastal defense and shoreline hardening;
(iii) to health, livelihoods, food, water, and economic growth with efficient irrigation, social safety nets, disaster risk management, risk spreading and sharing, and community-based adaptation; and
(iv) in urban areas with green infrastructure, sustainable land use and planning, and sustainable water management (footnote 106).

There are, however, "limits to adaptation and adaptive capacity for some human and natural systems at global warming of 1.5°C, with associated losses" (footnote 106). This observation emphasizes some critical points: (i) the target of limiting global warming to 1.5°C is not safe for everyone, and there are people it is impacting now; but (ii) collectively working to limit future warming to 1.5°C above preindustrial temperatures is the safest and most equitable option available to the people of the world. It is a future worth working toward, especially in 2020, as the world struggles to emerge from the grips of COVID-19.

[106] Footnote 1, p. 10, para. B.6.

Photo by Lester Ledesma/ADB.

Children in preschool in Bangladesh. Children are disproportionately affected by climate change, which undermines their human rights to life, food, water, education, family life, and culture. Climate justice can address the uneven distribution of climate impacts and help limit the extent of global warming (photo by Abir Abdullah/ADB).

PART THREE

CONCLUSION

The climate science paints a grim picture of the future unless the world takes urgent actions guided by science. Against this context, the blunt plea of Greta Thunberg—a youth climate activist—at the World Economic Forum in 2019 seems less alarmist:

> Adults keep saying we owe it to the young people to give them hope. But I don't want your hope. I don't want you to be hopeful. I want you to panic. I want you to feel the fear I feel every day. And then I want you to act. I want you to act as if you would in a crisis. I want you to act as if the house was on fire—because it is.[1]

We do not want to convey hopelessness in this series of reports, for there is still time to act. What the world needs to do is heed the warnings and advice of scientists about climate change. Scientists tell us that urgent action is necessary to avoid dire impacts that threaten untold suffering and massive loss of life—human, animals, and other species. Ignoring the risks posed by climate change will result in injustice and inequity that undermine human rights.

These reports are not advocating that judges take up the activist mantle. Such action is not needed to protect and promote climate justice. However, every sector of our modern-day world must do its share, including the courts and other legal forums. Courts are the guardians of justice, rights, and equity. Courts are responsible for refereeing government decisions and protecting fundamental rights. Around the world, courts are heeding this call. Courts are shaping climate justice by upholding the rule of law, and they are weaving this concept into their national lexicon. In ordering their governments to do their part in responding to climate change, courts are defining what it means to do one's part.

Courts, commissions, and tribunals have an important role to play in making findings of fact about climate science. The rigor applied in these forums, particularly in relation to facts, veracity, and integrity, is persuasive in the halls of government and the world at large. Judges, commissioners, and tribunal members are expected to make findings of fact and law in an impartial setting. Their findings of fact on climate change hold weight because courts and other semi-judicial

[1] "Greta Thunberg: Our House Is On Fire | Forum Insight," YouTube video, 5:48, from the World Economic Forum in Davos on 25 January 2019, posted by World Economic Forum, 20 September 2019.

bodies are trusted public institutions.[2] They, therefore, can sink untested and unsupported climate denial rhetoric.

Judicial forums can also remind governments and civil society of ethical and moral obligations. In 2019, Commissioner Roberto Eugenio Cadiz of the Philippine Commission on Human Rights reminded the private sector that its moral responsibility on climate change is as strong as its legal responsibility.[3] This statement sends a powerful message about the civil, political, and human rights of citizens. Leadership from courts and commissions helps pave a path toward greater climate equity.

A key goal of this series of reports is to share knowledge of climate law and litigation, as well as excellence in regional jurisprudence. This report—Report One—provides a basic summary of climate science and recent reports from the IPCC.

