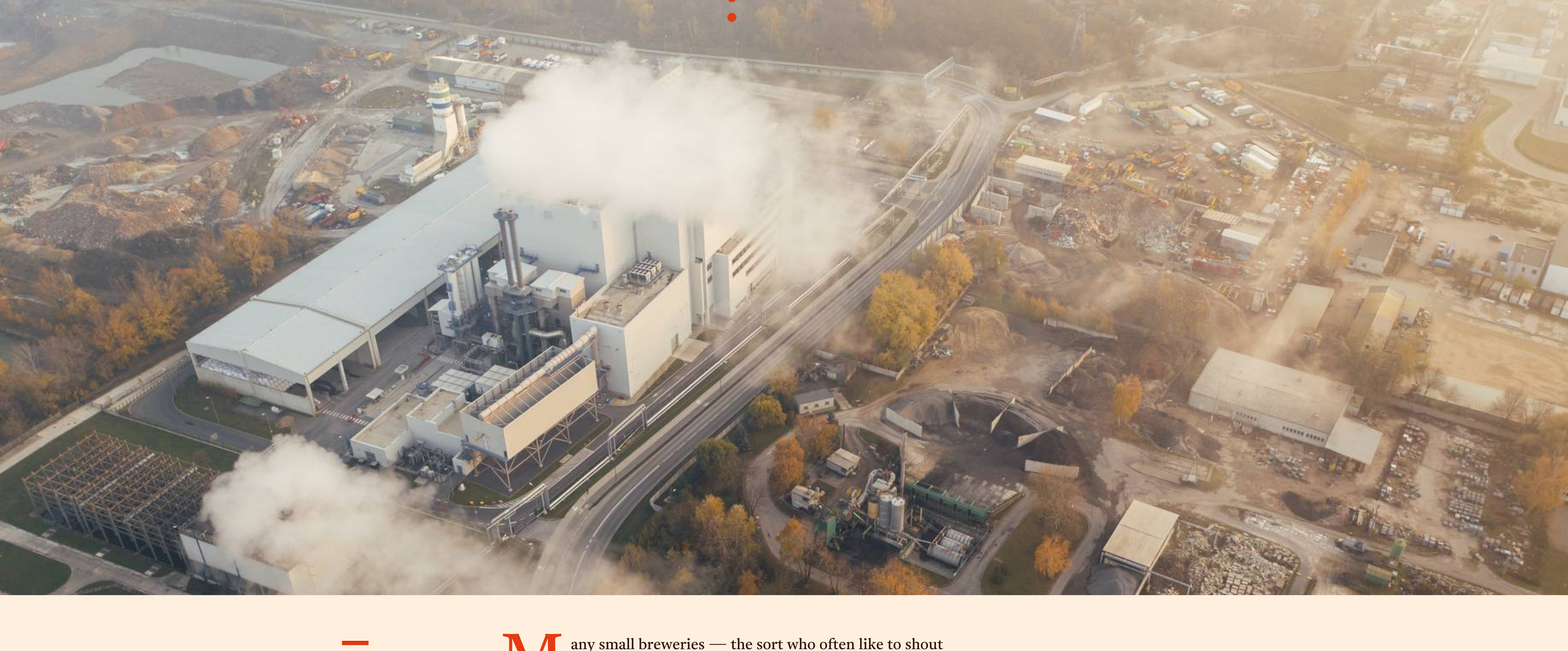


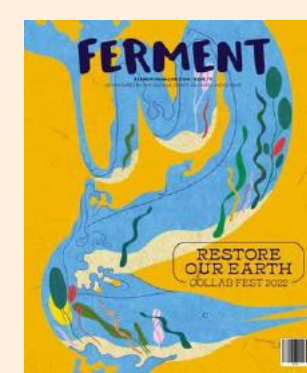
Gas giants

Harnessing waste brewing CO2 is no longer just for the big guys, discovers Anthony Gladman



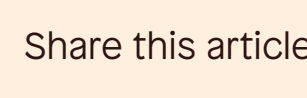
— Anthony Gladman

Cover photos: Marcin Jozwiak
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Many small breweries — the sort who often like to shout about how sustainable they are — have a dirty secret.

