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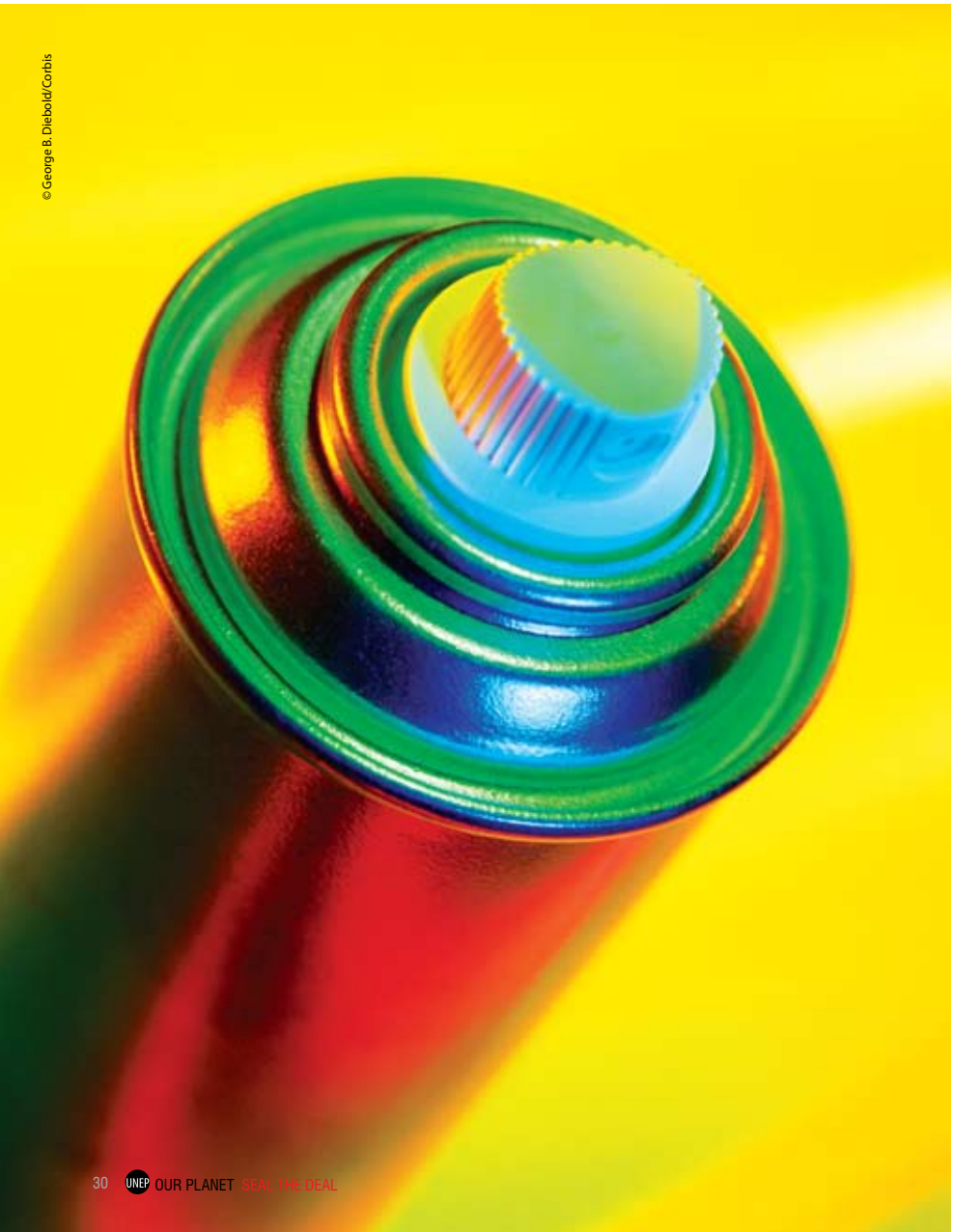

Climate change is occurring faster than the world's leading scientists thought only a few years ago. The climate system is dangerously close to passing temperature tipping points for abrupt and irreversible changes, if it hasn't already done so.

One such is the melting of all the Arctic summer sea ice, which is already rapidly disappearing: once it has gone, it is replaced by darker water that absorbs more heat, accelerating warming. Another tipping point is the melting of the snow and ice in the Himalayan and Tibetan glaciers, which feed the major rivers of China, India, Pakistan and the rest of the region.

