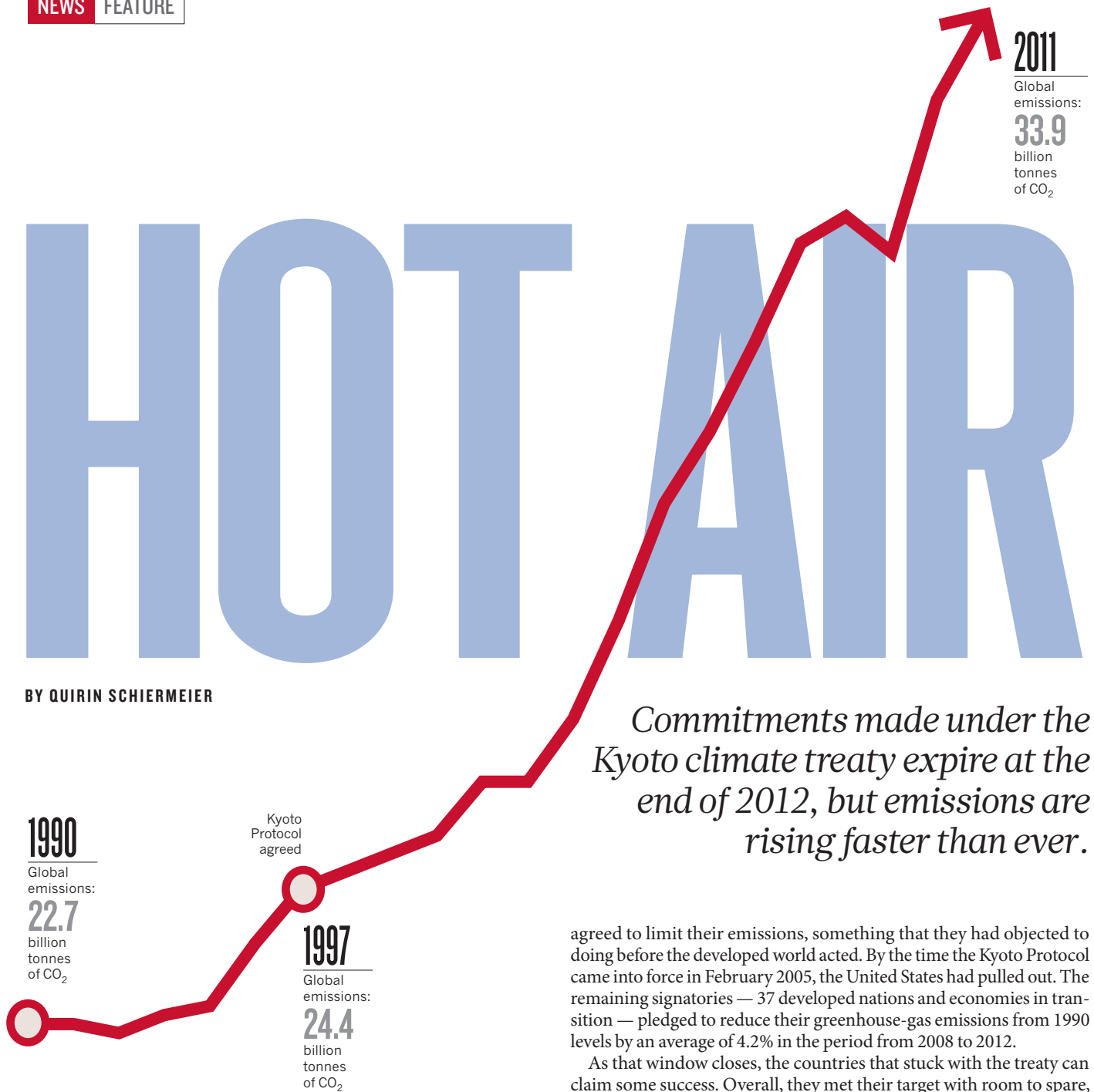


HOT AIR

BY QUIRIN SCHIERMEIER



Commitments made under the Kyoto climate treaty expire at the end of 2012, but emissions are rising faster than ever.

