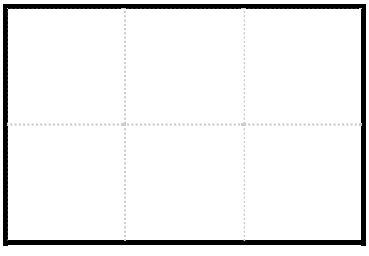
SUSTAINABILITY

State of the Science: Beyond the Worst Case Climate Change Scenario

The IPCC has declared man-made climate change "unequivocal." The hard part: trying to stop it

By David Biello on November 26, 2007 35



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Climate change is "unequivocal" and it is 90 percent certain that the "net effect of human activities since 1750 has been one of warming," the Intergovernmental Panel on Climate Change (IPCC) —a panel of more than 2,500 scientists and other experts—wrote in its first report on the physical science of global warming earlier this year. In its second assessment, the IPCC stated that human-induced warming is having a discernible influence on the planet, from species migration to thawing permafrost. Despite these findings, emissions of the greenhouse gases driving this process continue to rise thanks to increased burning of fossil fuels while cost-effective options for decreasing them have not been adopted, the panel found in its third report.

The IPCC's fourth and final assessment of the climate change problem—known as the Synthesis Report—combines all of these reports and adds that "warming could lead to some impacts that are abrupt or irreversible, depending upon the rate and magnitude of the climate change." Although countries continue to debate the best way to address this finding, 130 nations, including the U.S., China, Australia, Canada and even Saudi Arabia, have concurred with it.

"The governments now require, in fact, that the authors report on risks that are high and 'key' because of their potentially very high consequence," says economist Gary Yohe, a lead author on the IPCC Synthesis Report. "They have, perhaps, given the planet a chance to save itself."

Among those risks:

Warming Temperatures—Continued global warming is virtually certain (or more than 99 percent likely to occur) at this point, leading to both good and bad impacts. On the positive side, fewer people will die from freezing temperatures and agricultural yield will increase in colder areas. The negatives include reduced crop production in the tropics and subtropics, increased insect outbreaks, diminished water supply caused by dwindling snowpack, and increasingly poor air quality in cities.

Heat Waves—Scientists are more than 90 percent certain that episodes of extreme heat will increase worldwide, leading to increased danger of wildfires, human deaths and water quality issues such as algal blooms.

Heavy Rains—Scientific estimates suggest that extreme precipitation events—from downpours to whiteouts—are more than 90 percent likely to become more common, resulting in diminished water quality and increased flooding, crop damage, soil erosion

and disease risk.

Drought—Scientists estimate that there is a more than 66 percent chance that droughts will become more frequent and widespread, making water scarcer, upping the risk of starvation through failed crops and further increasing the risk of wildfires.

Stronger Storms—Warming ocean waters will likely increase the power of tropical cyclones (variously known as hurricanes and typhoons), raising the risk of human death, injury and disease as well as destroying coral reefs and property.

Biodiversity—As many as a third of the species known to science may be at risk of extinction if average temperatures rise by more than 1.5 degrees Celsius.

Sea Level Rise—The level of the world's oceans will rise, likely inundating low-lying land, turning freshwater brackish and potentially triggering widespread migration of human populations from affected areas.

"As temperatures rise, thermal expansion will lead to sea-level rise, independent of melting ice," says chemical engineer Lenny Bernstein, another lead author of the recent IPCC report. "The indications are that this factor alone could cause serious problems [and] ice-sheet melting would greatly accelerate [it]."

Such ice-sheet melting, which the IPCC explicitly did not include in its predictions of sea-level rise, has already been observed and may be speeding up, according to recent research that determined that the melting of Greenland's ice cap has accelerated to six times the average flow of the Colorado River. Research has also shown that the world has consistently emitted greenhouse gases at the highest projected levels examined and sea-level rise has also outpaced projections from the IPCC's last assessment in 2001.

"We are above the high scenario now," says climatologist Stephen Schneider of Stanford University, an IPCC lead author. "This is not a safe world."

Other recent findings include:

Carbon Intensity Increasing—The amount of carbon dioxide per car built, burger served or widget sold had been consistently declining until the turn of the century. But since 2000, CO_2 emissions have grown by more than 3 percent annually. This is largely due to the economic booms in China and India, which rely on polluting coal to power production. But emissions in the developed world have started to rise as well, increasing by 2.6 percent since 2000, according to reports made by those countries to the United Nations Framework Convention on Climate Change. Researchers at the Massachusetts Institute of Technology also recently argued that U.S. emissions may continue to increase as a result of growing energy demand.

Carbon Sinks Slowing—The world's oceans and forests are absorbing less of the CO_2 released by human activity, resulting in a faster rise in atmospheric levels of greenhouse gases. All told, humanity released 9.9 billion metric tons (2.18×10^{13} pounds) of carbon in 2006 at the same time that the ability of the North Atlantic to take in such emissions, for example, dropped by 50 percent.

Impacts Accelerating—Warming temperatures have prompted earlier springs in the far north and have caused plant species to spread farther into formerly icy terrain. Meanwhile, sea ice in the Arctic reached a record low this year, covering just 1.59 million square miles and thus shattering the previous 2005 minimum of 2.05 million square miles.

"The observed rate of loss is faster than anything predicted," says senior research scientist Mark Serreze of the U.S. National Snow and Ice Data Center in Boulder, Colo. "We're already set up for another big loss next year. We've got so much open water in the Arctic now that has absorbed so much energy over the summer that the ocean has warmed. The ice that grows back this autumn will be thin."

The negative consequences of such reinforcing, positive feedbacks (white ice is replaced by dark water, which absorbs more energy and prevents the formation of more white ice) remain even when they seemingly work in our favor.

For example, scientists at the Leibniz Institute of Marine Sciences at the University of Kiel in Germany recently discovered that plankton consumes more carbon at higher atmospheric concentrations of CO_2. "The plankton were carbon-enriched," says marine biologist Ulf Riebesell, who conducted the study. "There weren't more of them, but each cell had more carbon."

This could mean that microscopic ocean plants may potentially absorb more of the carbon emitted into the atmosphere. Unfortunately, other research (from the Woods Hole Oceanographic Institution) has shown that such plankton does not make it to the seafloor in large enough amounts to sequester the carbon in the long term.

Further, such carbon-heavy plankton do not begin to appear until CO_2 concentrations reach twice present values—750 parts per million (ppm) in the atmosphere compared with roughly 380 ppm presently (a level at which catastrophic change may be a certainty)—and they are less nutritious to all the animals that rely on them for food. "This mechanism is both too small and too late," Riebesell says. "By becoming more carbon-rich, zooplankton have to eat more phytoplankton to achieve the same nutrition" and, therefore, "they grow

and reproduce more slowly."

The IPCC notes that there are cost-effective solutions, such as retrofitting buildings for energy efficiency, but says they must be implemented in short order to stem further damage. "We are 25 years too late," Schneider says. "If the object is to avoid dangerous change, we've already had it. The object now is to avoid really dangerous change."

ABOUT THE AUTHOR(S)

David Biello

David Biello is a contributing editor at *Scientific American*. He has been reporting on the environment and energy since 1999.

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