The Intergovernmental Panel on Climate Change *Fourth Assessment Report*

The Intergovernmental Panel on Climate Change (IPCC), the world's most authoritative scientific body on the subject of global warming, was founded in 1988 at the request of the United States and the international community to assess the risk of human-induced climate change and to provide information needed by policymakers to inform and shape solutions to global warming. Each of the Panel's 2,500 scientists was nominated by their home government. The IPCC does not carry out new research, nor does it monitor climate-related data. Its periodic Assessment Reports, based on published and peer-reviewed scientific technical literature, are written to achieve the broadest possible consensus among Panel participants.

In 2007, the IPCC released its *Fourth Assessment Report* (AR4) on global climate change. The AR4 is organized into three Working Group Reports covering the science, impacts & adaptation, and mitigation. In November 2007, the IPCC released its synthesis report of the three individual parts. Below are the highlights from each.

Working Group I: The Physical Science Basis

The scientific literature reviewed by Working Group 1 (WG1) for its report "Climate Change 2007: The Physical Science Basis," significantly strengthened our understanding of two fundamentals. The WG1 report states:

- "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and risking global mean sea level."
- With 91-95% certainty, the IPCC concluded that "Most of the observed increase in global average temperatures since the mid-20th century is *very likely*[1] due to the observed increase in anthropogenic greenhouse gas concentrations [emphasis in original]."

With regard to observed and projected temperature rise, the WG1 report found:

- Anthropogenic (human produced) greenhouse gas emissions have driven up global average temperatures by about 0.75°C during the last century.[2]
- Eleven of the last twelve years (1995–2006) rank among the 12 warmest years in the instrumental record of global surface temperature (since 1850).

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- Absent sharp near-term emissions reductions, global temperatures are estimated to increase by about 4°C (7.2° F), with the potential to go as high as 7°C (12.6° F) or higher.[3]

The Working Group I report also reported on important ocean and carbon-cycle issues:

- Increasing atmospheric carbon dioxide concentrations are causing a chemical change in the world's oceans, making the water more acidic. Acidification harms marine life forms like coral reefs, snails, and other organisms that are vital supports for the food chain.[4]
- Feedback mechanisms in the global carbon cycle will begin adding previously stored carbon to the atmosphere as the climate system warms. If emissions continue growing as they are now, CO_2 feedback is projected to increase global average warming in 2100 by more than 1°C (in addition to existing projections).

IPCC Working Group II: Impacts on North America and Summary for Policy Makers

The Working Group II report "Climate Change 2007: Impacts, Adaptation, and Vulnerability," released in April 2007, identified in far greater detail than earlier reports how global warming is currently affecting life on earth and projected future impacts.

The report stated that the comparatively small amount of warming that has already occurred is contributing "to the global burden of disease and premature deaths"[5] through temperature and precipitation changes, sea-level rise and the increasing frequency of extreme events.[6] Regarding future impacts, the IPCC says "For increases in global average temperature exceeding 1.5°C–2.5°C (2.7° F–4.5° F)[7] . . . there are projected to be . . . predominantly negative consequences for biodiversity, and ecosystem goods and services *e.g.*, water and food supply."[8] Higher levels of greenhouse gases will have a devastating human impact.

- By mid-century, more than a billion people will face water shortages and hunger, including 600 million in Africa alone.[9]
- Weather extremes, food and water scarcity, and climate-related public health threats are projected to displace between 150 million and 1 billion people as climate change unfolds.[10]

Damage to ecosystems and wildlife is projected to reach devastating levels.