They're bubbling carbon dioxide off into the atmosphere every time they brew.

Brewing releases carbon dioxide mainly during fermentation but also at other stages along the way, notably during bottling or canning. Brewers usually think about beer in hectolitres, which are units of 100 litres to you and me. Fermenting one of those to 4% ABV creates about 4kg of carbon dioxide.

You might say the obvious solution here is to capture the carbon dioxide released during fermentation and use it again later on — for canning, for example — and you'd be right. Only it's easier said than done.

Capturing the gas is the easy part. All you need are a few one-way valves and some piping. But that's just the beginning. Brewers also need to scrub the gas of impurities, cool and compress it until it becomes a liquid, then find safe ways to move it around the brewery and to store it until it is time to use it again.

Plugging into a supply chain

For most small breweries, technology like this has long been out of reach. Typical systems are aimed at breweries making at least 500,000 hectolitres of beer per year. Last year Ramsgate Brewery made 3,500. Its head brewer, Eddie Gadd, says he knows of only two producers making carbon dioxide recovery equipment for breweries that small, neither of which has been around for all that long.

And there's another stumbling block for breweries of this size. "Once you've captured the carbon dioxide, you've got to find something to do with it," Gadd says. You can use some for carbonation and bottling in your brewery, he explains, but even a small brewery like his will quickly end up capturing more than it can use. "You're going to end up with an excess of carbon dioxide, quite a large excess."



PHOTO: Ramsgate Brewery

That's not the sort of thing you want hanging around in a brewery. How do you get it into a supply chain? "That's a question I still can't really answer at the moment," Gadd says. "There's nobody interested in picking up a quarter of tonne of carbon dioxide a week off you."

One solution being worked on in the USA by Earthly Labs pairs craft brewers up with marijuana growers, who use the brewers' carbon dioxide in their greenhouses to grow their crop faster. Gadd says he looked into trying something similar on an empty plot of land next to his brewery in Kent. It would have been fairly simple to pipe carbon dioxide into a greenhouse, and the landowners were on board, but the project never got off the ground because Gadd and the others couldn't settle on a suitable cash crop.

Despite these challenges, Ramsgate Brewery is investing over £50,000 to install a carbon capture and recovery system that should be up and running by June this year. "We're lucky in that we're partners in a company [South East Bottling] that packages bottled and canned beer. That packaging company is only a mile away and they go through 80 tonnes of carbon dioxide a year," Gadd says.

Ramsgate brewery produces around 18 tonnes of carbon dioxide a year, of which Gadd expects to be able to capture and purify about three quarters — about 13.5 tonnes. "The idea is once a week we stick a tank on the back of a van and drive it round and offload at the bottling business. It means 15% of their carbon dioxide supply then comes from within their own control, because I'm a director, and it means that also I've got a customer who's going to pay me an agreed fixed amount for carbon dioxide." If all works as planned, Gadd hopes to expand the project to other local breweries who could also sell their excess carbon dioxide to South East Bottling.

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The new system still needs some inputs to keep it running — it consumes water and electricity, plus glycol for cooling — but on balance it will reduce Ramsgate Brewery's direct carbon emissions and also offset some of the carbon from its other, non-brewing operations. "It's a pretty significant amount of carbon dioxide that we're removing from our process," Gadd says.

Even so, Gadd says carbon capture remains unsuitable for many small brewers. "For a lot of breweries there are no obvious advantages to doing this, and there are distinct disadvantages unless there's a network to feed carbon dioxide into."

