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In a High-Stakes Environmental Whodunit, Many Clues Point to China



Billboards in Xingfu, China, promoting locally made refrigerators. The city has around 1,700 businesses involved in the production of cooking and refrigeration equipment. Credit Gilles Sabrié for The New York Times

By [Chris Buckley](#) and [Henry Fountain](#), June 24, 2018

XINGFU, China — Last month, scientists disclosed a global pollution mystery: [a surprise rise in emissions of an outlawed industrial gas](#) that destroys the atmosphere’s protective ozone layer.

The unexpected spike is undermining what has been hailed as [the most successful international environmental agreement ever enacted](#): the Montreal Protocol, which includes a ban on chlorofluorocarbons, or CFCs, and which was expected to bring a full recovery of the ozone layer by midcentury. But the source of the pollution has remained unknown.

Now, a trail of clues leads to this scrappy industrial boomtown in rural China.

Interviews, documents and advertisements collected by The New York Times and independent investigators indicate that a major source — possibly the overwhelming one — is factories in China that have ignored a global ban and kept making or using the chemical, CFC-11, mostly to produce foam insulation for refrigerators and buildings.

“You had a choice: Choose the cheaper foam agent that’s not so good for the environment, or

<https://www.nytimes.com/2018/06/24/world/asia/china-ozone-cfc.html>

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the expensive one that's better for the environment," said Zhang Wenbo, owner of a refrigerator factory here in Xingfu, in Shandong Province, where he and many other small-scale manufacturers said that until recently, they had used CFC-11 widely to make foam insulation.

"Of course, we chose the cheaper foam agent," Mr. Zhang said during an interview in his office. "That's how we survived."

As it happens, a crackdown was underway in the town and moments later, four officials entered Mr. Zhang's factory, handed him a leaflet warning against a range of environmental violations, including using CFC-11, and ordered his factory closed.

"They never told us until last year that it was damaging the atmosphere," Mr. Zhang said. "Nobody came to check what we were using, so we thought it was O.K."



A refrigerator plant in Xingfu. Many factories in the city are small, with only a handful of workers. Credit Gilles Sabrié for The New York Times

China has the [world's largest polyurethane foam market](#), making up about [40 percent of global consumption](#). And China accounted for [nearly all East Asian production](#) of CFC-11 and similar chemicals before they were banned.

China's struggle to eradicate CFC-11 embodies the hurdles it faces in cleaning up after decades of frenetic industrial expansion, when officials often treated pollution as a necessary price of

prosperity. But it also has consequences far beyond the nation's borders.

Researchers [said in a study published last month](#) that a rise in emissions of CFC-11 was jeopardizing the effort to repair the [ozone layer](#), which protects people and crops from the sun's damaging ultraviolet rays.

That effort began in the 1980s with the adoption of the Montreal Protocol, which ultimately outlawed CFC-11 and similar chemicals that destroy the ozone layer (and, because they are greenhouse gases, contribute to global warming). Scientists predicted that, as the chemicals produced before the ban came into force degraded and disappeared, the layer would be fully restored by the middle of this century. But the recent study said the new emissions could delay that recovery by a decade.

Some experts were skeptical that foam production in China could be the culprit.

"It is a very large amount to appear so suddenly," David Sherry, a [British expert](#) on ozone chemicals who has worked in China, said by email.

But the study's authors said that such a large tide of emissions — on the order of 13,000 metric tons a year — could be explained only by new, illegal production, and said the source was probably in East Asia. Evidence suggests that an important focus may be small foam makers and their chemical suppliers in China, where regulators have long had a tough time bringing polluters to heel.

Chinese traders and experts candidly described how small, primitive chemical plants have kept making CFC-11 in spite of the ban, and their accounts are backed by government documents.

"Currently there is still a large volume of illegally produced CFC-11 being used in the foam industry," Shao Changying, an environment official in Shandong, wrote in a report [published last year](#). Another Shandong environment office [report in 2016](#) described a "quite vigorous illegal

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production of outmoded CFC-11,” which it said was “bringing risks to the market and environment.”



A wholesale kitchen appliance showroom in Xingfu. The banned chemical, CFC-11, is used to produce foam insulation for refrigerators and buildings. Credit Gilles Sabrié for The New York Times

Even while Shandong and other provinces have cracked down on the chemical, Chinese traders still offer it for sale online.

Stephen O. Andersen, a former official with the United States Environmental Protection Agency who served on one of the Montreal Protocol’s advisory committees, said cheaper legal alternatives to CFC-11 were available. In interviews, though, small Chinese manufacturers seemed unaware of them or unwilling to pay the costs of converting their equipment to use them.

And Liu Le, a refrigeration expert in Shandong, said there were still companies ready to provide the CFC-11.

“When nobody is watching, they can make some, or when they get an order — an underground order — they can also produce it,” Mr. Liu said. “They produce for a while until they’re discovered, and then move on.”

An independent group, the [Environmental Investigation Agency](#), said it had identified eight factories in four Chinese provinces where the chemical was being used in the foam-making process. The organization, based in Washington,

said that and other evidence — including conversations with confirmed sellers of CFC-11 — pointed to the Chinese foam industry as the primary source of the new emissions.

