Building sustainability into brewing

Introduction

Jonas B. Borrit, *Vice President, NIRAS*

Beer is one of the most ubiquitous drinks in the western world, with a global value of almost USD 800 billion. The industry is continually evolving, driven by consumers' appetite for ales, craft beers, continental lagers and, more recently, gluten and alcohol-free beer – an appetite matched by brewers' passion for experimentation.

Arguably the biggest long-term challenge – and opportunity – facing the sector is sustainability.

Sustainability is more than a trend – in the long-term, it will become a de facto 'licence to operate' in the sector, in the same way that health and safety is. With the right investments in building design and manufacturing processes, the sector can tap into this appetite for sustainable products both now and in the future, while also being in the strongest position possible to comply with new regulations.

Environmental considerations are a large part of sustainability but it also includes the longer-term impact on communities including people's wellbeing and job prospects.

With 80% of global consumers saying they are more likely to be swayed by a retailer offering a bigger choice of sustainable products, there is a clear incentive for FMCG (Fast Moving Consumer Goods) brands, including breweries, to reduce their environmental footprint.

The trend reflects the purpose-driven lifestyle many people are now adopting and, even if budget constraints mean they are moving away from premium craft beers (for now), their expectations around sustainability are still high. They just want it at a lower price.

All this represents a once-in-a-generation opportunity for large-scale brewers to set the standard for the industry, allowing them to meet their regulatory requirements and voluntary sustainability goals, and build loyalty in a competitive market. Innovative production processes and technologies make it possible to significantly drive down energy and water consumption, reduce waste and maximise efficiency, while paving the way for product development and growth, in line with consumer expectations around variety and sustainability.

In this report we will explore:

- **Where the brewing industry is now**
- **What is driving the sustainability agenda?**
- **How brewers can future-proof their facilities**

The brewing industry: where are we now?

Global companies, including large-scale brewers, are now committed to achieving net-zero. A combination of regulation and consumer pressure mean sustainability is fast becoming a licence to operate, not just a nice-to-have.

By its nature, brewing is resource-intensive. Energy and water consumption required in its production have come into sharp focus recently, not just because of net-zero or carbon neutral targets, but also due to the soaring energy costs and disrupted supply chains caused by geopolitical events.

There's a growing realisation too that water supplies must be preserved, especially in parts of the world where the supply of clean drinking water is under threat. Not only does beer itself comprise around 95% water, there is also waste water and cleaning to factor in. Large areas of land also have to be given over to growing ingredients such as barley, which can impact biodiversity and food security for some local communities.

Sustainability initiatives must be framed in the context of other changes and trends in the brewing industry. While beer might seem ubiquitous in many public places and homes, sales in key beer drinking nations have fallen.

One report from Heineken suggests that consumers are drinking less but opting for better-quality beers when they do go to venues.

In Germany, domestic sales were down 3.5% in the first half of 2023 compared to the same period last year. Meanwhile, sales dropped by 6% in the UK although, interestingly, no- or low-alcohol beer sales grew by the same proportion.

In fact, sales of low/no-alcohol beer are booming–fuelled by consumers looking to make healthier lifestyle choices. Globally, the non-alcoholic beer market is worth USD 22 billion and is expected to grow by 5.5% over the next decade. While some have given up drinking alcohol altogether, there is also a growing 'sober curious' movement, while Millennials and Gen-Z are said to be opting to drink more mindfully compared to previous generations.

5.5%

The predicted growth of the global non-alcoholic beer market over the next decade

The appetite for variety over volume creates opportunities for brewers but it can compromise sustainability. Instead of manufacturing five to 10 beer products, a large-scale plant might produce up to 100 different varieties including beers brewed under contract. This makes long production runs difficult – but short production runs require more energy and water. More resources may also be needed to produce alchohol-free beer because the processes are different.

What's happening now is that some companies are taking on substantial debts to transform their operations. However, because they are in relatively unknown territory, there's a risk that investments in sustainability initiatives will not deliver the ROI they are looking for. It's not just about who can invest the most, or even hitting sustainability KPIs at a company-wide level, but meeting targets at an industry, national and, depending on the location, EU-wide level.

