The Economist

The Montreal protocol

To coldly go

Extending an old treaty that saved the ozone layer could improve cooling technology—and slow global warming

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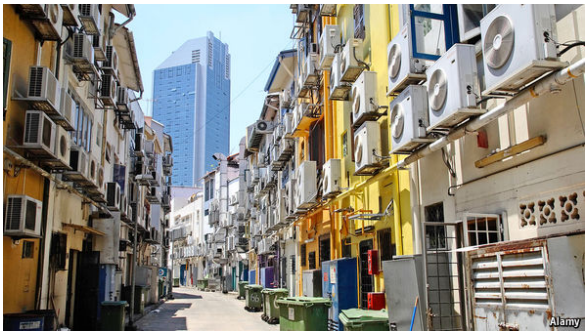


THE world's most lauded environmental treaty could be about to notch up a new success. In 1974 scientists discovered that chlorofluorocarbons (CFCs), chemicals used in refrigeration and as propellants in products such as hairsprays, release chlorine into the stratosphere as they decompose. This depletes the ozone that protects Earth from ultraviolet radiation. CFCs are also powerful greenhouse gases, which absorb solar radiation reflected back from the planet's surface and so trap heat in the atmosphere.

Initially, the consequences for the ozone layer caused most concern. In 1985 a gaping hole in it was found above Antarctica. Two years later, leaders from around the world acted decisively. They signed a deal, the Montreal protocol, to phase out CFCs. Now ratified by 197 countries, it has prevented the equivalent of more than 135 billion tonnes of carbon-dioxide emissions, and averted complete collapse of the ozone layer by the middle of the century. Instead, by that point the ozone hole may even have closed up.

Now America and China are leading efforts to use the Montreal treaty to solve another urgent problem—one that is a legacy of its original success. Barack Obama and Xi Jinping are among the presidents and prime ministers pushing for a deal at meetings in Rwanda next month. In order to manage without CFCs, firms replaced them in applications such as refrigeration, air-conditioning and insulation with man-made hydrofluorocarbons

(HFCs). These substances do not deplete ozone and last in the atmosphere for just a short time. However, they still contribute hugely to global warming.

The average atmospheric lifetime for most commercially used HFCs is 15 years or less; carbon dioxide can stay in the atmosphere for more than 500 years. But, like CFCs, HFCs cause a greenhouse effect between hundreds and thousands of times as powerful as carbon dioxide while they linger. Total emissions are still relatively low, but are rising by 7-15% a year. Controlling HFC emissions has been under discussion for the past decade; America and China, the world's two biggest polluters, made a deal on the issue in 2013, which paved the way for co-operation on limiting carbon emissions ahead of UN-sponsored climate talks in Paris last year. There leaders agreed to keep warming "well below" levels expected to be catastrophic.

Average global temperatures are already 1°C higher than in pre-industrial times; along with urbanisation, electrification and rising incomes in developing countries, this is boosting demand for air-conditioning. In several large, hot countries, including Brazil, India and Indonesia, the number of units sold is rising by 10-15% annually. Cavernous fridges and freezers mean that HFCs can account for almost half a supermarket's greenhouse-gas emissions. Other big polluters include fast-food outlets, with their under-counter refrigerators, ice-cream machines and the like. These are gaining popularity in the developing world: one estimate suggests that by the end of this year India's fast-food industry will be twice as large as four years ago. Globally, cooling devices could cause HFC emissions equivalent to 8.8 gigatonnes of carbon dioxide by 2050—almost as high as the peak level of CFCs in the late 1980s.

