

**WRITTEN STATEMENT OF
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ON THE
NOW OR NEVER: THE URGENT NEED FOR AMBITIOUS CLIMATE ACTION

BEFORE THE
HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY**

1. INTRODUCTION

Chairwoman Johnson, Ranking Member Lucas, and Members of the Committee, thank you for the opportunity to testify today regarding the Intergovernmental Panel on Climate Change's (IPCC) sixth assessment report cycle (AR6) and provide an overview of the state of climate science.

My name is Ko Barrett and I serve as the Vice Chair of the IPCC, and as the National Oceanic and Atmospheric Administration's (NOAA) Senior Advisor for Climate. While these are separate roles, NOAA's climate research contributes to the scientific basis for the IPCC assessment reports and, in turn, the agency uses IPCC information as a basis from which we provide climate services to the nation.

Throughout this testimony, I aim to highlight the key findings of the suite of recently released IPCC reports, their implications for the United States, and existing U.S. federal actions that help to address the findings of each report. Climate change is a global challenge, but the impacts and potential solutions are addressed at all scales, from international commitments to actions in our local communities. It is more critical than ever to implement the many solutions highlighted in the reports.

The IPCC reports are unambiguous in demonstrating that human-caused climate change is already resulting in widespread, adverse impacts in nearly every part of the planet, and that impacts will increase with further global warming. In no uncertain terms, the IPCC reports show that immediate and ambitious action is needed in order to prevent the worst impacts of climate change.

2. OVERVIEW OF THE IPCC

The IPCC is the United Nations' climate science body. It was created in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) in response to growing awareness of increasing greenhouse gas concentrations in the atmosphere, and with the purpose of providing governments with scientific information and regular assessments they could use to inform their climate policies. From the start, IPCC reports have informed international climate change negotiations. Increasingly, our reports are being used by decision makers and resource managers at all levels, including by individuals seeking to understand how to do their part to contribute to climate solutions.

The IPCC does not produce any original research. Rather, it assesses published, peer-reviewed scientific literature and presents a complete picture of climate change based on this work. Our reports contain tens of thousands of citations and go through multiple rounds of review. The concise *Summary for Policymakers* from each report is negotiated and formally adopted by government representatives from all 195 member governments, representing a unique global consensus on climate change science.

The most recent round of IPCC assessment reports was produced by over 1,000 scientists, experts, and reviewers from all over the world who volunteer their time to contribute their expertise and research. Authors are nominated by their governments to participate in the IPCC process as the main authors of IPCC reports, and hundreds of additional experts serve as contributing reviewers.

The IPCC operates through multiyear assessment cycles; it is currently in the midst of the sixth assessment cycle. Assessment cycles consist of multiple reports, with a core of three reports produced by the IPCC's three working groups, which are covered in this testimony:

- Working Group I: the Physical Science Basis of Climate Change
- Working Group II: Impacts, Adaptation, and Vulnerability
- Working Group III: Mitigation of Climate Change

Since the IPCC's last Working Group Reports in 2013/2014, there have been important advances in climate science worldwide. For instance, during these years, climate scientists filled in gaps in observations of past climate, improved climate models, and developed new ways to combine multiple lines of evidence to provide more robust conclusions. As a result, these current reports provide the clearest picture ever of the science of climate change. With greater confidence and more evidence, we know how the climate has changed, is changing, and will likely continue to change. We know what the impacts are and will likely be in the future; how we can adapt; and how we can prevent future warming.

In addition to the Working Group Reports, IPCC report cycles also include updates to guidelines used world-wide to create greenhouse gas inventories and special reports on specific topics of interest that are requested by the member governments. In the sixth assessment cycle, there were three special reports and one task force report:

- Special Report on Global Warming of 1.5 °C (October 2018)
- Special Report on Climate Change and Land (August 2019)
- Special Report on the Ocean and Cryosphere in a Changing Climate (September 2019)
- Task Force Report: 2019 Refinement to the 2006 IPCC Guidelines on National Greenhouse Gas Inventories

At the end of each assessment cycle the IPCC releases a synthesis report that combines information from all the reports in that cycle to provide a complete overview of knowledge. The AR6 Synthesis Report is due out in fall 2022.