Sustainability challenges are felt differently by large and small brewers. Small breweries may have incorporated sustainability into their identity, and are now facing the prospect of remaining sustainable as they scale up.

Others, who haven't prioritised sustainability previously, usually find it difficult to achieve because their resources are more limited. This makes them particularly vulnerable to changes in regulation and consumer expectations because it is too costly for them to catch up.

Larger brewers, on the other hand, do have better access to loans and investment to drive the sustainability agenda. The issue for them is that they have to balance the needs of different stakeholders, across multiple sites and territories.

Still, it's the bigger companies now driving the changes because they need to deliver on their regulatory and voluntary sustainability goals, and protect their reputations. From hop farming to production to transport, they know that sustainability is key to future-proofing their operations.

View from a master brewer: Carsten Jørgensen

Senior Project Manager and brewing specialist, NIRAS

In the digital age, news and ideas travel quickly - so it's no surprise that attitudes to sustainability are often shared by people around the globe and they have high expectations about the products they buy, including beer.

A craft brewery might naturally have a shorter supply chain, which is appealing to environmentally-conscious consumers. It can be more challenging for the bigger breweries but, as FMCG companies, they also have a clear focus on sustainability initiatives. These breweries want all of their sites and supply chains to be as sustainable as possible – but how they do this varies depending on local access to energy sources. For instance, some countries have more hydroelectric plants which can support electrification and reduce reliance on fossil fuels.

Heat pumps are developing too, and the size of warehouse buildings in breweries mean they are suited to solar panels. However, there is no one-size-fits-all solution, and you have to consider the short, medium and long-term risks and rewards. At the moment, solar panels don't always provide the payback brewers are looking for, but that's not to say they won't in the future. We could therefore design a warehouse – and future-proof it – by including space for solar panels in case they prove more cost-effective later down the line.

The fact that there are so many challenges like these is not necessarily a bad thing. Particularly for the next generation of engineers and project managers entering the industry, it is an opportunity to come up with new and innovative solutions to long-standing problems.

Some measures to improve sustainability are nothing new but can nevertheless make a real difference. Reducing waste not only saves money but also reduces the amount of energy per litre required to produce beer. Similarly, switching out barley for another raw material such as maize or rice is a longstanding practice but can remove the energy-intensive malting. Where malted barley is needed, a heat pump could make the process more energy-efficient.

Another method being explored is late differentiation, where a mother beer is created and moved through the production process but is only customised into different varieties at the end, or even once it is in the keg or bottle. Spent grains have typically been sold to farmers but people are looking into other more innovative uses – such as turning it into furniture. A clear strategy for industrial symbiosis can further minimise resource usage and waste through collaboration with complementary co-located businesses. It's a really interesting time to be in this industry. Challenging, yes. But we are seeing traditional practices being transformed by a need to be more sustainable.

Sustainable brewing and its drivers

The brewing industry has come a long way in recent years - due to a combination of tighter regulations alongside greater scrutiny from the press and public. A sustainable beer product, or brewing company, is an attractive prospect for both consumers and investors but what exactly does it mean in today's world?

Much of the focus around sustainability – including net-zero – is around CO_2e emissions, and it remains one of the most important ways to measure change and improvement.

It is worth noting that CO_2e is a more precise metric than CO_2 since it doesn't only include carbon dioxide but all the greenhouse gases, like methane, responsible for warming the atmosphere. The use of fossil fuels in energy generation and transportation are the biggest contributors to CO_2e emissions but a successful green initiative involves making improvements across the supply chain, from farming to the end user.

Other sustainability metrics in brewing:

Water consumption
The amount of water used at the growing and production stage.

Biodiversity
Avoiding crop monocultures and regenerating soil.

Waste
Ensuring that waste is minimised and disposed of in a responsible way.

Health and safety
Avoiding accidents by improving workers' health and safety.

Changing regulations

Introduced in 2020, the EU Taxonomy provides a framework for investment in activities that will help the union to deliver on its Green Deal. By setting out exactly what it means to be sustainable – including mitigating and adapting to climate change, companies should be able to channel their investments into the areas that genuinely improve sustainability and attract more investment.

