



Crafting a CO₂ closed loop in beer

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Craft breweries have surged ahead in North America in recent times. Now some are adopting CO₂ recycling from their fermentation process to prop up supply, remove that cost, and to cut their carbon impact.

Christian Annesley casts a watchful eye over developments

Industrial gases markets are often in flux. Opportunities wax and wane as technologies emerge and processes evolve. While new markets come into view or existing opportunities ramp up, other spaces can either shrink or take on a different complexion.

For industrial gas producers and distributors, it is crucial to understand these shifts and pivot as needed, and one notable market where change is afoot is the brewing industry, which is a significant consumer of carbon dioxide (CO₂) and nitrogen.

On the one hand, the past decade or two has seen an explosion of craft breweries across North America and beyond. This has created new opportunity to serve the surging gases needs of these businesses, with scores of new operations launching in some years.

Next to this, however, there is now a notable shift underway in relation to CO₂ capture and recycling among just these mid-tier and craft breweries. For a long time now, most large-scale breweries have had technology in place to capture and recycle their CO₂, but it was confined to companies of significant scale.

That's no longer true. In the past few years in particular, off-the-shelf technologies from the likes of Earthly Labs – now owned by Chart Industries – and Pentair have moved the dial and offered the chance to recover CO₂ to smaller outfits. And in a context where tangible sustainability efforts are ever more important for reputational and planet-cooling reasons, it is a shift that will surely gather momentum.

No-one is arguing that the market for merchant CO₂ from brewers is about to vanish overnight, but it is a shift that is worth understanding, as well as some of the other changes that could ripple from it.

Griffin Claw's pandemic reset

Breweries are highly resource-aware in their thinking and operations, reflecting the volumes of water and grain that are used in their production processes, not to mention the CO₂ that is generated through fermentation, as well as the cost of packaging and distributing a heavy, liquid product.

One microbrewery in Birmingham, Michigan had this broader resource question in mind back in 2020, just when the pandemic restrictions were kicking in and leaving its management team with more time than usual to ponder the big questions.

Pat Craddock is Chief Financial Officer at Griffin Claw and starts off by recalling how things unfolded.

“Really it all began with me noticing an advert in a trade-brewer magazine in 2020. It briefly felt a bit like the world was ending back then, if you recall, and with some of the manufacturing shutdowns that were seen came a well-documented loss of CO₂ supply in some parts of the country. In brewing, a threat to CO₂ supply sharpens your instincts to find another way. We simply cannot do without it.”

In Michigan, a CO₂ supply disruption never actually landed, but it didn't stop the threat weighing heavily on Craddock and co.

“But there I was looking at this advert from Earthly Labs that talked about CO₂ recovery for smaller outfits. In my experience, the technology to do this had always been out of reach to smaller brewers like us – we produce about 12,000 barrels a year – but suddenly it felt like an option.”

Craddock quickly moved on the opportunity and got talking to Earthly Labs and to its founder and President Amy George.

“It wasn't an easy thing to push forward, because of the pandemic,

“We are extremely happy with our investment, and it is easy to visualize the benefit it delivers”

which had upset supply chains. I dare say that today it would all happen much more seamlessly. But once we'd gotten over that hump and had the unit and components ready things happened quickly and Earthly Labs was a great partner.”

Craddock says the simple, plug-and-play aspect of the carbon capture technology was part of the attraction, as well as the chance to capture and reuse thousands of pounds of waste CO₂ annually from the brewing process.

“It was really simple – and that is always good. It took a day for the Earthly Lab folks to do the install and then a day or so of training for our team. It is a much simpler and easier-to-maintain bit of kit than our centrifuge, for example. Plus, we pay an annual fee to Earthly Labs for ongoing customer service and fixes, if anything were to crop up.”

Griffin Claw's production facility is, in Craddock's words, “long and skinny,” which has limited the brewer's capacity to maximize its use of the technology with a larger dewar, just because of space limitations and the layout of the site for pipework. All the same, the payback on the investment still stacks up and the aspiration is to upsize the dewar down the line.

“In the meantime, we are extremely happy with our investment, and it is easy to visualize the benefit it delivers through the software dashboard from Earthly Labs. We even have a real-time graphic that captures the CO₂ benefit of the set-up and what it delivers in terms of trees saved. And there are some new ▶

▶ dashboard enhancements on the way, too.”