3. WORKING GROUP I: THE PHYSICAL SCIENCE BASIS

The Working Group I report: The Physical Science Basis, released last August, laid the scientific foundation regarding the changes to earth's climate system - past, present, and future. It showed how the recent changes in the climate system are now widespread, rapid, and intensifying, and that some of these changes are unprecedented in thousands of years - or never seen before. The results were clear: *without rapid and extreme reductions in CO₂ emissions, limiting warming to 1.5°C (a level at which there would be significantly reduced risks and impacts of climate change) will be out of reach.*

To measure how the climate is changing, the report looked at a key indicator: the average temperature of the Earth's surface over a period of at least a decade compared to the average in the late 1800s (pre-industrial times). The average surface temperature over the past 10 years was 1.1°C degrees warmer than pre-industrial times. Moreover, each of the last four decades has successively been the warmest on record, and the recent rate of warming is unprecedented in at least 2,000 years. This report also showed that other elements of the climate are changing in a way that would be expected in a warming world. For instance, levels of heat-trapping gasses in the atmosphere continue to increase quickly - the root cause of human-induced climate change. Current CO₂ concentrations are the highest they have been for at least 2 million years. Over the past 100 years, sea level has risen at faster rates than it did in the past 3,000 years.

Importantly, this report also drew unequivocal connections between human activity and climate change, finding that it is indisputable that human influence has warmed the atmosphere, ocean and land. Human influence is making extreme climate events, including heat waves, heavy rainfall, and droughts, more frequent and severe. For example, hot extremes (including heatwaves) have become more frequent and more intense since the 1950s, and some recent hot extremes would have been extremely unlikely without human influence on the climate system.

Furthermore, we know that human influence has been the main driver of ocean warming since the 1970s, and that human-caused CO₂ emissions are the main driver of ocean acidification, both of which can have adverse impacts on marine life. Human influence is contributing to reduced oxygen levels in the ocean observed since the mid-20th century. Human influence is also the main driver of changes we see in the frozen areas of the planet (the cryosphere) - driving the global retreat of glaciers since the 1990s, the 40% decrease in late-summer Arctic sea ice since 1979, and the decrease in spring snow cover since the 1950s.

The advances in our understanding of how human activities are affecting the climate contribute to the ability to better estimate the changes we may experience from different amounts of emissions, different levels of warming, and across different regions. As we look to the future, under every emissions scenario considered in this report, the IPCC found that global surface temperature will continue to increase until at least the mid-century and that global warming of 1.5°C and 2°C will be exceeded during this century unless deep reductions in CO₂ and other greenhouse gas emissions occur. In addition, some changes in the earth system are irreversible on human timescales; for instance, sea levels will continue to rise for thousands of years. However, other impacts of climate change, including glacial retreat, could be slowed or stopped if we steeply cut emissions and stabilize temperature.

Although the IPCC's assessments cover global climate science, impacts, and solutions, climate change is a regional and local issue, with U.S. citizens facing the impacts and benefiting from adaptation and mitigation actions. In recognition of the regional and local aspects of climate change, for the first time, the report contained regional information that can be used for climate risk assessments, including accompanying regional fact sheets and a new Interactive Atlas.¹ These resources give people more tools to understand how the climate is affecting their corner of the world, including for the communities in North America. For example, in Eastern North America, the IPCC found that, in the future, there will very likely be increases in mean and extreme precipitation, with expected increases in river and coastal flooding. In Central and Western North America, the IPCC identified increases in drought and fire weather, and projected continued increases, particularly at higher warming levels.