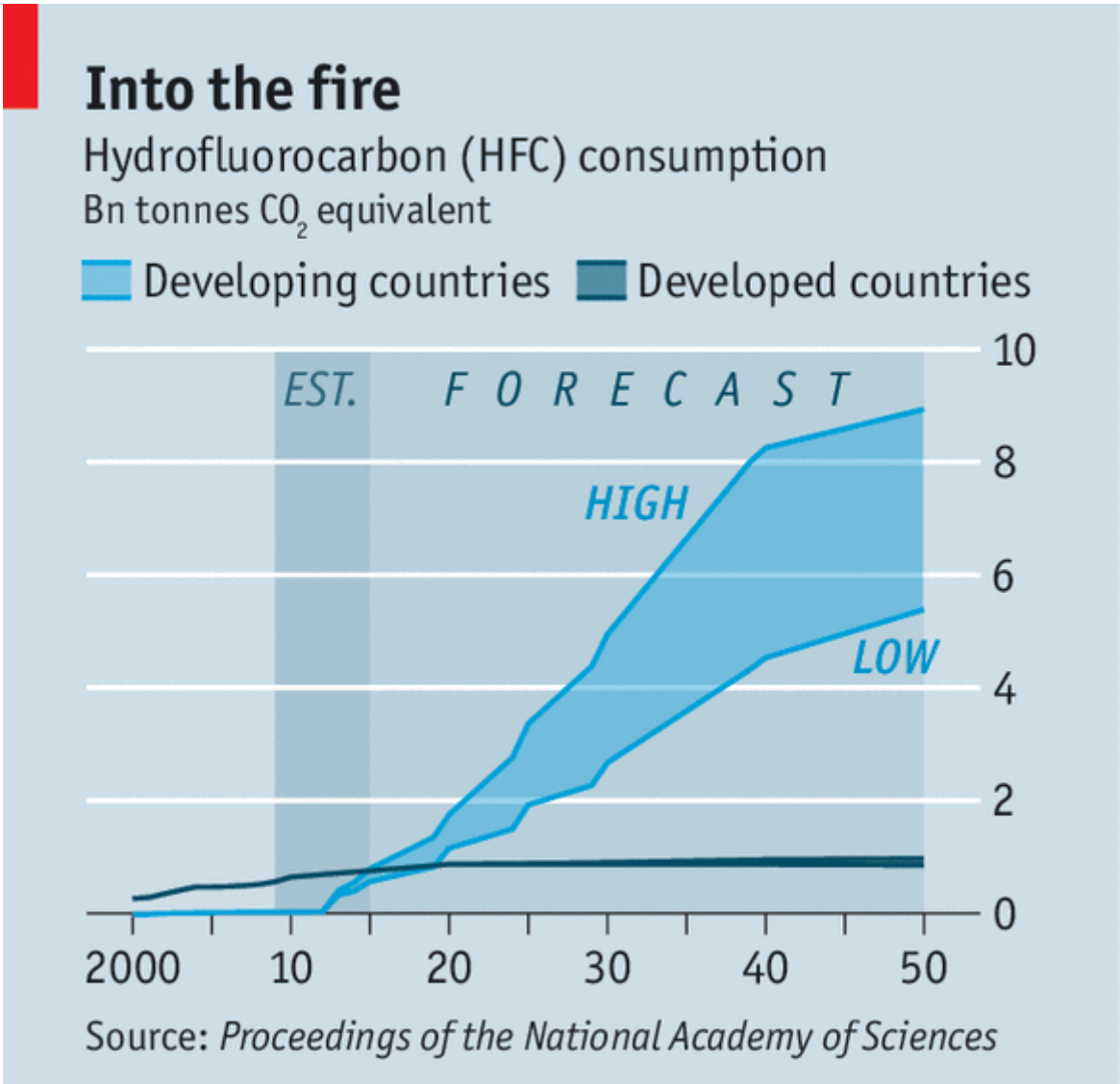
Move along, please

America wants action on HFCs speedy enough that emissions will peak in 2021 and then start to fall; after recent talks in Hangzhou between Mr Obama and Mr Xi China may be ready to commit to reaching that point by 2023. Brazil, Indonesia and Malaysia lean towards 2025, and India has lobbied for a later date, closer to 2030. But many African countries and low-lying island states, concerned already by the changing climate, are pushing for a tighter timetable. Whatever the deadline, and however steep the cuts, the plan is to require rich countries to act faster, while allowing poorer ones more time to adjust.

In 1991 a fund was established to help developing countries meet their obligations under the original Montreal protocol. Its cash grants, training and technical assistance since then have amounted to more than $3 billion. Though the exact sum needed to sweeten an HFC deal will not be decided until next year, it will need to be considerable, since many developing countries manufacture the white goods that will be affected. Though the fund

will only partially cover countries' costs, rich countries look set to offer more to poorer ones that act ahead of schedule.

