

No easy way out

Scientists look seriously at the possibility of warming beyond the 2 °C target.

Anna Barnett reports.

Concerned by escalating greenhouse gas emissions, scientists are now looking in earnest at the possibility of global temperatures rising by 4 °C or more. Gathering this month at the University of Oxford, they sketched out a world affected by severe climate change, which they now see as increasingly probable.

The conference, which took place 28–30 September, marks a shift in experts' hopes of keeping average global temperatures to 2 °C above pre-industrial levels — widely considered the threshold for 'dangerous climate change'. "Emissions have not gone down globally, as people had hoped they would do," says Kevin Anderson, director of the Tyndall Centre for Climate Change Research, UK, who spoke at the conference. "The rate of increase has actually gone up."

Recent greenhouse gas emissions match the trajectory for most extreme scenario used by the Intergovernmental Panel on Climate Change (IPCC). But this scenario, A1FI, has received little study compared with its more moderate

counterparts, says Richard Betts of the UK Met Office's Hadley Centre in Exeter, who presented new research in Oxford. "Now we know that emissions are at the upper end of what the IPCC projected a decade ago, it justifies taking the higher-emissions scenario more seriously," he notes. Diana Liverman, director of the Environmental Change Institute at Oxford, says that until now, "it was almost like the 2 °C target was driving the science".

RAPID RISE

But without swift and steep curbs on emissions, temperatures could rise as much as 4 °C by 2060, according to Betts' new study.

The study predicts that oceans would warm less than the 4 °C average and land areas more — 7 °C in many areas, says Betts. Temperatures could climb by up to 10 °C in western and southern Africa and by the same or more in the Arctic. Decreases in rainfall of at least 20 per cent would be widespread in parts

of Africa, Australia, the Mediterranean and Central America.

Added to escalating emissions, he says, is accumulating evidence that rising temperatures will weaken natural carbon sinks, speeding the rate of warming. So far, sinks have absorbed 50 per cent of the greenhouse gases produced from the burning of fossil fuels. Depending on how much sinks weaken — a key source of uncertainty — average global temperatures could reach 4 °C above pre-industrial levels by the 2070s. With weaker sinks, this could occur as early as 2060.

PEAK PRACTICE

A separate study presented by Nigel Arnell, director of the Walker Institute for Climate System Research at the University of Reading, looked at the impacts of temperatures rising 4 °C by 2080. This scenario would expose 1 billion people to higher water stress and would intensify flood risks for half those living in flood-prone areas. Agricultural lands would shift markedly, with yields of certain crops such as soybeans plummeting. As much as 15 per cent of today's cultivatable land would turn barren, but an extra 20 per cent would be added as cold areas warmed up, found the study. The Amazon rainforest could die back significantly, while pines and firs replace northern grasses.

To avoid temperatures rising to this extent, global emissions will have to peak within about 30 years, says Betts. And to stay within 2 °C, they'll have to peak within a decade. According to papers published in *Nature* this year^{1,2}, the later emissions peak, the more precipitously they'll have to fall afterwards to avoid dangerous warming. Even if ambitious action is agreed at this year's UN climate conference in Copenhagen, notes Betts, it is likely to take years to implement.

OPPOSITE APPROACHES

If business as usual continues, extreme climate change could occur soon enough to affect a host of decisions being made today. Infrastructure and forestry plans in preparation now are meant to last for



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Warming of 4 °C would cause large declines in rainfall in Africa, Australia, the Mediterranean and Central America, according to climate modellers.

decades or more, and experts on adapting to climate change say these plans may need to be much bolder.

“As you can’t rule out a more severe scenario, potentially you have to invest in more expensive, proactive adaptation,” says Mark Stafford-Smith, director of the Climate Adaptation Flagship at the Commonwealth Scientific and Industrial Research Organisation in Crace, Australia. In some cases, such as with forest management, he says, planners will need to hedge against a wide range of possible climatic futures by simultaneously pursuing multiple adaptation strategies and later abandoning those that don’t work. “You can’t just do incremental adaptation and then gradually shift to transformative thinking,” he says. Instead, these opposite approaches need to be combined — for example, by protecting

trees from wildfires in some areas so that they could survive slight warming, but allowing blazes elsewhere, potentially clearing the way for a very different ecosystem to arise in a 4 °C world.

“You can’t just do incremental adaptation and then gradually shift to transformative thinking.”

Mark Stafford-Smith

Tailoring all adaptation to deal with the impacts of 4 °C warming would be expensive. For sea level rise alone, protecting global coastlines could cost at least US\$25 billion per year, and up to \$215 billion if current best guesses are surpassed, according to new figures presented at

the Oxford conference. UN experts have previously estimated costs of \$49-171 billion a year for all adaptation³.

Polymakers are left between a rock and a hard place, concludes Anderson. “Mitigating for 2 °C is much more challenging than was previously thought, but adapting to 4 °C is also extremely challenging,” he says. “There is no easy way out.”

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References

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Climate change: The two-degree target

In December, policy makers will meet in Copenhagen, Denmark to thrash out a new global deal on climate change. The aim is to limit global warming to two degrees Celsius above pre-industrial temperatures. We sent three young climate researchers along with *Nature's* Olive Heffernan to find out just how much of a challenge this ambitious target will be. Join them as they seek advice from climate experts including the IPCC's Rajendra Pachauri, challenge the sceptical views of political scientist Bjørn Lomborg, and learn lessons from the Nobel Laureates who showed that CFCs were destroying the ozone layer.



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