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Carbon Dioxide Shortage in the United Kingdom

*By Ankur K. Tohan and Alyssa A. Moir**

The authors explain that the carbon dioxide shortage in the United Kingdom illustrates challenges faced by industry and governments. They add, however, that it also represents an opportunity for the carbon-capture industry to grow.

Most discussion of carbon dioxide these days centers on the fact that there is too much of it—too much in the atmosphere already and too much being emitted on a daily basis. However, in September 2021, the United Kingdom was faced with a seemingly unlikely challenge: a carbon dioxide shortage. Scarcity of this gas threatens a wide variety of activity in the carbon dioxide merchant market, from the beverage industry, which relies on carbon dioxide bubbles, to British abattoirs, which uses it to humanely stun pigs, to the oil recovery industry, which uses liquid carbon dioxide during the oil extraction process.

In the United Kingdom, most carbon dioxide used in the merchant market is captured as a byproduct of ammonia production. As ammonia is a fertilizer used by farmers, many ammonia producers conduct planned closures in the summer, when demand for fertilizer is lower. Poor timing was widely seen as the cause of a previous shortage in 2018, when planned closures coincided with hot weather and an increased demand for carbonated beverages.

A spike in the price of natural gas, a key ingredient in ammonia, exacerbated the shortage this year. In September, high natural gas prices prompted CF Industries—an American ammonia producer that supplies 60 percent of the United Kingdom's carbon dioxide as a byproduct—to shut down operations for an extended period. When the cost of operating its ammonia production became economically unfeasible, the company shut its doors, cutting off much of the country's supply of carbon dioxide.

September's shortage spurred government action.

On September 23, the UK government agreed to cover CF Industries' operating costs for one of its plants for three weeks while the carbon dioxide market adapted to the rise in global natural gas prices.

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On October 11, the UK government announced it had brokered a deal between CF Industries and its customers to ensure production of carbon dioxide until January 2022.¹

However, carbon dioxide prices remain elevated, so consumers will likely continue to feel the impact of the shortage for months to come.

THE UK'S VULNERABILITY

The United Kingdom is particularly vulnerable to carbon dioxide shortages because it stores little of its natural gas supply. While the United Kingdom's European neighbors store approximately 20 percent of their annual demand for natural gas, the United Kingdom stores less than six percent,² making the island nation—fresh out of the European Union—more vulnerable to variations in supply and demand.

In 2018, the UK government decided against building new natural gas storage facilities, compounding the problem underlying the current carbon dioxide shortage. Industry players have called on the government to increase its natural gas storage capacity and long-term planning.³

In addition to the challenge that this shortage poses to governments and industry, however, it also presents an exciting opportunity for the burgeoning carbon-capture industry to enter the carbon dioxide merchant market. The need is evident: the European merchant market for carbon dioxide, which includes carbon dioxide used in food and beverages, uses 20 million metric tons annually. And as alluded to above, there is no shortage of carbon dioxide being released into the atmosphere. Europe emits 4.4 billion metric tons of carbon dioxide from fossil fuels annually.⁴ Despite this potential, much needs to be done to scale up new technologies to allow this supply to meet demand.

For example, the largest direct air carbon-capture plant in the world recently opened in Iceland, which will take in about 4,000 tons of carbon dioxide per year, which is equivalent to about 0.001 percent of the UK's 2019 emissions.⁵ Even if carbon dioxide prices rise because of increased demand, no new carbon-capture technology has yet demonstrated that it is cost-effective at the scale necessary to participate in the merchant market.

¹ <https://www.gov.uk/government/news/agreement-reached-to-ensure-supplies-of-co2-to-businesses>.

² <https://www.wired.co.uk/article/carbon-dioxide-shortage-gas-uk>.

³ <https://theconversation.com/gas-price-spike-how-uk-government-failures-made-a-global-crisis-worse-168324>.

⁴ <https://qz.com/1321073/the-seemingly-illogical-reason-europe-is-running-low-on-carbon-dioxide-and-thus-beer/>.

⁵ <https://www.wired.co.uk/article/climeworks-carbon-capture>.

The Iceland plant, run by the carbon-capture firm Climeworks, increased Earth's annual carbon-capture capacity by 40 percent, to 13,000 metric tons, compared with the approximately 31.5 billion metric tons of carbon dioxide emitted in 2020. But the estimated costs for capturing one metric ton of carbon from the atmosphere currently run between US\$600 and US\$1,000. In contrast, one metric ton of recovered carbon sells for about US\$200.⁶

OPPORTUNITIES

While it may take years for advances in carbon-capture technology to fully erase the gap between supply and demand, opportunities have been demonstrated at a small scale. For example, Climeworks' first direct-air carbon-capture facility, in Hinwil, Switzerland, recycles captured carbon and sells it to local greenhouse operators to increase plant productivity. Carbon-capture apparatuses attached to coal-fired power plants could provide a more cost-effective source of carbon dioxide in the short-term, but such an approach likely is not sustainable as coal-fired power plants are phased out.

Natural gas prices will likely remain volatile in the coming years, putting continued pressure on carbon dioxide suppliers. As carbon-capture technology improves and becomes cheaper, the feasibility of using carbon capture to supplement carbon dioxide supply may increase. The improvements already can be seen on a small scale: the modular units used at Climeworks' plants are cheaper than previous direct-air carbon-capture devices, and the company hopes to scale up quickly.

Further, as governments are pressured to meet increasingly stringent carbon dioxide reduction goals, many could begin subsidizing carbon capture as a viable addition to their arsenal of weapons for fighting climate change. Climeworks' Iceland facility demonstrates the carbon-negative possibilities of carbon capture by injecting the captured carbon deep underground.

CONCLUSION

In a world where nations grapple with the fastest and most effective way to reduce carbon dioxide in the atmosphere, the carbon dioxide shortage in the United Kingdom illustrates challenges faced by industry and governments. But it also represents an opportunity for the carbon-capture industry to grow. Time will tell whether the industry is able to scale up to take this opportunity.

⁶ <https://www.wired.co.uk/article/climeworks-carbon-capture>.