Action on short-lived climate pollutants such as HFCs, methane and soot is not an alternative to cutting emissions of carbon dioxide, which hangs around doing harm much longer. But a deal on HFCs would benefit the climate fast—and not only in the most obvious way, by obliging countries to cut emissions of these powerful greenhouse gases in order to meet their obligations. On its own this direct effect could make a real difference. An ambitious deal, for example one demanding that they start to be phased out by 2020, would avert the equivalent of 100 billion-200 billion tonnes of carbon-dioxide emissions by 2050, enough to chop 0.5°C from the rise in average global temperatures by 2100 (see chart). In the context of the agreed goal of global climate policy, which is to limit such warming to less than 2°C, this is significant.



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Just as important is that the Montreal protocol is a “start and strengthen” treaty, says Durwood Zaelke of the Institute for Governance and Sustainable Development, an American think-tank. The improvements to technology and manufacturing spurred by even a modest deal could lead to a transition from HFCs much more quickly than envisioned, as firms, knowing they will have to switch eventually, decide not to delay.

This is what happened with CFCs: progress was so fast that the original timetable, which varied between rich countries and poorer ones, was replaced by a goal of complete elimination within a decade when it became clear that this was feasible. In some sectors firms are already preparing to move away from HFCs: in 2015 the Consumer Goods Forum, an international industry group whose members include Walmart and Tesco, began enacting a plan to phase out the substances.

A big question is what to use instead. Since different HFCs remain in the atmosphere for varying lengths of time, and therefore have varying impacts on the atmosphere, one possibility is to substitute the shortest-lived for those that linger. Some HFCs commonly used in refrigeration could be replaced by others that would have an impact more than 1,000 times smaller. Honeywell, an electronics giant, already makes air-conditioning units containing these less-damaging alternatives. But patents covering such substances have been a sticking point in past discussions, says Achim Steiner, until recently the head of the UN Environment Programme.

Other possible

Survival kits, new and improved replacements include isobutane, propane and propylene, all of which occur naturally. These hydrocarbons are cheap and non-toxic, and can be used as coolants without the same harm to the ozone layer. Another option is ammonia, which is already present in some large industrial cooling systems. Even carbon dioxide can be used, though that may seem counter-intuitive, since it is the gas most to blame for global warming. But tonne for tonne it is far less warming in the short term than many other greenhouse gases. The reasons it is of such concern are that so much more of it has been released, and that it hangs around for so long.

Officials representing extremely hot countries, such as Kuwait and Saudi Arabia, at climate talks fret that these natural replacements for HFCs will simply not be as effective.

But there is a good reason to focus research and development on them, says Drew Shindell, who works for Duke University on aerosols and climate change. Their effects on the atmosphere are already known. No one wants more unintended consequences, as with the replacement of CFCs with HFCs.

The third way in which extending the Montreal protocol could benefit the environment is that, as devices are redesigned to use new coolants, firms can take the opportunity to make them more energy-efficient as well. That would cut carbon emissions from power generation. Again, this happened after the original deal: some cooling appliances sold afterwards were 60% more efficient than those they replaced. By 2000 close to half of America's large air-conditioning units—the types found in office buildings—had been converted or replaced to eliminate CFCs. According to America's Environmental Protection Agency, the switch saved enough electricity to power 620,000 homes.

Efficiency gains from the original protocol were less pronounced in the developing world, since fewer appliances were in use at the time. That is changing. In hot spots such as Delhi, air-conditioning can make up half the power load on a summer's day. A deal to tackle HFCs could be the catalyst for a much-needed efficiency drive. Without it, if global warming continues unabated, rising demand for fans, refrigeration and air-conditioning could increase electricity usage by four-fifths globally between 2010 and 2100. Less wasteful cooling methods could avert that rise, which would have climate-changing implications, no matter the coolant used. The scale of the possible savings can already be seen in South Korea. Air-conditioning units on sale there require half as much energy as is typical elsewhere.

Lee Kuan Yew, the first prime minister of Singapore, once said that air-conditioning was the greatest invention of the 20th century (since it enabled people to work comfortably in offices in the tropics). Over the next 100 years, it may prove even more important. As well as contributing to climate change, it will play a big part in enabling humanity to adapt to it. Research published last year in *Nature*, a scientific journal, found that warmer-than-usual years boosted economic growth in both rich and poor countries, but only up to an annual average of 13°C, above which temperature productivity suffered. As 2015 proved the hottest year on record, and 2016 looks certain to steal that title, a deal that means air-conditioning does as much good and as little harm as possible is what a warmer world needs.

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