4. WORKING GROUP II: IMPACTS, ADAPTATION, AND VULNERABILITY

The IPCC AR6 Working Group II released its report on Impacts, Adaptation, and Vulnerability in late February 2022. This report provided an updated assessment of the observed and projected impacts of climate change, our vulnerabilities to it, different options, capacities, and limits to adapt to climate change, and how nature is adjusting to our adaptation efforts. Impacts of climate change (that is, the effects on natural and human systems) include sea level rise and more severe storms, for example. Vulnerability (that is, the propensity or predisposition to be adversely

¹ <https://interactive-atlas.ipcc.ch/>

affected) can include exposure to more intense heat extremes. Adaptation refers to the process of adjustment to actual or expected climate and its effects, including, for example, efforts that range from nature-based solutions (like restoring mangroves or protecting coasts) to rewriting zoning codes to ensuring that new infrastructure is built a certain distance from wildfire-prone areas or at levels protected from increasing floods.

The report confirmed that global warming of 1.1°C has already adversely impacted billions of people around the world, especially marginalized communities, and that some species and ecosystems have suffered irreversible losses. For instance, increased frequency, intensity, and duration of extreme climate events has led to mass die-offs of many species, such as corals and trees in some places. The overexploitation of limited natural resources is also a threat, and in combination with climate change, will result in the degradation of forests, coral reefs, and coastal wetlands globally.

While impacts, risks, and vulnerabilities were seen in every region of the globe, the specifics vary by region. For example, here in North America, the IPCC identified a range of impacts and future risks, including that:

- High temperatures have increased human mortality and morbidity, and these heat-related risks are projected to increase with increased warming.
- Extreme events and climate hazards are adversely affecting economic activities and have disrupted supply-chain infrastructure and trade.
- Climate change will continue to shift agriculture and fishery suitability ranges and intensify production losses.
- Intensified droughts and earlier runoff from diminished snowpack will increase water scarcity during the summer, especially in regions with limited aquifers and extensive irrigated agriculture.
- Even if global warming is limited to 1.5°C, human life, safety, and livelihoods, especially in coastal areas, will be placed at risk from sea level rise, severe storms, and resulting damage.

Impacts and risks like these are not distributed equally; some populations are more vulnerable than others. For instance, climate impacts are magnified in cities, where heat waves can combine with urban heat islands and air pollution to make the effects of climate change worse.

Furthermore, climate change can exacerbate other challenges, such as poverty, limited access to basic resources, and food insecurity, which often impact the most marginalized people and further increase their vulnerability. The report found that 3.3 to 3.6 billion people live in global hotspots of high vulnerability to climate change subject to overlapping challenges, including across large parts of Africa, as well as South Asia, Central and South America, small islands, and the Arctic.

These are grim tidings though not without glimmers of hope. The report also found that *adaptation efforts are effective for reducing risks, and they can protect people and ecosystems from the worst impacts of climate change*. Specifically, we found that equitable, inclusive, and participatory approaches that integrate climate impact projections into near-term and long-term decision-making reduce future risks. In other words, diversity, equity, and inclusion are central to addressing climate change.

While the report finds that adaptation efforts can be extremely effective in minimizing climate-fueled impacts and damages, it also concluded that the world has not acted at anywhere near the pace and scale needed to meaningfully adapt to current and future impacts of climate change. Furthermore, adaptation alone cannot prevent all climate impacts. *To achieve long-term climate resilience, adaptation must be paired with deep emissions cuts- the topic of the subsequent report- and the next decade is critical for these actions.*

5. WORKING GROUP III: MITIGATION OF CLIMATE CHANGE

IPCC's report on Mitigation, produced by Working Group III, was released earlier this month, and provided an updated assessment of climate change mitigation (actions to prevent further climate change), greenhouse gas emissions reductions, and greenhouse gas removal from the atmosphere. The report addressed all aspects of mitigation, including feasibility, cost, and governance requirements. Examples of mitigation include reducing greenhouse gas emissions, increasing use of renewable energy, and supporting reforestation in critical places like the Amazon rainforest.

