

GLOBAL EFFORT (Note: because of the Montreal Protocol)

Scientists: Restoration of Ozone Layer Back on Track

A refrigerator factory in 2018 in Xingfu, China, an area that defied restrictions on ozone-depleting CFC-11 until a government crackdown.

Credit...

Gilles Sabrié for The New York Times

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The weakened ozone layer, which is vital to protecting life on Earth, is on track to be restored to full strength within decades — the latest success of a global effort by nations to stop using chemicals that had been destroying the critical layer in the upper atmosphere.

In a report for the United Nations, scientists said Monday that China had largely eliminated rogue emissions of one of those chemicals, known as CFC-11.

Once widely used as a refrigerant and in foam insulation, CFC-11 was first synthesized a century ago. Along with similar chemicals, collectively called chlorofluorocarbons, CFC-11 destroys ozone, which blocks ultraviolet radiation from the sun that can cause skin cancer and otherwise harm people, plants and animals. Chlorofluorocarbons were banned under the Montreal Protocol, a landmark environmental agreement that took effect in 1989.

(Note: 1974 Mario Molina and Frank S. Rowland worked tirelessly to influence law makers which eventually led to the Montreal Protocol. Molina, Rowland and Crutzen were awarded the 1995 Nobel Prize for Chemistry for their work on this problem.)

If countries continue to maintain the bans on chlorofluorocarbons and other chemicals, ozone levels between the polar regions should reach pre-1980 levels by 2040. Ozone

holes, or regions of greater depletion that appear regularly near the South Pole and, less frequently, near the North Pole, should also recover, by 2045 in the Arctic and about 2066 in Antarctica.

“The recovery of the ozone layer is on track,” said David W. Fahey, director of the National Oceanic and Atmospheric Administration’s Chemical Sciences Laboratory and a co-chairman of the protocol’s scientific assessment panel. “The peak destruction of the global ozone layer is behind us due to the effectiveness of the control measures of the Montreal Protocol that have been adopted by all nations.”

In the 1970s, scientists first determined that chlorofluorocarbons were depleting ozone high in the atmosphere. By the mid-1980s, researchers discovered a hole in the ozone over the Antarctic, sparking an urgent international effort to repair it. More than 100 ozone-depleting compounds were eventually banned and phased out.

The Chinese emissions had threatened to delay restoration of the ozone layer by a decade but the new report said it had only been put off by a year.

Emissions of CFC-11 began increasing after 2012 and appeared to come from East Asia, according to [a 2018 study](#) by Dr. Montzka. [Investigations by The New York Times and others](#) strongly suggested that small factories in Eastern China were the source of the rogue emissions.

“The emissions dropped amazingly abruptly,” said Stephen A. Montzka, a NOAA research chemist and one of the report’s authors. The delay in recovery “is a lot smaller than it could have been if the emissions persisted,” he added.

At the time, the head of the United Nations Environment Program, which oversees the protocol, called illegal production of CFC-11 “nothing short of an environmental crime which demands decisive action.”

But a follow-up study in 2019 showed that emissions were declining, a sign that the Chinese government was cracking down on new production of CFC-11.

The Chinese CFC-11 was very likely used as a blowing agent in making foam insulation. During foam production, some of the CFC-11 escapes into the atmosphere, where it can be detected and measured, but much of it is contained within the foam as it hardens.

In this way, the researchers said, the Chinese rogue production had contributed to the “banks” of chlorofluorocarbons that were produced worldwide before ban went into effect and are in foams as well as refrigeration equipment and fire-extinguishing systems. These existing chemicals are not yet in the atmosphere, but are being released slowly through foam deterioration and destruction, leaks or other means.

Dr. Montzka said the size of the Chinese contribution to the banks was not known. “But if the banks have been built up substantially, that would add a few more years to that expected delay in recovery,” he said.

Durwood Zaelke, president of the Institute for Governance & Sustainable Development, a Washington-based research and advocacy organization, said the elimination of the rogue emissions was another example of the success of the protocol, which is generally considered to be the most effective global environmental pact ever enacted.

Atmospheric monitoring, which is required by the protocol, detected the problem, Mr. Zaelke said, and brought it to the attention of the treaty’s directorate. “Without admitting guilt, the offending parties got their act together,” he said. “And the measurements are back where they should be.”