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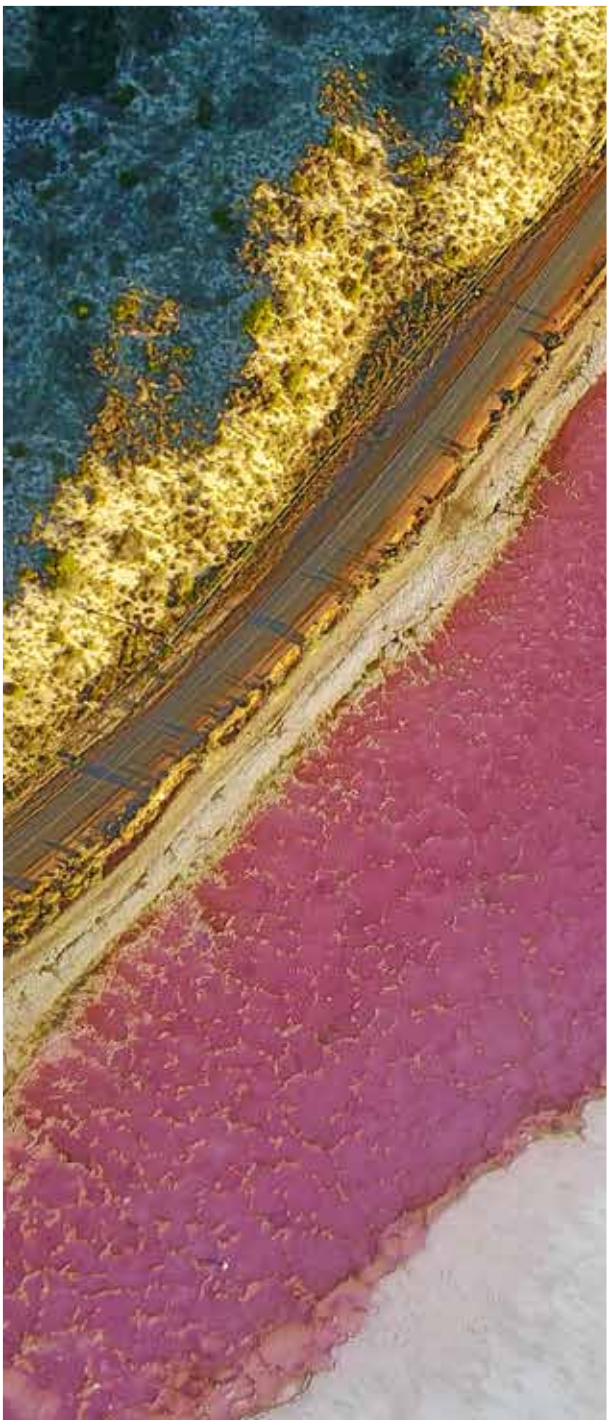
The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report

Synthesis Report 2023 - Summarizing the state of knowledge



The IPCC recently concluded reporting for its Sixth Assessment Report (AR6) with the production of the Synthesis Report (SYR). This latest report summarizes the state of knowledge of climate change, its widespread impacts and risks, and climate change mitigation and adaptation.

The information presented in the SYR is not new. It draws on findings presented in the three previous AR6 Working Group Assessment Reports and three earlier Special Reports, as outlined in Table 1 below. It plays a valuable role in synthesizing key content from these reports and reinforcing the need for urgent climate action.

Jacobs' Global Principal Climate Resilience Craig Clifton and Principal Technologist Water Resources & Climate Resilience Tapash Das summarize the key messages and help us understand the pace and scale of mitigation and adaptation required to deliver a more sustainable future.

Table 1: Previous AR6 Working Group Assessment Reports and Special Reports

Assessment Reports
Working Group I The physical science basis
Working Group II Impacts adaptation and vulnerability
Working Group III Mitigation of climate change
Special Reports
Global warming of 1.5 degrees Celsius
Climate change and land use
The ocean and cryosphere in a changing climate

