



News & Highlights

Latest Climate Report Sounds Alarm on Closing Window for Mitigation

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In a year that had already seen dozens of heat and extreme weather records shattered [1] and temperatures approaching the limit of human survival [2], the Intergovernmental Panel on Climate Change (IPCC) published its latest large-scale report, concluding that the world has warmed 1.1 °C above pre-industrial levels [3]. Along with dire warnings for the future, the authors of the March 2023 report issued the hopeful message that many feasible and effective options are currently available to reduce greenhouse gas emissions and adapt to human-caused climate change—they just need to be implemented at greater speed and scale.

The first sentences of the 3657-page report, called the Sixth Assessment Report or AR6, succinctly acknowledge humanity's role in bringing about climate disaster (Fig. 1) [3]: “Human activities, principally through emissions of greenhouse gases, have unequivocally caused global warming, with global surface temperature reaching 1.1 °C above 1850–1900 in 2011–2020. Global greenhouse gas emissions have continued to increase, with unequal historical and ongoing contributions arising from unsus-

tainable energy use, land use and land-use change, lifestyles and patterns of consumption and production across regions, between and within countries, and among individuals.”

“We know that human activities are causing climate change and that climate change is also causing impacts on our biodiversity, on ecosystems, and on human wellbeing including health and economics,” said William Cheung, professor and director of the Institute for the Oceans and Fisheries at the University of British Columbia in Vancouver, BC, Canada, and coordinating lead author of the assessment's Special Report for the Oceans and Cryosphere in a Changing Climate [4]. “We also know there are available solutions, and the world has the financial capability to implement the solutions. We just need action to achieve effective climate mitigation.”

“Every country that engaged in the IPCC's process now knows what the timeframe is, and they know that there are no options to kick the can down the road,” said William Collins, professor of earth and planetary science at the University of California, Berkeley, and associate laboratory director for Earth and



Fig. 1. Experts now generally agree that human-caused climate change is driving today's increasingly disastrous rise in the frequency and intensity of extreme weather events such as floods, storms, wildfires, drought, and tornadoes. Credit: Pixabay (public domain).

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environmental sciences at Lawrence Berkeley National Laboratory in Berkeley, CA, USA. “We have run out of road.”

The IPCC’s First Assessment Report, issued in 1990, inspired the creation of the United Nations Framework Convention on Climate Change (UNFCCC), a treaty aimed at stabilizing greenhouse gases [5]. The Second Assessment acted as the backbone of the 1997 Kyoto Protocol, the first global agreement regarding binding emissions targets for developed countries [6]. The Fifth Assessment informed 2015’s Paris Agreement, the historic global accord addressing climate change mitigation, adaptation, and finance [7].

According to the 2023 report, if temperatures are to be kept to 1.5 °C above pre-industrial levels, carbon emissions need to be cut almost in half by 2030, and the world would need to reach net-zero emissions by 2050 [3]. The report also suggests that overshooting those timelines could be offset by increased deployment of negative emissions technologies [8], such as direct air capture [9,10]. “Rather than spurring a new kind of agreement, AR6 helps us understand the extent to which we are achieving the climate targets under the Paris Agreement, especially as countries are trying to develop or update their mitigation and adaptation commitments,” Cheung said.

The IPCC’s urgency may actually be understated, according to meteorologists who predicted earlier this year that the global average temperature for a single year has a two-in-three chance of exceeding 1.5 °C above pre-industrial levels within the next five years [11]. That does not mean that the world will have officially violated the aspirational goal of the Paris Agreement, which, to overcome the influence of natural variability, is concerned with temperature increases over a two-decade period. However, because global warming is uneven, more than one-fifth of the world’s population currently lives in regions that have already exceeded 1.5 °C of warming in at least one season [12].

Limiting warming to 1.5 °C, rather than 2 °C, “could reduce the number of people exposed to climate-related risks and susceptible to poverty by up to several hundred million by 2050,” the AR6 report states. At an increase of 1.5 °C, the number of people globally at risk of inadequate water supplies could be 50% lower than at 2 °C. Other species would also be worse off with a 2 °C increase. At that level of warming, coral reefs could experience a complete die-off, and twice as many plant species—and three times as many insects—could lose at least half of their habitat compared with a 1.5 °C rise [3].

The AR6 report laid out five increasingly dire scenarios that correspond to different timelines of climate action and their predicted degrees of warming [3]. Under even the most optimistic scenario, one in which the world collaborates on slashing emissions immediately, the Earth will continue to warm until at least mid-century. “Increasing sea-level rise, for example, is inevitable,” said Greg Flato, senior research scientist at Environment and Climate Change Canada in Victoria, BC, Canada, who also serves as vice-chair of IPCC’s Working Group I and has been an author on the past three assessment reports. “We will see sea levels continue to increase for centuries after global temperatures stabilize.”