1990

Global emissions:
22.7 billion tonnes of CO₂

Kyoto Protocol agreed

1997

Global emissions:
24.4 billion tonnes of CO₂

2011

Global emissions:
33.9 billion tonnes of CO₂

After 8 days of fractious negotiating, delegates at the 1997 climate conference in Kyoto, Japan, were running out of time to deliver a treaty aimed at slowing global warming. The leader of the talks, Michael Zammit Cutajar of Malta, took the unusual step of invoking Zen Buddhism, telling everyone that they must break through mental barriers to achieve enlightenment. Two days later, after a marathon all-night session, the negotiators finally hammered out the climate agreement known as the Kyoto Protocol. It was the first — and so far, only — pact to commit rich countries to reducing emissions of carbon dioxide and other greenhouse gases.

But even before the ink was dry on the agreement, it was clear that the protocol faced a rocky future. Although the United States had signed the treaty, President Bill Clinton signalled that the world's largest economy would not ratify the pact unless China and other developing nations

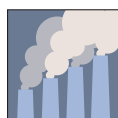
agreed to limit their emissions, something that they had objected to doing before the developed world acted. By the time the Kyoto Protocol came into force in February 2005, the United States had pulled out. The remaining signatories — 37 developed nations and economies in transition — pledged to reduce their greenhouse-gas emissions from 1990 levels by an average of 4.2% in the period from 2008 to 2012.

As that window closes, the countries that stuck with the treaty can claim some success. Overall, they met their target with room to spare, cutting their collective emissions by around 16%. But most of those cuts came with little or no effort, because of the collapse of greenhouse-gas producing industries in eastern Europe and, more recently, the global economic crisis.

Furthermore, the cuts by industrialized nations have done little to combat the global problem. Worldwide emissions have surged by 50% since 1990, driven by economic growth in China and other parts of Asia, South America and Africa. In the 1990 base year, developed nations including the United States accounted for two-thirds of global emissions. Now, their contribution has dropped below 50%.

“Kyoto had a very limited impact on climate,” says Atte Korhola, an environmental-policy researcher at the University of Helsinki. “It was too narrow in ambition, its tools were too massively bureaucratic and it offered too many loopholes.”

But the treaty has taught policy-makers some valuable lessons



AFTER KYOTO

The legacy of a climate treaty
nature.com/kyoto

and possibly laid the groundwork for more ambitious efforts. “Kyoto was a grand policy experiment with important lessons we ought to take forward. It had its flaws — no wonder, you rarely get policies right the first time — but the overall architecture is still useful,” says Roger Pielke Jr, who studies energy and innovation policy at the University of Colorado Boulder.

DIFFICULT LEGACY

The seeds of Kyoto’s problems were planted long before the treaty took shape. Many go back to June 1992, when negotiators at the Earth Summit in Rio de Janeiro, Brazil, were hammering out the United Nations Framework Convention on Climate Change (UNFCCC), the umbrella treaty that would encompass the Kyoto Protocol. Negotiators in Rio were still crafting the document just hours before heads of state arrived to sign it. Pressed by time and mounting expectations, the delegates borrowed heavily from past treaties, including a US–Soviet nuclear-arms agreement and the 1989 Montreal Protocol designed to protect the ozone layer, says Gwyn Prins, who studies environmental politics at the London School of Economics and acted as an adviser for the British negotiating team in 1992.

“Take out nuclear warheads, put in CO₂ — the basic idea was as easy as that,” says Prins. “But it turned out that climate change is a much more wicked beast — scientifically and economically — than ozone chemistry or nuclear-arms control.”

A meeting in Berlin in 1995 created another major problem, when parties to the UNFCCC decided to divide the world into two categories for the future treaty. There would be a set of rich countries with ambitious climate responsibilities and a set of less-developed economies — including China — with no responsibilities.

That decision, part of an agreement known as the Berlin Mandate, did not sit well with US politicians. In the summer of 1997, Robert Byrd, a Democratic senator from West Virginia and one of the senior politicians of his day, declared: “It is the Berlin mandate — and the fact that it lets the developing world off the hook scot-free — that will seriously harm the global environment in future years.”