At the start of 2023, the EU's Corporate Sustainability Reporting Directive (CSRD) came into force, requiring most companies to 'disclose information on what they see as the risks and opportunities arising from social and environmental issues, and on the impact of their activities on people and the environment.' Once again, it is hoped that this will encourage companies to become more sustainable in order to attract investment but, of course, it has created a new reporting requirement, and may mean brewers first need to make their own investments to improve practices.

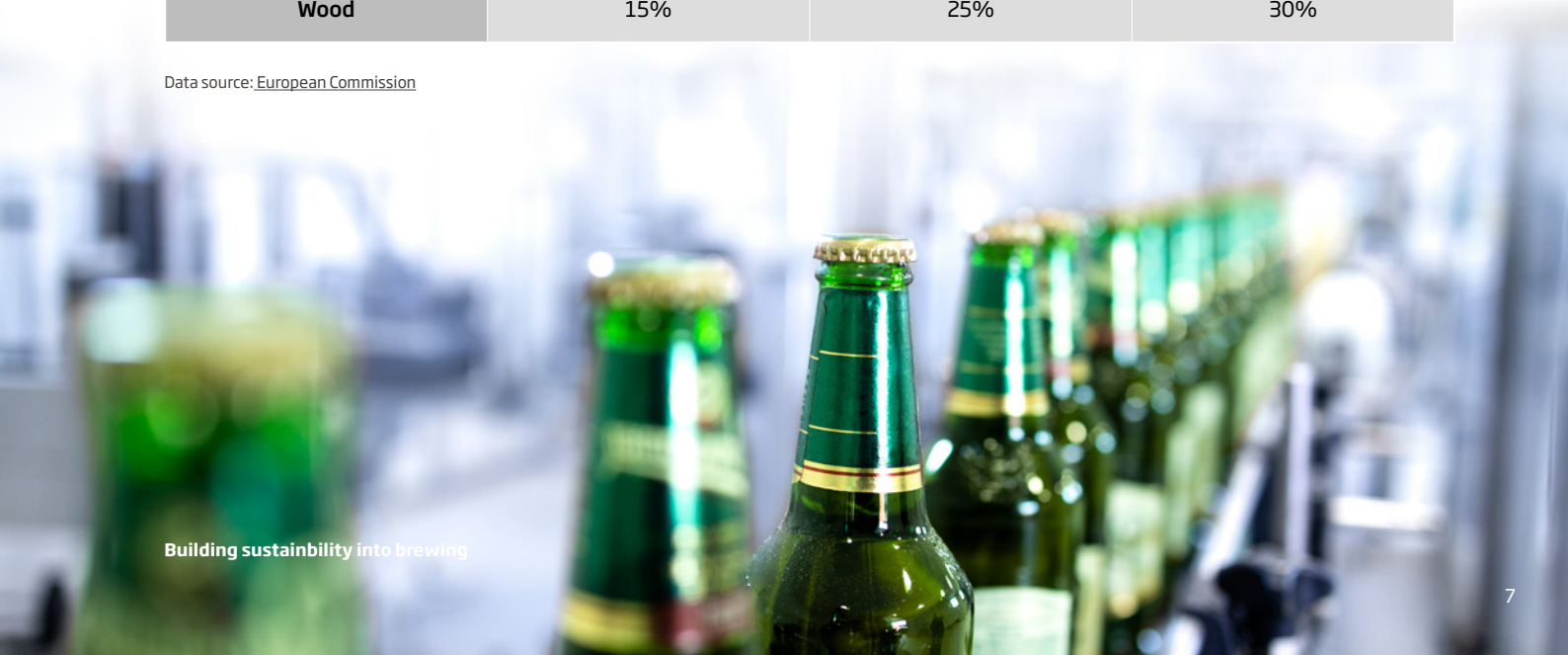
The EU's Packaging and Packaging Waste Directive sets out new recycling targets for materials used in packaging. As well as glass and aluminium, this includes wood (such as pallets) and paper (cardboard).

The directive requires member states to set up 'return, collection and recovery systems' – which could mean a wide rollout of deposit return schemes. Germany, Denmark and Sweden have long-established systems, while the UK government has laid out its own plans for one.