In closing, Craddock makes the point that the benefit in terms of public relations and customer response is hard to quantify but clearly important, and it gives the company some strong messages for its social channels.

“Plus it brings pride to all of us in the business. It is demonstrably a good thing to have in place and an important element of our company story. And not forgetting, of course, that it has protected us against the worry about CO₂ shortages and made us that much more self-sufficient, which was obviously the initial driver.”

Earthly Labs’ evolution

There are a few suppliers offering CO₂ recovery technology to smaller breweries, but the leading player today is Earthly Labs, which was founded in 2016 by Amy George and is these days part of the Chart Industries stable.

Looking back to the start of the business, George says, “My original concept was to look to address carbon

capture for residential properties, but compliance was too hard and the payback just wasn’t there. From there, I looked at other emissions sources and through a neighbor I reached out to a brewery and soon saw the potential of CO₂ capture from the fermentation tanks used in brewing.”

It was an easier source-point all round, says George, with high CO₂ concentrations and a compelling payback for brewers from the investment.

“The technology at this point was well-defined, so it was all about accelerating adoption and finding the right market to start. Brewing was the one,” she says. “With a domestic boiler the vented gas was 8% to 13% CO₂ and in brewing fermentation tanks it was 80% to 90% – and with a need by brewers for CO₂ elsewhere in their production processes, for purging tanks and carbonating the finished product.”

The technology collects the CO₂ - heavy gas stream then purifies and liquefies and stores it for reuse – and

it can deliver this in a standard sized box-unit that is relatively small in an industrial context.

“The aim all along was to keep it simple – to take something that used to take months or years for large brewers to implement, with bespoke engineering, and turn it into something that’s fast and simple to install and get working.”

These days Earthly Labs has different models addressing different sizes of brewer, with its standard CiCi Oak plug-and-play proposition being the most widely sold.

“There is an element of customization to each CiCi Oak project, to the extent that a custom manifold needs to be designed and built to take account of the tanks and the distances involved. But everything else is standard – the CiCi unit backed up by Chart tanks and vaporizers,” says George. The CiCi Elm offer, for larger operations, is a bit more bespoke but still largely standardized, though its lead time is north of 12 months whereas the Oak proposition

In brief – gases in brewing

CO₂ recovery systems: Given the immense volume of CO₂ produced during fermentation, larger breweries have long used CO₂ recovery systems and smaller brewers now have the option too. These systems capture the CO₂ emitted, clean it, and then reuse it within the brewing and packaging process. It reduces reliance on external CO₂ suppliers, though this may still be needed, and cuts the product’s carbon footprint, which is good reputationally and plays well with large retailers that have ESG on the agenda.

Nitro beers: The use of nitrogen

over CO₂ in certain beers has been a notable innovation. Nitrogen gives beer a creamier, smoother mouthfeel compared to the prickly sensation of CO₂. Guinness, with its draft stout, was a pioneer, but many North American craft breweries are now offering nitro versions of their brews.

Oxygen scavenging: Oxygen is detrimental to beer, causing it to become stale. To counteract this, innovations in packaging, such as oxygen-scavenging bottle caps and purging cans with CO₂ or nitrogen before filling, have been implemented.



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can be in place in just a handful of weeks or months typically.

With about 18,000 breweries around the world, there is a huge market for Earthly Labs and others in the space to go at, and in the case of Earthly Labs the growth is dramatic right now, with four to five times sales growth recorded in the past financial year for its units, which cost around \$100,000 apiece to install in the case of CiCi Oak.

Now that the brewing market is well addressed, there are also other markets to tap, from wineries and distilleries to the biogas market.

“We are just getting started really,” says George. “It’s an exciting moment.”

What does it all mean for the merchant CO₂ supply to breweries? Clearly there will be plenty of supply into this market for a good many years

to come, but the potential is there for CO₂ recycling to become a common or even standard part of a brewery set-up. Whether that will take years or decades to unfold remains to be seen, but an understanding of the trajectory of change is useful for everyone with a stake in the market space to grasp.

There is even the point that brewers could become small players in merchant CO₂ supply in time, with about half of Earthly Labs’ customers currently producing a surplus that can be sold on or else used in CO₂ exchange programs.