His colleagues agreed. The US Senate voted 95 to 0 in favour of a proposal demanding that developing nations participate in emissions commitments. Because Kyoto included no such commitments, the United States — the world’s largest greenhouse-gas emitter at the time — would not ratify it.

The industrialized countries that remained with the treaty were each bound by individualized commitments, based on the state of their economy and energy mix at the time (see ‘Uneven progress’). The developed nations of Germany and Denmark agreed to cut their emissions by 21% relative to 1990 levels, whereas Portugal, with its less-developed economy, was allowed to increase its emissions by 27%.

Kyoto covered four main greenhouse gases — CO₂, methane, nitrous oxide and sulphur hexafluoride — and two further groups of gases, hydrofluorocarbons and perfluorocarbons. But it did not include another warming force: black soot particles from the incomplete combustion of wood and fossil fuels.

Countries could meet their commitments by cutting their own emissions or by buying emission allotments from other nations that had exceeded their required reductions. Rich countries could also get credit by investing in low-carbon technologies in developing countries.

For most central and eastern European nations, the job was easy: industrial emissions were high in the base year but had plummeted even by the time the treaty was signed. By 2010, Russia’s CO₂ emissions were 34% lower than in the base year (excluding cuts attributable to land-use changes) and Ukraine’s had fallen by 59%. The United Kingdom also easily met its 12.5% reduction target, thanks to the closure of many coal mines and a corresponding drop in consumption.

More recently, the economic downturn has helped to reduce emissions. Economists estimate that between 2007 and 2008, decreased

energy use caused a 2% drop in the emissions of the Kyoto Protocol countries; and that trend has continued as economies have sputtered.

But the reductions made under the treaty were dwarfed by the rise in emissions not covered by the accord, especially in Asia. Since 2000, CO₂ emissions in China have nearly tripled to almost 10 billion tonnes, and those in India have doubled to around 2 billion tonnes.

The rise in Asian emissions is partly a result of the migration of heavy industry from developed nations to developing countries, which make products that then get shipped back to wealthy nations. Between 1990 and 2010, the emissions embodied in such products grew by an average of 10% per year — to an annual total of 1.4 billion tonnes — surpassing the total emissions reductions achieved under Kyoto, says Glen Peters,

“KYOTO WAS A GRAND EXPERIMENT WITH IMPORTANT LESSONS WE OUGHT TO TAKE FORWARD.”

a climate-policy researcher at the Center for International Climate and Environmental Research — Oslo. The gains made by the treaty were therefore deceptive, says David Victor, an energy-policy researcher at the University of California, San Diego. The treaty, he adds, was based on “dubious economic assumptions and flawed accounting systems”.

FAULTY REASONING

One of those dubious assumptions was that fossil fuels would soon grow scarcer and prices would spiral upwards, helping to push countries towards alternative energy sources. But the globe is currently going through a massive coal renaissance, driven by abundant supplies that have grown much cheaper relative to other fuels in much of the world: the share of energy derived from coal has increased in the past ten years in both developing and developed countries. There has even been a shift towards coal in some parts of Europe, despite the mandatory cap-and-trade system to limit emissions. As a result, global energy production has grown more carbon-intensive in the past decade.

“The fathers of the UNFCCC and Kyoto Protocol quite severely underestimated the amount of hydrocarbons buried in the ground,” says Ottmar Edenhofer, chief economist at the Potsdam Institute of Climate Impact Research in Germany and a lead scientist with the Intergovernmental Panel on Climate Change.

These trends in energy use have made it nearly impossible for countries to limit global warming to less than 2 °C above preindustrial levels, the value chosen by the EU as a threshold likely to prevent dangerous climate change. Calculations suggest¹ that emissions of CO₂ must stay below 1,000 billion tonnes between 2000 and 2050 to give the world a 75% chance of containing the temperature rise to 2 °C.