The report also documents how, so far, words have outweighed action. While 149 nations have set net-zero targets, only about 75% have formalized them in law or policy documents, though that number jumped up from 7% in 2020. And in almost all cases, actionable plans to implement those pledges have not materialized, according to a separate report compiled by climate researchers who track net-zero commitments [13]. More than 1000 companies worldwide have made net-zero pledges, but the overall impact may be little more than “greenwashing,” claims made to appease environmental concerns while not significantly changing business practices [14]. Additionally, of the 114 fossil-fuel firms the researchers assessed, 67% have net-zero pledges. But none has a plan to phase out oil and gas completely [13]. Furthermore,

according to a 2022 United Nations report and a 2021 report by the respected group Climate Action Tracker, current pledges from the world’s governments are not even enough to prevent a temperature rise between 2.4 and 2.5 °C [15,16].

The AR6 report does indicate that some progress is being made [3]: “The UNFCCC, Kyoto Protocol, and the Paris Agreement are supporting rising levels of national ambition. Many regulatory and economic instruments have already been deployed successfully. In many countries, policies have enhanced energy efficiency, reduced rates of deforestation and accelerated technology deployment, leading to avoided and in some cases reduced or removed emissions.”

Still, global year-over-year growth in emissions was just over 1% in 2022, continuing a trend that saw a doubling in the last 40 years [17]. There have been local bright spots, though, with many countries already seeing their emissions plateau or even decrease. Emissions in the United States peaked in 2005 and have declined since then by just over 10%. Emissions have also plateaued in Japan, Russia, and the European Union. The world’s two most populous countries, India and China, continue to release increasing amounts of carbon annually [18], but China has pledged its emissions will peak by 2030 [19] and at least one estimate suggests they could peak as early as 2025 [20]. On a broader level, the International Energy Agency (IEA) has said while worldwide energy-related carbon emissions plateaued in 2019 [21], it foresees 2025 as the year total global emissions will peak, due in part to a push for renewables stemming from the energy crisis precipitated by the Russian–Ukraine conflict [22].

Under recent legislated plans such as the United States’ Inflation Reduction Act and the European Union’s emission reduction package, and proposals by Japan, the Republic of Korea, China, India, and others, global investment in solar, wind, and nuclear power will approach 2 trillion USD per year by 2030, a more than 50% increase from 2023 [23]. However, the IEA says annual investment in clean energy would need to rise to 4 trillion USD by 2030 to reach the AR6 goal of net-zero carbon emissions by 2050 [23].

The picture is less encouraging in developing countries, where investment in climate-change mitigation actions has stalled. In 2018, public and private climate funding contributed from developed to developing countries fell about 20 billion USD short of the goal of 100 billion USD per year by 2020 outlined in the Paris Agreement [3].

In one piece of good news, while overall investment in renewables is increasing, prices are dropping, according to the AR6 report [3]: “Several mitigation options, notably solar energy, wind energy, electrification of urban systems, urban green infrastructure, energy efficiency, demand-side management, improved forest and crop/grassland management, and reduced food waste and loss, are technically viable, are becoming increasingly cost-effective and are generally supported by the public. From 2010 to 2019 there have been sustained decreases in the unit costs of solar energy (85%), wind energy (55%), and lithium-ion batteries (85%).”

The report also highlights large increases in the deployment of renewables over that period: more than ten-fold for solar and more than 100-fold for electric vehicles [3]. Though companies are eager to provide renewable energy, transmission capacity has prevented a large amount of renewable energy from potential new projects from reaching consumers. Just in the United States, where the capacity of all existing power plants is 1250 GW, 2000 GW worth of potential renewable energy capacity is awaiting regulatory approval to be connected to the grid [24]. The often years-long delay in project approval has seen many proposals for grid connection ultimately withdrawn over the past few years [25].

Globally, renewable electricity capacity is expected to reach as high as 6200 GW by 2027, with annual additions of about 460 GW [26]. However, to achieve sustainability goals aligned with the AR6 report, a massive 50% increase in global spending is needed over

the next decade to install nearly 7 million kilometers of transmission lines to tie that renewable capacity into existing grids [27].

Other, society-wide changes will also be needed, said Collins. “We are facing a very eventful future of having to uproot and replace a gigantic amount of our infrastructure to make it much more sustainable. Imagine a world where every roof is painted white, solar cells are deployed everywhere and anywhere, and recharging lines are embedded in roads—the sky is the limit. The engineering profession will not lack for opportunities.”

The IPCC is now electing a new chair and co-chair for its seventh assessment, scheduled to be issued sometime later this decade. Collins and Cheung said a special report on cities will be one of the upcoming products. “Cities occupy approximately 2% of the surface area of the habitable surface area of the planet. But by the end of this century, somewhere north of 70% of the world’s population will be living in them,” Collins said. “Understanding the particular challenges that climate change poses to human societies organized increasingly into urban configurations is critical.”

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