“Some of our customers can redistribute their excess CO₂ to their satellite operations, but CO₂ exchange hubs for brewers are now getting established and could well grow,” says George. “It is all part of making the economics of the investment stack up and work as hard as possible.”

CO₂ for sale

Some are selling it on now, in fact – though probably only a handful at this stage. gasworld spoke to one

Virginia outfit, Hardywood Park Craft Brewery, that has recently installed Earthly Labs tech with the aim of collecting up to 2,000 lbs a week of CO₂. But instead of reusing it for its own needs right now it is selling it on to a local organic microgreens farmer, where it is being used to boost crop yields.

Brian Nelson is Hardywood’s Brewmaster and says, “It is early days for us. We are a month in with the new system and somewhere down the line we might reuse some CO₂ ourselves, but that will require extra kit. This way, we fill up the dewars, swap them out and send them down the road. It is a deal that creates a revenue stream that offsets our own CO₂ costs and more.”

Early days, maybe, but it is yet another take on the potential of the system. And while these kinds of small-scale moves aren’t a threat to conventional merchant CO₂ suppliers in terms of volumes, they do illustrate how the landscape in brewing is starting to shift. [gw](#)



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Five more brewers recovering CO₂

Grey Sail Brewing (Rhode Island)

In 2021, Grey Sail rolled out Earthly Labs' CiCi CO₂ recovery system. The system is aiming at a return on investment of about five years against the up-front capital investment.

Buoy Beer Co (Oregon)

In 2020, Buoy Beer Company installed an Earthly Labs CiCi unit. Buoy produces between 15,000 and 20,000 barrels annually and that was the sweet spot for CiCi unit at the time of the install, though options have expanded since. "Once we started realizing what some of the projected payback schedules were, you can find something that has a real quick payback and is the right sustainable choice, makes it a pretty easy option," said Buoy's co-founder Dave Kroening. With its CiCi unit, Kroening says Buoy can recapture about a third more CO₂ than it uses each year. The goal for Buoy is to not have to purchase any CO₂ ever again, said Kroening.

Jackalope Brewing Co (Tennessee)

In 2019, Jackalope became the first brewery in Tennessee to use Earthly Labs' CiCi CO₂ recapture system. It says of the system: "As we continue to align all Jackalope fermenters with CiCi, this will prevent over 100,000 lbs of CO₂ from entering the atmosphere each year."

Maui Brewing Co (Hawaii)

In 2018, Maui Brewing installed Pentair's CO₂ mpactBrew recovery plant, which reduced its CO₂ emissions by over 600,000 lbs in the first year alone. The adoption was driven substantially by the limited CO₂ supply on Maui.

Widmer Brothers Brewing (Oregon)

In 2017, Widmer Brothers installed a CO₂ recovery system, built in partnership with ICC Engineering. Sustainability Manager Julia Person said, "We will be able to reuse our captured CO₂ for packaging, reduce on-site emissions, and eliminate the need to have multiple trucks delivering bulk CO₂ to the brewery."

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CO₂ times two: Algae bioreactors and carbon capture

As smaller breweries begin to explore carbon dioxide capture with drop-in technology, one Australian brewer has taken things a step further.

Young Henrys in Newtown, New South Wales has just added Earthly Labs' CiCi CO₂ capture tech to its efforts to collect CO₂, but the firm already has algae bioreactors in the brewery to cut its total CO₂ footprint.

It is a first-of-a-kind combination, recycling CO₂ into two key ingredients – purge gas for

the brewery and feedstock for the algae.

Working with a University of Technology Sydney (UTS) lab, Young Henrys has simulated the ability for its CO₂-rich algae to be combined as a feed supplement with spent grain and fed to livestock to reduce methane emissions.

"Chart's Earthly Labs CO₂ capture technology now adds to Young Henrys' portfolio," said Richard Adamson of Young Henrys. "From inception, we wanted to be an innovative showcase for

sustainability in all we did."

With its enhanced set-up, the brewery now captures thousands of pounds of CO₂ each month, largely using it to offset all the CO₂ consumption used to purge the tanks. And the 400-liter algae bioreactor installed in the Newtown brewery produces as much oxygen as 2.5 acres of Australian forest, it has been calculated. The UTS lab is now working with Young Henrys to evaluate how to scale the system for the brewer's benefit and so others could follow suit.