At a glance

- Average global surface temperatures were 1.1 degrees Celsius (2 degrees Fahrenheit) higher across the period 2011-2020 compared to 1850-1900.
- In the decade from 2010 – 2019, annual greenhouse gas emissions were higher than in any previous decade; however, the rate of growth in emissions has slowed by 40% compared to the preceding decade.
- Climate change has already had a pervasive effect on the global climate system, including on weather and climate extremes. This has adversely affected food and water security, human health, economies, society, nature and people.
- Vulnerable communities who have historically contributed the least to current climate change are disproportionately affected by its impacts.
- All modeled mitigation pathways or scenarios to limit warming to 1.5 degrees Celsius (2.7 degrees Fahrenheit) require rapid, deep and in most cases immediate GHG reduction in all sectors. Only a small number of the most ambitious pathways will actually achieve this target. The others will all overshoot this target to some degree.
- The conclusion is clear: climate change is a threat to human well-being and planetary health. If we delay comprehensive action on adaptation and mitigation any longer, we will miss the brief and rapidly closing window of opportunity to secure a livable and sustainable future for all.
- Strengthening climate change mitigation action will require more rapid transitions commencing in this decade and higher up-front investment, but will bring benefits from avoiding damages from climate change and reducing adaptation costs.
- For better or worse, the choices and actions we take in response to climate change now will have profound impacts for thousands of years.

Current status and trends in climate, climate change impacts and climate action

Status and trends

The IPCC concludes that human activities, principally through emissions of greenhouse gases (GHGs), have undoubtedly caused global warming, with average global surface temperature in 2011-2020 reaching 1.1 degrees Celsius (2 degrees Fahrenheit) above 1850-1900 levels.

Global GHG emissions are driven by unsustainable energy use, land use and land-use change, lifestyles, and patterns of consumption and production.

Climate change has already had a extensive effect on the global climate system, including on weather and climate extremes, which have adversely affected food and water security, human health, economies, society, nature and people. However, the impacts of climate change are not being felt equally around the globe. Vulnerable communities which have historically contributed the least to current climate change are disproportionately affected by its impacts.

While average annual GHG emissions during 2010–2019 were higher than in any previous decade, the rate of growth in emissions during the decade was 40% lower than during the previous decade.

International climate agreements, rising ambitions for climate action, and growing public awareness are accelerating efforts to address climate change, and global energy and carbon intensity is decreasing as a result. Low-emission technologies are also becoming more affordable and accessible across industry and society. A growing number of countries have achieved absolute emission reductions for more than a decade.

Impacts and action

Despite recent progress, global warming is increasingly contributing to widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere. The frequency and/or severity of climate extremes such as heatwaves, heavy rainfall, droughts and tropical cyclones have changed and their attribution to human influence has strengthened.

Climate change has caused substantial damages and increasingly irreversible losses across all ecosystem types. It has also reduced food and water security and hindered efforts to meet Sustainable Development Goals (SDGs).

In urban settings, climate change has caused adverse impacts on human health, livelihoods and key infrastructure. Economic damages from climate change have been detected in climate-exposed sectors, such as agriculture, forestry, fishery, energy and tourism, and through outdoor labor productivity. Economic impacts attributable to climate change are increasingly affecting peoples' livelihoods and are causing economic and societal impacts across national boundaries.

Progress in climate change adaptation planning and implementation has been observed across all sectors and regions.

Ambition, scope and progress on adaptation have risen among governments at all levels, businesses, communities and civil society. Yet there are still gaps between current levels of adaptation and levels needed to respond to impacts and reduce climate risks, particularly among lower income groups, because:

- Many adaptation initiatives prioritize immediate and near-term climate risk reduction, which reduces the opportunity for transformational adaptation.
- Most observed adaptation is fragmented, small in scale, incremental, sector-specific and focused more on planning rather than implementation.
- Systemic barriers (e.g., resource limitations, insufficient community and industry engagement, lack of political commitment and low sense of urgency) make implementing adaptation options in vulnerable sectors, regions and social groups difficult.

Climate change by the numbers

3.3-3.6 billion

The number of people living in locations highly vulnerable to climate change.

2021-2040

The period during which 1.5 degrees Celsius (2.7 degrees Fahrenheit) warming is likely to be exceeded.

100%

Percentage of modeled pathways or scenarios that require immediate, rapid and deep GHG reduction across all sectors to limit warming to 1.5 degrees Celsius (2.7 degrees Fahrenheit) with no or limited overshoot.

In the long-term

Future emissions will drive future warming and affect all major climate system components. All regions will experience multiple and co-occurring changes. Many changes become larger in direct relation to increasing global warming. Some changes, particularly those affecting oceans and ice sheets, will be irreversible on centennial to millennial time scales.