This report reaffirmed the message from Working Group I: *unless there are immediate and deep greenhouse gas emissions reductions across all sectors, 1.5°C is beyond reach*. Further, it clarified that, in the scenarios assessed, limiting warming to 1.5°C requires:

- global greenhouse gas emissions to peak before 2025 at the latest and be reduced by 43% from 2019 levels by 2030,
- methane emissions to be reduced by about a third by 2030, and
- rapid and deep greenhouse gas emissions reductions throughout the 2030s, 2040s, and 2050s and net zero carbon dioxide emissions by the early 2050s.

While the challenge to decarbonize society is great, *the assessment identified increased evidence of climate action and progress*. For example, the report found that an increasing range of policies and laws have enhanced energy efficiency, reduced rates of deforestation, and accelerated the deployment of renewable energy, low-carbon heating systems, and electric vehicles. These policies have resulted in avoided and reduced emissions. Additionally, a growing number of countries have achieved sustained greenhouse gas emissions reductions for more than 10 years. There have been sustained decreases in the costs of renewables and batteries - by up to 85% - and, at the same time, large increases in their deployment (>10x for solar, >100x for electric

vehicles) since the 2010s.

The report reviewed mitigation options across all sectors and activities, including energy (e.g. transitioning away from fossil fuels and toward renewable energy) and building (e.g. constructing and retrofitting buildings to be more energy-efficient through, for instance, the use of energy-efficient windows and insulation). The transportation, industry, waste, and agriculture sectors were also studied. In doing so, the assessment found *there are options available now in all sectors that can more than halve greenhouse gas emissions by 2030*. Moreover, for the first time, this report included a chapter on the social aspects of mitigation, drawing from behavioral sciences and exploring topics such as consumer behavior and cultural norms. It demonstrated that significant changes across transport, industry, buildings, and land-use will make it easier for people to lead low-carbon lifestyles and, at the same time, improve wellbeing. Through the implementation of policies, improved infrastructure, and technologies, behavioral changes could decrease global emissions by 40-70% by 2050.

These findings highlight the growing role of non-state and sub-national actors including cities, businesses, Indigenous Peoples, citizens including local communities and youth, transnational initiatives, and public-private entities in the global effort to address climate change. More specifically, the report found that broad and meaningful participation of all relevant actors in decision-making at all scales, paired with attention to equity, can build social trust, and deepen and widen support for transformative changes. Much like the Working Group II report, this reaffirms the importance of diversity, equity, and inclusion in solving our climate challenges.

6. FEDERAL RESPONSIVENESS TO AND SUPPORT OF THE IPCC

The United States is a member of the IPCC and participates in the drafting, review, and approval of its reports. The United States, including through federal agencies, provides essential scientific information that is assessed and referenced in the IPCC's robust conclusions and we provide authors for most of the chapters in each report. Some of the United States' leading capabilities were highlighted for this committee in a hearing last month. Specifically, the Under Secretary of Commerce for Oceans and Atmosphere and NOAA Administrator, Dr. Richard Spinrad, shared how NOAA serves as a world leader in climate science and services, providing actionable environmental information that is the basis of smart policy and decision making in a changing world. During the same hearing, representatives from NASA, GAO, and DOE described the actions their agencies are taking to address climate change. This U.S. Federal global leadership is reflected in the IPCC reports discussed above, as I can attest to given my dual roles with IPCC and NOAA. NOAA scientists, along with scientists from other agencies (e.g. DOE, NASA, NSF, USDA, USGS) as well as academia, authored the IPCC reports, and these reports relied on Federal research, climate models, and observations. NOAA plays a unique role in the climate arena, working along the entire lifecycle from climate observations and data collection, to research and modeling, to product development and dissemination, and continuous assessment.