Nature finds a way

In the Preseli Hills of Pembrokeshire, Bluestone Brewing Co. is working on something rather different. There's a carbon-capture project based on harnessing nature, and works towards removing the carbon from the environment rather than reusing it.

"We looked quite closely at trying to buy a machine that could capture carbon dioxide, clean it and reuse it in a bottling plant for carbonation or such like," says Bluestone's founder, Simon Turner. "There is something built in America, but it was way too expensive for us."

So instead Bluestone plans to capture the carbon dioxide released by its fermenters, as well as the gas vented during bottling, and use algae to photosynthesise the gas into oxygen and biomass (in other words, more algae).

Bluestone aims to become a carbon neutral company, and has won several awards over the years for its efforts at sustainable production. These include a reed bed filtration system for its wastewater, tree planting, sourcing electricity from 100% renewables, through to compost toilets and building with salvaged materials, but Turner says this carbon-capture scheme is the firm's most ambitious project so far.

It's a pretty significant amount of carbon dioxide that we're removing from our process

The project is partially funded by the Welsh Government ERDF SMART Expertise Programme which aims to support collaborations between industry and academic institutions. Bluestone has partnered with Swansea University, which will provide the technical knowhow for the scheme.

The captured carbon dioxide is piped across the road from the brewery into a polytunnel, inside which sits a 400-litre photobioreactor — picture an oversized sun bed flipped onto one side with tubing running horizontally to the ground. There is water in the tubes, in which grows a blue-green algae called spirulina. The carbon dioxide bubbles up through these tubes, where it is taken up by the algae to fuel its photosynthesis.

The polytunnel also houses something called a raceway, which can hold a further thousand litres. Turner says it is essentially a bath equipped with a paddle that turns very slowly to keep the water inside moving. As the liquid runs around the raceway carbon dioxide is bubbled through it. "Nothing could be more simple. You fish out all your algae when you think you've got maximum capacity, fill it up with water, and off you go again. You just keep chugging away."

While it's simple to use, there are some technical concerns. For instance, adding too much carbon dioxide at once would make the water too acidic for the algae to grow, so the system measures and controls this automatically to maintain the right pH levels.

The final stage in the process is to deal with the biomass the algae produces. For this Bluestone has teamed up with Phytoquest Ltd, a firm that specialises in turning algae into sustainable ingredients for the food, pharmaceutical and cosmetic industries.



PHOTO: Bluestone Brewing Co.

It may look like icky blue-green sludge, but algae is rich in proteins, lipids, carbohydrates and other highly valuable compounds. Harvested algae contains omega-3, making it suitable for use in producing a range of nutrients and supplements. Algae is an important component of some bio-plastics. And it is also possible to extract pigments from algae, such as phycocyanin. Just one kilogram of this greenish-blue pigment is worth somewhere in the region of £72,000.