- A 1.0°C increase in local temperatures at lower latitudes (especially seasonally dry and tropical regions) is projected to reduce crop productivity, which would increase risk of hunger [~5.4].
- Widespread coral mortality is expected with 2.0°C warming and higher.
- With a warming of 3.0°C and more, agricultural systems will begin to break down, causing a global decrease in food production potential. [5.4, 5.ES].
- With about a 4°C increase in global temperatures, more than 40% of known plant and animal species are projected to go extinct.[11]

Summary of Key North America Impacts:[12]

- Tens of millions of Americans are likely to face greater risks of injury and mortality due to higher pollution levels, more frequent and more intense heat waves, more intense storms, elevated pollen levels, and increased likelihood of water and insect-borne diseases.
- Western and Southwestern states, already facing increased water scarcity, are expected to experience inadequate and unreliable water supplies as snowpack diminishes and evaporation increases in both regions, with added stress in the Southwest caused by decreases in precipitation.
- North American forests face more destruction from the increasing incidence of wildfire, insect infestation, and disease. These disturbances could cost wood and timber producers between $1 billion and $2 billion a year during the 21st century.
- Coastal states face rising sea-levels accompanied by greater vulnerability to intense storms and storm surges, coastal erosion, and gradual inundation-effects that will also contribute to wetland losses. Storm impacts are likely to be more severe especially along the Gulf and Atlantic coasts, where any increase in destructiveness of coastal storms threatens significant loss of life and property damage.

Summary of Key Impacts around the World:[13]

- **Africa**: By 2020, between 75 million and 250 million people are projected to be exposed to increased water stress due to climate change. If coupled with increased demand, this will adversely affect livelihoods and exacerbate water-related problems.

- **Asia**: Glacier melt in the Himalayas is projected to increase flooding and rock avalanches from destabilized slopes, and to affect water resources within the next two to three decades. This will be followed by decreased river flows as the glaciers recede. Coastal areas, especially heavily-populated megadelta regions in South, East and South-East Asia, will be at greatest risk due to increased flooding from the sea and, in some megadeltas, flooding from the rivers.

- **Australia and New Zealand**: As a result of reduced precipitation and increased evaporation, water security problems are projected to intensify by 2030 in southern and eastern Australia and, in New Zealand, in Northland and some eastern regions.

- **Europe**: Nearly all European regions are anticipated to be negatively affected by some future impacts of climate change, and these will pose challenges to many economic sectors. Climate change is expected to magnify regional differences in Europe's natural resources and assets. Negative impacts will include increased risk of inland flash floods, and more frequent coastal flooding and increased erosion (due to storminess and sea-level rise). The great majority of organisms and ecosystems will have difficulty adapting to climate change. Mountainous areas will face glacier retreat, reduced snow cover and winter tourism, and extensive species losses (in some areas up to 60% under high emission scenarios by 2080).

- **Latin America**: By mid-century, increases in temperature and associated decreases in soil water are projected to lead to gradual replacement of tropical forest by savanna in eastern Amazonia. In drier areas, climate change is expected to lead to salinisation and desertification of agricultural land. Food security will be threatened by declining productivity of some important crops and livestock. Changes in precipitation patterns and the disappearance of glaciers are projected to significantly affect the availability of drinking water, as well as water for agriculture and energy generation.

- **Polar Regions**: The main projected biophysical effects are thinning and shrinking of glaciers and ice sheets and changes in natural ecosystems with detrimental effects on many organisms including migratory birds, mammals, and higher predators. In the Arctic, additional impacts include reductions in the extent of sea

ice and permafrost, increased coastal erosion, and an increase in the depth of permafrost seasonal thawing.

- **Small Islands**: Small islands, whether located in the tropics or higher latitudes, have characteristics which make them especially vulnerable to the effects of climate change, sea-level rise, and extreme events. Deterioration in coastal conditions, for example through erosion of beaches and coral bleaching, is expected to affect local resources, *e.g.*, fisheries, and reduce the value of these destinations for tourism. Sea-level rise is expected to exacerbate inundation, storm surge, erosion, and other coastal hazards, thus threatening vital infrastructure, settlements, and facilities that support the livelihood of island communities.