And NOAA is mandated to make its data operational, providing actionable information - to both the public and private sectors - that protects lives and livelihoods, and fuels the economy.

The IPCC reports shared a strong, consistent message - that urgent action on climate change is needed now. Just as the federal agencies have been integral to advancing the scientific understanding of our climate challenges, federal agencies are playing a key role in implementing solutions in alignment with the findings of IPCC reports. For instance, the U.S. Global Change Research Program convenes extensive federal expertise to compile Federally-developed indicators related to the IPCC's *Physical Science Basis* Report, including the Annual Greenhouse Gas Index (NOAA), Terrestrial Carbon Storage (USFS, USDA, EPA, USGS, DOI etc.), Arctic Sea Ice Extent (NASA and NOAA), and the Start of Spring (USGS, NOAA, DOE, etc.). These indicators also support U.S.-focused climate assessments, including the quadrennial National Climate Assessment. In the area of *Impacts, Adaptation and Vulnerability*, the U.S. State Department, USAID, NOAA, and other agencies are working to implement the President's Emergency Plan for Adaptation and Resilience (PREPARE), which will support more than half a billion people in developing countries to adapt to and manage the impacts of climate change by 2030. Here at home, a number of federal agencies support regional hubs, centers and scientific consortia with mandates to provide the information needed to understand and respond to increasing climate risks in states, municipalities and communities, and on federal land. Finally, in support of *Mitigation*, from DOE's \$62 billion investment in clean energy, to facilities that adhere to the highest environmental standards like NOAA's LEED-certified Observatory in Utqiagvik, Alaska, federal agencies are working to reduce greenhouse gas pollution by 50-52% below 2005 levels in 2030 and net zero emissions economy-wide by 2050.

Still, the IPCC reports suggest that if we are to avert the worst impacts of climate change, we need to redouble our efforts to achieve these mitigation and adaptation goals and even greater progress is needed globally, with action that starts now. There is an opportunity for federal agencies to derive lessons from these reports and to lead the way on sustained climate action. NOAA, for instance, will do this through the implementation of the *Climate Ready Nation* vision to strengthen collective climate action by 2030, while protecting lives and promoting prosperity. Through this initiative, NOAA is working with its partners to promote equitable access to climate information, products, and services; provide support for tribal, rural, and other underserved communities; and expand our resources for climate readiness, response, and resilience. In addition, multiple U.S. Government agencies will contribute by advancing the President's *Plan to Conserve Global Forests*, which leverages our domestic leadership and deploys diplomatic, policy, and finance mechanisms. The Plan takes a whole-of-government approach to help end natural forest loss and restore at least an additional 200 million hectares of forests and other ecosystems by 2030, while showcasing new economic models that reflect the services provided by critical ecosystems.

Overall, the knowledge within IPCC reports is, in part, a credit to the work of U.S. federal agencies, while also being a call for more ambitious action. Through the Biden Administration's whole-of-government approach to the climate crisis, federal agencies are demonstrating responsive action with benefits stretching within and beyond the U.S. borders. Still, federal agencies can leverage the IPCC reports to inform future efforts and support the action needed to combat climate change.

7. SUMMARY

The IPCC reports collectively demonstrate how climate change is already resulting in widespread, adverse impacts in nearly every part of the planet, and that impacts will increase with increasing warming.

They confirm that we are not on track to limit warming to 1.5°C above pre-industrial levels - a level at which there would be significantly reduced risks and impacts of climate change. Further, they showed that, unless there are immediate and deep greenhouse gas emission reductions across all sectors, 1.5°C is beyond reach.

The good news is that these reports also show that there are effective, available solutions now for both mitigation and adaptation.

Finally, these reports show that immediate and ambitious action is needed, if we hope to forestall the worst impacts of climate change. To be effective, we will need international cooperation, government leadership, and partnerships with the private sector and civil society. The next decade is critical for action - the climate we experience in the future depends on our actions now.