The Earth is speeding toward these and other tipping points with no signs of slowing down. Mitigation measures being discussed by the major countries all fall far short of what will be required to avoid abrupt and irreversible climate changes.

But there is also some good news. It starts with understanding that CO_2 from burning fossil fuels and

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cutting forests is only responsible for about half of anthropogenic global warming, even though it has received the most attention from policymakers deliberating how to control climate change.

Aggressively reducing CO_2 pollution is essential for a safe climate system, but it is not sufficient. Indeed it is not only just half of the problem, but the slow half. Carbon dioxide emissions remain in the atmosphere for centuries or even millennia, so reducing them won't lead to cooling for at least a thousand years. We need to reduce CO_2 by 100 per cent by the middle of the century — but we need to do more as well.

This is where the other half of human-caused global warming comes in — the effects of aerosols and other gases, largely overlooked by policymakers. This is the fast half that can produce cooling in days to decades, and the one that may be easier to solve quickly in the near term. It deserves the urgent attention of policymakers. Much is already known about how to reduce these pollutants and, in many cases, there are laws in place that address them – and they could delay warming by up to 40 years.

A combination of non-CO2 climate mitigation strategies can therefore help avoid the growing threat of abrupt and irreversible climate changes. Four such 'fast-action' strategies are discussed by Nobel Laureate Dr. Mario Molina and colleagues in a recent paper in the Proceedings of the National Academy of Sciences — reducing hydrofluorocarbons, or HFCs, black carbon soot and tropospheric ozone, and expanding bio-sequestration through biochar.

Rapid growth in the production of HFCs — synthetic chemicals used in air conditioning, refrigeration and in making foams — will make them a major contributor to climate change, responsible for up to 10 per cent of warming by 2050. Dr. Molina and his colleagues point out that the Montreal Protocol ozone treaty is ready, willing, and able to phase down HFCs, just as it has done for 96 other chemicals — a process that has already provided

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climate mitigation equivalent to a net 135 billion tons of CO_2-equivalent, delaying climate forcing by up to 7–12 years.

They also point out that many alternatives to HFCs already exist and are on the shelf waiting for the right regulatory incentive to be deployed. Indeed there is growing political support for phasing down their production and consumption under the Montreal Protocol. The small island states of Micronesia and Mauritius proposed this last April. And the US, Canada, and Mexico submitted a similar proposal, in an unprecedented joint effort announced by President Obama, President Calderon and Prime Minister Harper.

Black carbon soot is another short-term forcer of climate change. Produced largely from incomplete combustion of fossil fuels, particularly in diesel vehicles, and through burning of biomass for heating and cooking in developing countries, it contributes up to 25 per cent of total warming and is responsible for much of the melting of snow and ice in the Arctic and Tibetan-Himalayan glaciers. It can be reduced significantly by using diesel particulate filters and solar or cleaner-burning biomass stoves.

Tropospheric ozone — or ground-level smog — provides up to 10 per cent of warming and is formed by a number of 'ozone precursor' gases such as carbon monoxide, nitrogen oxides, methane, and other hydrocarbons. It can be mitigated by increasing efficiency in industrial processes where most of these precursor gases are produced.

Cutting black carbon and tropospheric ozone makes sense for public health and food security as well as the climate. Both are major pollutants which damage health. Black carbon is a major contributor to 1.6 million deaths from indoor air pollution worldwide. Ozone is also a killer, and — according to one recent study — causes $14 billion to $26 billion of damage to crop yields annually.

Biochar offers a rare 'carbon-negative' strategy that can reduce existing concentrations of CO_2. The fine-grained charcoal product is produced by cooking biomass with little oxygen through pyrolysis, turning it to a stable form of carbon that can be ploughed into soil where it remains — and acts as a valuable fertilizer — for hundreds to thousands of years. Turning agricultural waste into biochar could save the emission of more than 3 billion tons of CO_2 per year by 2040. Under the most aggressive scenario, which would use plantation-grown biomass as well as waste, this might become 20 billion to 35 billion tons of CO_2 per year.

These fast-action mitigation strategies are win-win for both developed and developing countries. Many can be implemented now with available technology at a relatively low price, and they do not require a new global agreement. Though time is running out, we can still save ourselves if we take 'fast action' now on both halves — CO_2 and non-CO_2 — of the problem.

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