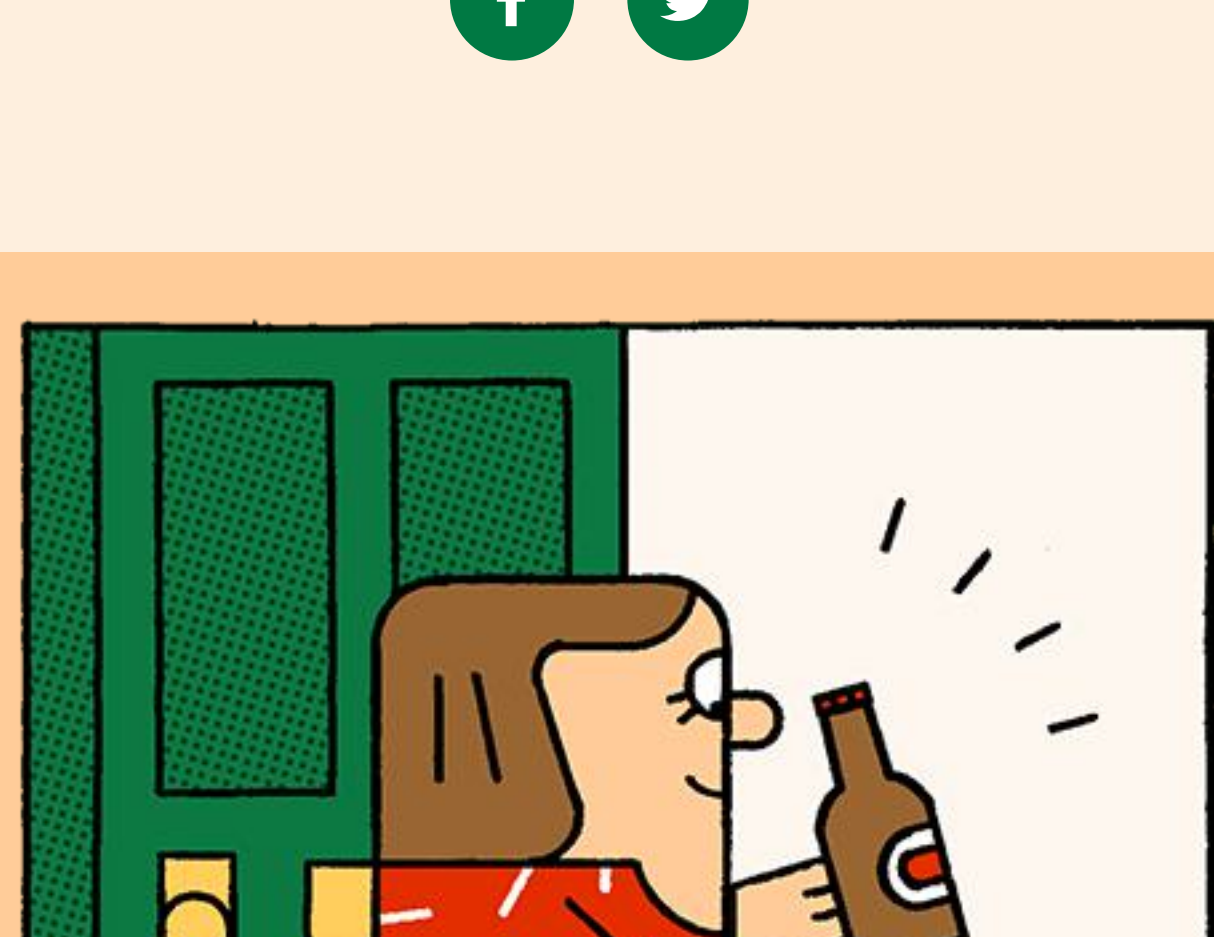
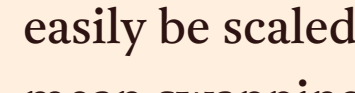
Acting at scale

Turner hopes other small breweries (or any company that produces carbon dioxide) will be able to repeat this project. "It's not highly technical work," he says. "It's a bit like gardening really. Which, because it's simple, makes it very easy for people to do their own thing. You only need a bit of ground and a polytunnel and one of these things."

Bluestone, which is about half the size of Ramsgate Brewery, has invested the equivalent of a few tens of thousands of pounds in their carbon capture project. Some of that was hard cash, the rest was their own time and labour. For any company that wants to do the same, the barrier to entry is relatively low, plus the photobioreactor can be scaled up or down as needed. For a small brewery it may mean swapping out old open-top fermenters for conical vessels equipped with spunding valves, but that's not a great hardship — many are making this choice anyway for the sake of their beer.

"It's the sort of thing that's easily repeatable all over the place," Turner says. "It's just a way of cleaning up carbon dioxide a bit. And it shows a certain responsibility, doesn't it?"