With further global warming, every region is expected to increasingly experience concurrent and multiple changes in climatic impact-drivers. Many climate-related risks are now believed to be higher than previously thought, and projected long-term impacts are up to multiple times higher than currently observed. Multiple climatic and non-climatic risks will interact, resulting in compounding and cascading risks across sectors and regions. This will increase the complexity and difficulty of adaptation.

A worst-case scenario – global warming of 4 degrees Celsius (7.2 degrees Fahrenheit) or more

Should it occur, global warming of 4 degrees Celsius (7.2 degrees Fahrenheit) or more would have far-reaching impacts on natural and human systems.

Species extinctions and biome shifts would be widespread. Approximately 10% of the global land area would face both increasing high and decreasing low extreme streamflow (the flow of water in rivers), affecting more than 2.1 billion people. Four billion people would experience water scarcity.

Sea level rise would be unavoidable for centuries to millennia due to continuing deep ocean warming and ice sheet melt.

Extreme sea level events that occurred once per century in the recent past would occur at least annually at more than half of all tide gauge locations by 2100. Sea level rise in particular poses a distinct and severe adaptation challenge, as it requires responses to both slow onset changes and increases in the frequency and magnitude of extreme sea level events.

Long term mitigation pathways

Limiting human-caused global warming requires net zero anthropogenic carbon emissions (emissions caused or influenced by people).

Only a small number of the most ambitious global modelled pathways or scenarios limit global warming to 1.5 degrees Celsius (2.7 degrees Fahrenheit). All mitigation pathways that limit warming to 1.5 degrees Celsius (2.7 degrees Fahrenheit) or 2 degree Celsius (3.6 degreed Fahrenheit) require rapid, deep and in most cases immediate, GHG emission reductions in all sectors. Overshooting either of these warming levels implies increased risks and potential irreversible impacts.

Modeled mitigation pathways reaching net zero carbon and GHG emissions include transitioning from fossil fuels without carbon capture and storage (CCS) to very low- or zero-carbon energy sources, such as renewables or fossil fuels with CCS, implementing demand-side measures and improving efficiency, reducing non-carbon GHG emissions, and carbon dioxide removal (CDR).

CDR methods vary in their maturity, mode of operation, time scale of carbon storage, mitigation potential, cost, co-benefits, impacts and risks, and governance requirements. Afforestation, reforestation, improved forest management, agroforestry and soil carbon sequestration are the most widely practiced.

CDR can complement other mitigation and adaptation measures by lowering emissions in the near term and counterbalancing 'hard-to-abate' residual emissions (e.g., from agriculture, aviation, shipping and industrial processes).

Mitigation and adaptation can lead to synergies and trade-offs with sustainable development and are critical to achieving sustainable development.

Counting the cost of mitigation

Strengthening action on climate change mitigation will require more rapid transitions and higher up-front investments, but brings benefits from avoiding damages from climate change and reduced adaptation costs.

Cost-benefit analysis remains limited in its ability to represent all damages from climate change; however, even without accounting for non-monetary damages, the diverse nature of damages and the risk of catastrophic damages, or the co-benefits of mitigation, the global benefits of limiting warming to 2 degrees Celsius (3.6 degrees Fahrenheit) exceed the cost of mitigation. This finding is robust against a wide range of assumptions about social preferences on inequalities and discounting over time.

Limiting global warming to 1.5 degrees Celsius (2.7 degrees Fahrenheit) would increase the costs of and disruption arising from mitigation but would also increase the benefits.

In the near-term

Deep, rapid and sustained mitigation and accelerated adaptation reduces the risks of climate change for humans and ecosystems.

In modelled pathways that limit warming to 1.5 degrees Celsius (2.7 degrees Fahrenheit) with no or limited overshoot, global GHG emissions are projected to peak in the early 2020s followed by rapid and deep reductions.

Adaptation options often have long implementation times and many will become less effective beyond 1.5 degrees Celsius (2.7 degrees Fahrenheit) warming. Therefore, accelerated implementation, commencing in this decade, is important to close or avoid adaptation gaps.