IPCC Working Group III: Mitigation

The Third Working Group Report, "Climate Change 2007: Mitigation," concluded that "there is substantial economic potential for the mitigation of global GHG emissions over the coming decades, that could offset the projected growth of global emissions or reduce emissions below current levels."[14]

The WGIII report lays out several climate stabilization scenarios. By stabilizing greenhouse gases at CO_2 equivalent concentrations of roughly 450-500 parts per million, global temperature rise could be limited to 2–2.4°C and sea-level rise due to thermal expansion to 1.4 meters.[15]

However, to limit the global temperature rise to these levels requires that global emissions peak by 2015 and decline to as little as 15% of 2000 levels by the year 2050.The IPCC estimates that doing so will reduce average GDP growth rates by less than 0.12 percentage points per year and notes that "Climate change policies related to energy efficiency and renewable energy are often economically beneficial, improve energy security and reduce local pollutant emissions." Other mitigation options can provide sustainable development benefits such as avoided displacement of local populations, jobs, and health improvement.The scientists found that, "In all analyzed world regions near-term health co-benefits from reduced air pollution as a result of actions to reduce GHG emissions can be substantial and may offset a substantial fraction of mitigation costs."

Fortunately, the IPCC report makes clear that the tools needed to start reducing the threat of global warming are available now. “The stabilization levels assessed can be achieved by deployment of a portfolio of technologies that are either currently available or expected to be commercialized in coming decades.” The WGIII report lists a wide range of technologies that are commercially available and could be used to immediately begin reducing emissions.Government and industry can collaborate on policies and practices that reduce emissions. Below are some ways each economic sector can contribute in to these stabilization goals.

- **Energy Supply**: Efficiency improvements, along with increased dependence on renewable energy sources and early applications of Carbon Capture and Storage (CCS) would considerably reduce emissions
- **Transportation**: Encouraging the production of more fuel efficient and hybrid vehicles is an easy way to limit emissions from the transportation sector.
- **Buildings**: Improved residential and commercial building standards, along with widespread implementation of passive and active solar design for heating and cooling would reduce the carbon dependency of buildings.
- **Industry**: More efficient end-use electrical equipment and heat and power recovery would improve industrial energy efficiency and help firms reduce energy costs. Materials recycling and substitution, and a wide array of process-specific technologies would also help reduce energy usage from this sector.
- **Agriculture**: Improved crop and grazing land management and restoration of cultivated peaty soils and degraded lands would increase soil carbon storage, while improved rice cultivation techniques and livestock and manure management would reduce methane emissions. This sector can also contribute alternative fuels with dedicated energy crops to replace fossil fuel use.
- **Waste Management**: Landfill methane recovery, waste incineration with energy recovery, and composting of organic waste are some of the options to reduce emissions and energy usage in this sector.

[1] The IPCC explains that when the term ‘very likely’ is used, it means 91-95% certain.
[2] IPCC, Working Group I, “Summary for Policy Makers” (SPM), p. 5.

[3] WGI, SPM, p. 13. The 4°C is the 'best estimate' of the temperature increase that will result from continued fossil-fuel intensive economic growth (the A1F1 scenario). In addition, the IPCC noted that carbon cycle feedbacks are likely to drive actual temperature increases even higher.
[4] WGI, Chapter 5.
[5] WGII, Chapter 8, p. 3.
[6] WGII, SPM.
[7] 2.7°F-4.5°F
[8] The statement asserts: "For increases in global average temperature exceeding 1.5-2.5°C and in concomitant atmospheric carbon dioxide concentrations, there are projected to be major changes in ecosystem structure and function, species' ecological interactions, and species' geographic ranges, with predominantly negative consequences for biodiversity, and ecosystem goods and services *e.g.*, water and food supply." WG III, SPM, p. 8.
[9] Intergovernmental Panel on Climate Change, Working Group II Assessment Report, Chapters 3 and 9.
[10] Sir Nicholas Stern, "Stern Review on the Economics of Climate Change," <www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm>. See also Christian Aid, "Human Tide: The Real Migration Crisis," by, May 2007, <www.christianaid.org.uk/stoppoverty/climatechange/resources/human_tide.aspx>.
[11] WGII, "Chapter 4. Ecosystems, their properties, goods and services," p. 242, <http://www.ipcc-wg2.org/>.
[12] WGII, chapters 14 and 19.
[13] IPCC, WGII, Fourth Assessment Report, SPM
[14] WGIII SPM, p. 9.
[15] The IPCC specifies that this sea-level rise estimate excludes contributions from ice sheets, glaciers and ice caps, which are now known to be rapidly increasing the rate of sea-level rise and whose contributions could potentially raise sea-levels by many more meters.

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