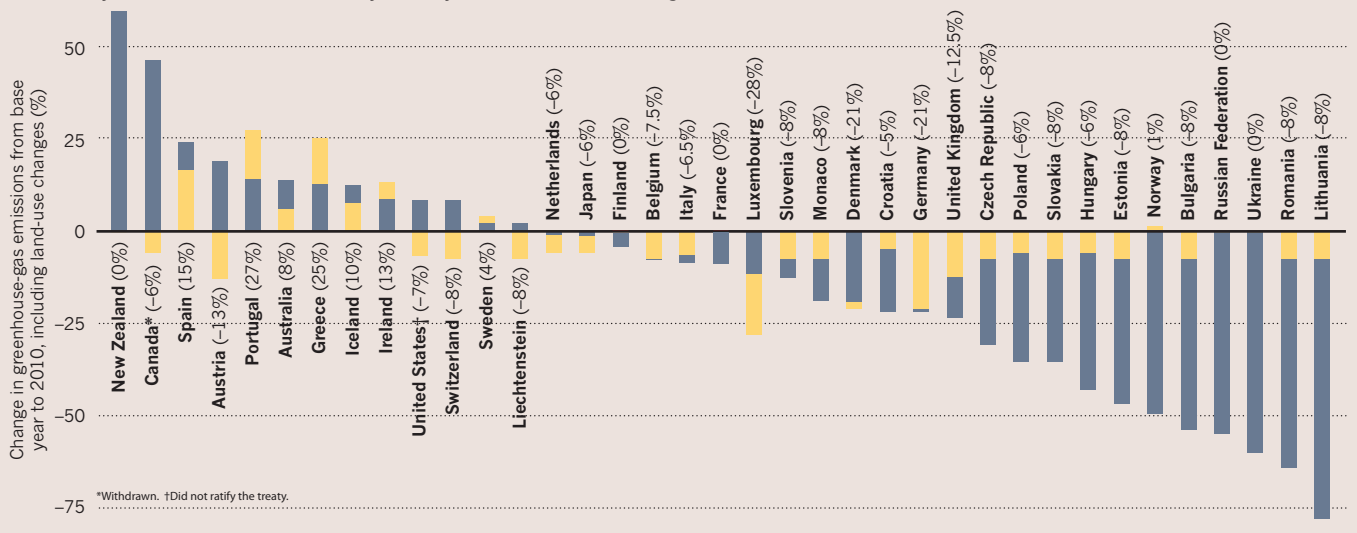
But emissions from fossil-fuel burning and deforestation since 2000 have already pumped more than 450 billion tonnes of CO₂ into the atmosphere. If the current trend continues, the 1,000-billion-tonne margin will be surpassed in a little more than a decade.

Despite its shortcomings, Kyoto has not been an utter failure, says Robert Stavins, an environmental economist at Harvard University in Cambridge, Massachusetts. Rather than judging the agreement on the emissions reductions it has achieved, he says, people should consider whether it has put the world on the right path.

“Nobody with a right mind could have expected that a climate regime that treats China like sub-Saharan Africa and that excludes 50 developing countries with a higher per-capita income than Romania could be anything other than a cautious first step,” he says. “What we need to create is a workable successor with binding national emission targets that all governments can be realistically expected to adopt.”

UNEVEN PROGRESS

The nations with binding limits under the Kyoto Protocol reduced their overall greenhouse-gas emissions by 16% from 1990 levels, but many are likely to miss their individual targets.



SOURCE: NETHERLANDS ENVIRON. ASSESSMENT AGENCY/EC JOINT RES. CENTRE

Kyoto will leave a valuable legacy, says Yvo de Boer, former chief executive secretary of the UNFCCC and adviser for global auditing firm KPMG. The methodologies developed for reporting and verifying national greenhouse-gas emissions and land-use changes will be important components of any future climate treaty, he says.

The protocol also gave birth to a method for trading carbon emissions among countries that face limits. Pioneered by the EU's Emissions Trading Scheme, which launched in 2005, this carbon market could one day become a globally linked CO₂ cap-and-trade system, says de Boer.