Global warming will continue to increase in the near term to 2040, mainly due to increased cumulative carbon emissions. We will more likely reach 1.5 degrees Celsius (2.7 degrees Fahrenheit) under even very low GHG emission scenarios and are likely or very likely to exceed 1.5 degrees Celsius (2.7 degrees Fahrenheit) under higher emissions scenarios. Every region in the world is projected to face further increases in climate hazards as a result, increasing multiple risks to ecosystems and humans.

Hazards and associated risks at 1.5 degrees Celsius (2.7 degrees Fahrenheit) warming

While not as extreme as global warming beyond 4 degrees Celsius (7.2 degrees Fahrenheit), global warming of 1.5 degrees Celsius (2.7 degrees Fahrenheit) still presents a range of hazards and associated risks, including:

- Increased intensity and frequency of hot extremes and dangerous heat-humidity conditions, with increased human mortality, morbidity, and labor productivity loss.
- Increasing frequency of marine heatwaves and increase risks of biodiversity loss in the oceans, including from mass mortality events.
- Moderate or higher near-term risks for biodiversity loss in forest ecosystems, kelp and seagrass ecosystems, Arctic sea-ice and terrestrial ecosystems and warm-water coral reefs.
- More intense and frequent extreme rainfall and associated flooding in many regions including coastal and other low-lying cities, and increased proportion of intense tropical cyclones, with greater peak wind speeds.
- High risks from dry land water scarcity, wildfire damage, and permafrost degradation.
- Continued sea level rise and increased frequency and magnitude of extreme sea level events encroaching on coastal settlements and infrastructure, committing low-lying coastal ecosystems to submergence and loss, and expanding land salinization, with cascading risks to livelihoods, health, well-being, cultural values, food and water security.
- Increased climate-sensitive food-borne, water-borne and vector-borne disease risks, mental health challenges including anxiety and stress, and ill health and premature deaths from the near- to long-term.
- Cryosphere-related changes in floods, landslides and water availability may lead to severe consequences for people, infrastructure and the economy in most mountain regions.
- Increased frequency and intensity of heavy precipitation will increase rain-generated local flooding.

Delaying adaptation and mitigation may escalate costs arising from such risks. It may also lock-in fossil fuel infrastructure and their future emissions, strand assets worth trillions of US dollars, and reduce the feasibility and effectiveness of adaptation and mitigation options.

Multiple climate change risks will increasingly compound and cascade in the near term. For example, risks to health and food production will be made more severe from the interaction of sudden food production losses from heat and drought, exacerbated by heat-induced labor productivity losses. With no or low levels of adaptation, these interacting impacts will increase food prices, reduce household incomes and lead to health risks of malnutrition and climate-related mortality, especially in tropical regions.

Accelerating climate responses

Rapid and far-reaching transitions across all sectors and systems are necessary to achieve deep emissions reductions and secure a livable and sustainable future for all.

Actions that prioritize equity, climate justice, social justice and inclusion will lead to more sustainable outcomes, co-benefits, reduce trade-offs, support transformative change and advance climate resilient development.

Feasible, effective and low-cost options for mitigation and adaptation are already available. Shifting the dial on effective climate action requires political commitment, well-aligned multi-level governance and institutional frameworks, laws, policies and strategies. It needs clear goals, adequate finance and financing tools, coordination across multiple policy domains and inclusive governance processes. Many mitigation and adaptation policy instruments have been deployed successfully and could support deep emissions reductions and climate resilience if scaled up and applied widely.

Conclusion

Climate resilient development pathways are progressively constrained by every increment of further warming. There is a rapidly closing window of opportunity to secure a livable and sustainable future for all. We must act urgently if that window of opportunity is to remain open. This will require international cooperation, improved access to financial resources, inclusive governance and coordinated policies.

For better or worse, society's choices and actions in this decade will have profound impacts for thousands of years.

Explore the Synthesis Report of the IPCC's Sixth Assessment Report here:

https://www.ipcc.ch/ar6-syr/

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Jacobs offers an unparalleled breadth of climate response services. From Advanced Manufacturing, Cities & Places, Energy, Environment, Health and Life Sciences, Infrastructure, National Security to Space, we're always looking at ways to make the world better and address climate change. From strategy through to implementation, our global team of advisors and technicians can work with local teams to help cities, infrastructure providers, utilities and communities respond to climate change through energy system transition, decarbonization, adaptation and resilience, and improved environmental stewardship.

Learn more about climate response at Jacobs:

https://www.jacobs.com/climate-response

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