Climate change is unfair and gender-biased, and will intensify global inequities and undermine the world's goal of sustainable development. In 2018, the IPCC said:

> The consideration of ethics and equity can help address the uneven distribution of adverse impacts associated with 1.5°C and higher levels of global warming, as well as those from mitigation and adaptation, particularly for poor and disadvantaged populations, in all societies.[4]

Courts may do just that—ethically and equitably balance economic development with social well-being and environmental protection. Science must underpin these considerations. For justice to be impartial in climate cases, we must clearly see and hear the science.[5]

At the time of writing, the world is significantly impacted by the COVID-19 pandemic. Governments have responded with emergency measures, curtailing civilian movements and halting economies on a scale akin to wartime responses. The physical, emotional, and economic scars of COVID-19 will run deep, but recovery will eventually come. In the post-COVID-19 recovery, the world needs to focus on low-carbon and sustainable growth and resist undoing climate-related market innovations by falling back on established approaches.

Now is not the time to stall climate action. What the world does now will have repercussions for years to come. Delaying action and exhausting the 1.5°C–2°C

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2 M.L. Banda. 2020. *Climate Science in the Courts: A Review of US and International Judicial Pronouncements*. Washington DC: Environmental Law Insitute.

3 J. Paris. 2019. CHR: Big Oil, Cement Firms Legally, Morally Liable for Climate Change Effects. *Rappler*. 11 December.

4 IPCC. 2018. Summary for Policymakers. In V. Masson-Delmotte et al., eds. *Special Report: Global Warming of 1.5°C*. Geneva: World Meteorological Organization. p. 18, para. D.2.2.

5 For a discussion about climate science attribution, see M. Burger, J. Wentz, and R. Horton. 2020. The Law and Science of Climate Change Attribution. *Columbia Journal of Environmental Law*. 45 (1); and footnote 2.

carbon budget in the short term is dangerous. The ability of CO_2 removal technology to draw down vast quantities of CO_2 is untested. Exceeding the global temperature goal will leave the world with fewer options for reversing warming trends in the future and will lead to higher costs and tragic loss of life. And, as United Nations Secretary-General António Guterres said, "The Stone Age did not end because the world ran out of stones. We do not need to wait for coal and oil to run out to end the age of fossil fuels."[6]

Justice is not only for the powerful but also for the poor and vulnerable. Justice balances the rights of every individual and values the rich contribution of different ethnicities, women, children, indigenous peoples, minorities, and differently abled people. Justice recognizes the need to ensure that there is a world worth inheriting. Courts have the unique ability to give the gift of justice, including to the world's youth.

Elijah E. Cummings—American politician and civil rights advocate—once said:

> Our children are the living messages we send to a future we will never see. The question is, what will they leave us and how will we send them into that future? Will we send them strong? Will we send them hopeful? Will we rob them of their destiny? Will we rob them of their dreams? No, we will not do that![7]

With this series of reports, we hope to inspire justice that allows the future to behold the wonders of the world we take for granted.

6 "UN chief: Climate change poses 'existential threat' to humanity." YouTube video, 0:56, speech given by UN Secretary-General António Guterres at the R20 Austrian World Summit in Vienna on 15 May 2018, posted by the United Nations.

7 E.E. Cummings. 2016. Comments made during a congressional house committee hearing into the Flint Water Crisis. Quoted in A. Phillips. 2016. The First Hearing on the Flint Water Crisis was Heated and Emotional. Here Are 6 Key Moments. *Washington Post*. 4 February.

Photo by Pushpa Kumara/ADB.

Report Series Purpose and Introduction to Climate Science

Climate Change, Coming Soon to A Court Near You—Report One

Climate change is the defining challenge of our time. Without urgent climate action, humanity faces a world that cannot sustain civilization as we know it. People around the globe are demanding action, some with climate litigation. This four-part report series recognizes the inevitability of increased litigation in the era of climate change and judges need a tool kit to respond. Report One explains how judges from Asia and the Pacific contribute to climate governance, along with the Asian Development Bank's rationale for producing this report series. It guides readers through some of the basics about climate change: What is causing it? How do we know? How bad might it get? What do we do about it?

About the Asian Development Bank

ADB is committed to achieving a prosperous, inclusive, resilient, and sustainable Asia and the Pacific, while sustaining its efforts to eradicate extreme poverty. Established in 1966, it is owned by 68 members —49 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.

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