An additional element of the Kyoto agreement — the Clean Development Mechanism (CDM) — established a way for rich countries to get credits towards their targets by making cost-effective emissions cuts in poor countries. Critics have charged that the CDM is plagued by cumbersome bureaucracy and that some Western-funded clean-technology projects in developing countries would probably have been built without it. Nevertheless, a total of 5,000 CDM projects have attracted investments worth almost US\$100 billion. The projects have ranged from providing rural Chinese villagers with solar cookers to supporting a 100-megawatt wind farm in Mexico.

“Without Kyoto we wouldn't have achieved anything at all” in that area, says Victor. He would like to see a successor treaty constructed more like trade accords, which are tailored using realistic assumptions about commitments and rely on mutual action. “What one country is willing to pay to control emissions depends a lot on what its economic competitors will pay as well,” he says. “More flexible treaties could help countries craft deals that are truly interdependent — where the efforts of one country get multiplied because they lead others to do more.”

FOLLOW THE MONEY

Many other policy experts agree that the next climate treaty must take a more pragmatic approach than the UNFCCC and the Kyoto Protocol, which failed to win over the biggest polluters in part because it relied on a mix of ethical and environmental rationales rather than economic ones. “Making energy more expensive is a political liability everywhere,” says Pielke. “When emission reductions run up against economic growth, economic growth will inevitably win out. There is no magical solution, so you better set yourself tangible goals that aren't doomed to clash with the iron laws of politics.”

Emissions targets for all countries should be allocated in a way that acknowledges the political and economic costs of complying with a climate agreement, argued Valentina Bosetti, a climate-impact modeller at the Eni Enrico Mattei Foundation in Milan, Italy, and Jeffrey Frankel, an

economist at Harvard, in a discussion paper last year². China, for example, would be asked to accept only targets that it could meet without sacrificing its developmental aspirations; the United States would be assigned more stringent goals. But with time, all nations' emissions targets would be adjusted progressively according to a common economic formula.

Attaching a price to carbon, through cap-and-trade mechanisms or a direct carbon tax, would help by stimulating technological advances that reduce emissions. The challenge, says Pielke, is to get the price right and make sure that the revenue will go towards investments in technology.

A moderate carbon tax — applied when fossil fuels are removed from the ground — might work best to stimulate innovation in technologies that will eventually make alternative energy sources cheaper than fossil fuels, he says. But the approach has to be global.

In a policy paper³ published in 2010, Pielke, Prins and 12 others called for a more pragmatic, diversified and less bureaucratic approach than Kyoto, which would wean the global economy off carbon as a by-product of reducing poverty and expanding energy access to the poor.

The group takes the focus off CO₂, which has a long lifetime in the atmosphere, and instead emphasizes cuts in black carbon and methane emissions, which don't last as long. This, say the paper's authors, would slow global warming more quickly and would provide time for a transition to a low-carbon economy. They also suggest that negotiations for the next emissions treaty avoid topics such as deforestation, land use, air quality and adaptation, which would greatly complicate its architecture.

That agreement will take shape slowly over the next few years. In Copenhagen in 2009, nations failed to produce a follow-on treaty to the Kyoto Protocol. However, in Durban, South Africa, last year, countries including China and the United States agreed to negotiate a new climate treaty by 2015. If the past is any indication, the final details of that pact will not emerge until the sleep-deprived delegates have reached the deadline of the final negotiating session.

Will the world find a solution to this so far intractable problem? “I'm confident it will,” says de Boer, who presided over the unsuccessful negotiations in Copenhagen. “But I'm not convinced that it will come on time.” ■

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1. Meinshausen, M. *et al.* *Nature* **458**, 1158–1162 (2009).
2. Bosetti, V. & Frankel, J. *Sustainable Cooperation in Global Climate Policy: Specific Formulas and Emission Targets to Build on Copenhagen and Cancun Discussion paper 2011-46* (Harvard Project on Climate Agreements, 2011).
3. Prins, G. *et al.* *The Hartwell Paper: A New Direction for Climate Policy After the Crash of 2009* (LSE, 2010).