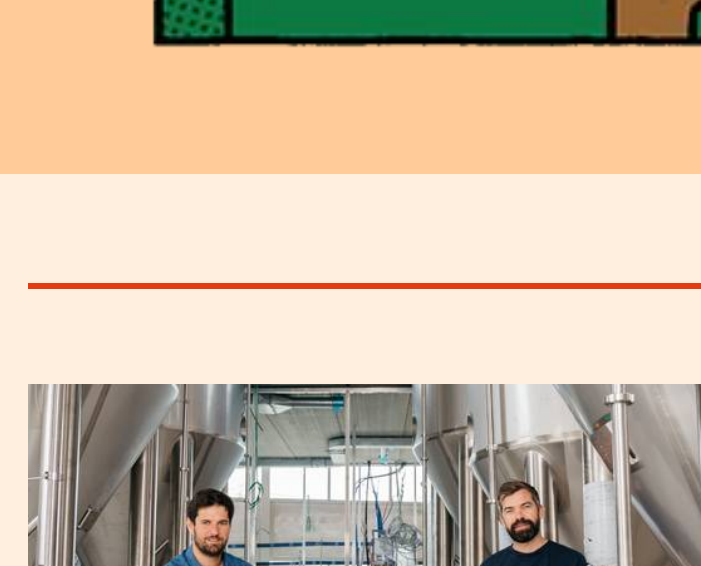
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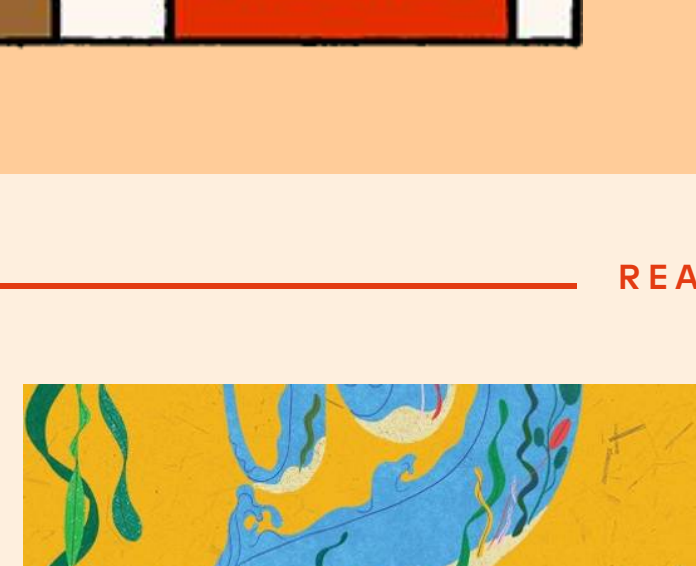
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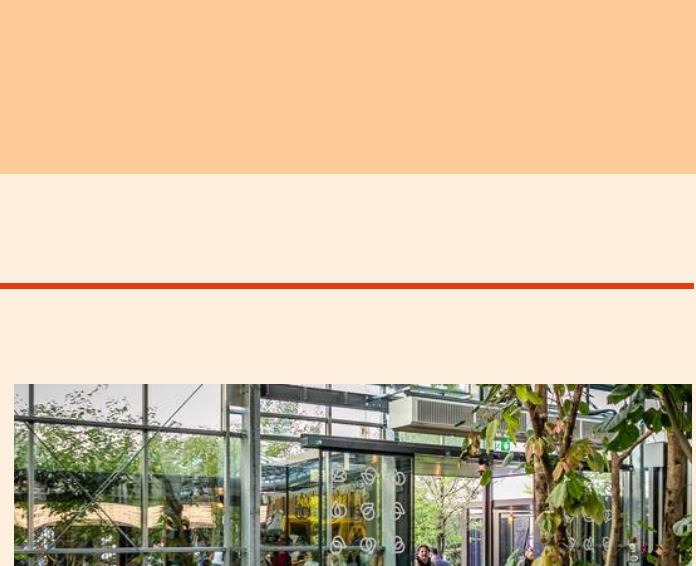
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