“The scale of this environmental crime is devastating, with massive potential impact on the climate and the ozone layer,” said Alexander von Bismarck, executive director of the group. He said the agency had given initial findings to the Chinese government and the secretariat of the Montreal Protocol, and would publish a full report next month. “We’re hoping for a strong response from a strong environmental agreement,” Mr. von Bismarck said.

Made aware of both The Times’s and the Environmental Investigation Agency’s findings, Erik Solheim, head of the United Nations Environment Program, which oversees the protocol, called illegal production of CFC-11 “nothing short of an environment crime which demands decisive action.”

“At the same time, we have to dig deeper,” Mr. Solheim said in a statement. “Based on the scale of detected emissions there is good reason to believe the problem extends beyond these uncovered cases.”



Wang Xuechuan has worked in the appliance industry for 14 years. He said profit margins were tight because of increasing labor costs. Credit Gilles Sabrié for The New York Times

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The Chinese Ministry of Ecology and Environment did not respond to questions about regulation of ozone-damaging chemicals and illegal output, and said it was preparing a response. [Hu Jianxin](#), a professor at Peking University who studies such chemicals and advises policymakers, said he and other experts needed time to check the findings and track down possible sources in China and elsewhere.

“Illegal production and use of CFCs can of course contribute to the atmospheric concentrations,” Professor Hu said. But, he added, the jump in emissions indicated by the latest study also meant there may be new sources that had not been considered before.

Over the past decade, Chinese Communist Party leaders have come to see smog, tainted water and other pollution as serious threats to trust in the government. The government has made strides in [curbing smog](#) and slowing the growth of [emissions of carbon dioxide](#) and other planet-warming gases. Likewise, since announcing the ban on CFC-11, China has demanded that companies switch to less harmful chemicals.

But officials and traders said it was a seesaw battle. Many polluters are small factories that slip through the net of inspections or treat fines and shutdowns as just the price of business.

“On the one hand, 11 is cheaper, and on the other, its foaming effect is better,” said Ge Changqing, a manager for a legitimate chemical company, referring to CFC-11. “The demand is there downstream and local governments turn a blind eye. There’s money to be made.”

The illicit producers often set up in isolated sites, sometimes protected by local cadres unaware of, or indifferent to, the risks.

“These businesses are often out of the way, don’t have commercial registration, and don’t even have a name for their factories,” Mr. Liu, the expert on refrigeration chemicals, said in a [presentation to officials](#) last year. “Some of them

regularly move, making it very difficult for the acting agencies to exercise oversight.”

There have been successes. In 2015, officials said that Shandong had [shut 15 illegal makers](#) of CFC-11 and a similar banned chemical since 2013, and that two people in the trade had been convicted.



The padlocked gate of Zhang Wenbo’s factory in Xingfu. He acknowledged using a banned chemical to cut costs. “That’s how we survived,” Mr. Zhang said. Credit Gilles Sabrié for The New York Times

Sometimes the closed plants have been sizable. Over just four months, one of those shut in 2015 [made over 300 tons](#) of an illegal ozone-destroying chemical often used as a coolant. Another, shut in 2012, made 1,100 tons of CFC-11 in 11 months and dumped toxic waste, causing a die-off at nearby fish farms, according to a [court verdict](#).

But the number of Chinese factories that use polyurethane foam here is daunting — Xingfu alone has around 1,700 businesses involved in making cooking and refrigeration equipment, according to [the local government](#) — and officials have said that tracking and punishing illegal chemical production is difficult.

“Illegal production and use is highly concealed, evidence is hard to obtain, and it’s quite difficult to crack cases,” Ms. Shao, the Shandong official, said in her report. “Among the cases of lawbreaking in recent years, only a small number

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of the suspects have received the punishment they deserve.”

When contacted, some online chemical traders denied selling the gas despite offering it in ads; some said their sales pages were out of date. But others said that they still sold the gas.

“Using CFC-11 doesn’t necessarily mean violating the law,” said Wu Shaoji, a chemical salesman based in Shanghai. “The government doesn’t check.”

There are hints that Chinese officials were taking action even before the scientists’ warning. In January, the government [announced tighter controls on carbon tetrachloride](#), a chemical that can be used to make CFC-11, and ordered unlicensed companies not to sell it off as a byproduct from making other chemicals.

But paradoxically, underground demand for CFC-11 may have been partly spurred by China’s increasingly strict environmental standards. The government has demanded better insulation of

buildings so they waste less energy, and that means more foam.

At the same time, the government has tightened supplies of the main legal foam-making agent used in China, HCFC-141b, which is less harmful to the ozone layer. That chemical is scheduled to be phased out in China’s polyurethane foam sector [by the end of 2025](#), to be replaced by even safer alternatives.

But Ms. Shao, the environment official, said that the surging price of HCFC-141b had encouraged some foam makers to fall back on black-market CFC-11 instead of embracing unfamiliar, next-generation alternatives.

Factory owners in Shandong agreed.

“They’ve reduced the amount of 141b every year so we just can’t afford it,” said Fan Jingang, a chemical factory owner who said he did not use illegal chemicals and had pulled out of making foam. “Energy conservation is a national policy, but if you can’t make a legal foam agent affordable, then you can’t achieve that goal.”

Chris Buckley reported from Xingfu, and Henry Fountain from New York. Zoe Mou and Katrina Northrop contributed research from Beijing.

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