On paper, this certainly seems like a positive step towards minimising waste. But reusing bottles impact breweries' carbon efficiency because of the water and energy required to clean them. Some are contaminated beyond use so have to be disposed of, and there are questions about whether consumers want 'aged-looking' bottles – especially those who value the attractive packaging now synonymous with the craft beer scene.

Recycling target			
Material	31 Dec 2008	31 Dec 2025	31 Dec 2030
Glass	60%	70%	75%
Paper	60%	75%	85%
Aluminium	50%	50%	60%
Wood	15%	25%	30%

Data source: European Commission



Global goals

US: The **National Recycling Goal** is to increase the recycling rate to 50% by 2030

South Africa: Under the **The South African Plastics Pact**, 70% of plastic packaging should be effectively recycled.

Japan: **100% of plastics** to be recycled by 2030.

Brazil: Companies are required to recycle **22% of the packaging** that enters the market each year.

Australia: **80% of the country's waste** should be recycled or reused by 2030

Helping breweries become more energy-efficient

Nick Hickman,
Vice President, Projects,
NIRAS

The processes involved in brewing – boiling, cooling, refrigeration and so on – make it an energy-intensive industry, and a significant contributor to CO_2e emissions.

With sustainability a growing concern, and the recent energy price volatility, brewers are stepping up their efforts to reduce energy consumption. Heat recovery systems and electrification are being introduced, and there's also a move to replace traditional malt with green malt, which hasn't been kilned, to reduce the amount of carbon used during drying.

As in other areas of manufacturing, renewables represent a major opportunity to reduce a brewery's carbon footprint, and ensure a cost-effective and sustainable power supply.

We're already starting to see examples of what this could look like. At the start of 2023, Bavaria, part of AB InBev, **announced that it is investing $413m** in a new solar-powered brewery in Columbia. It is expected to achieve net-zero emissions as soon as it is operational, contributing to Bavaria's commitment to brew all of its products using solar power.

With targets set for the long-term, and short-term pressure on costs and expenditure, aligning CapEx and OpEx projects to make an impact and deliver an effective return on investment, alongside meeting future sustainability goals, is a complex challenge.

Minimising water consumption

Søren Nøhr Bak,
Senior Expertise Director,
NIRAS

Water is not only critical for our survival – it's key to the success of economies too. What was once a plentiful commodity is now increasingly recognised as something that needs to be preserved both for the environment and to avoid the high cost of wastewater disposal.

As many as three out of four jobs are either heavily or moderately dependent on water, according to the UN, so any droughts or restrictions on supply will impact a company's success and a nation's prosperity too.

Brewing, as mentioned previously, is water-intensive and, whereas CO_2e emissions are a global concern, there are local differences in the availability and quality of water. This not only impacts processes within a brewery but also where to locate it.

We've seen examples of breweries being forced to move to a new site because they couldn't get the required water volume to produce its beers efficiently and cost-effectively. As climate change heightens the risk of water scarcity, access to water is critical to future-proofing a site.

Finally, raising awareness about the steps breweries are taking to reduce water consumption can help the public to make informed purchase choices that align with their values around sustainability. We can see evidence of manufacturers outside the brewing industry taking steps to reduce the risk of water scarcity in the areas where they operate – notably Coca-Cola via its **Water Stewardship initiative**.

In order to increase water efficiency, it's helpful to apply the Four Rs framework.

The Four Rs

Reduce – reduce the amount of water consumed at a machine level, or by switching to processes that don't use as much water.

Reuse – the industry has been working on ways to reuse water in other secondary processes since the 1980s – so, while there is still waste, significant progress has been made. Carlsberg halved its water consumption with a water recycling system (see case study below). There are also **examples of brewers** using treated wastewater from other sources to produce beer – and it has gone down well with the public.

Recycle – Carlsberg also set the standard for recycling in a move that has been emulated across the industry. Now more breweries are recycling water, not just for technical purposes but for process critical elements, such as the final rinse when cleaning production equipment and packaging materials. The barrier they need to overcome is how to safely use processed wastewater while maintaining the same quality standards.

Rethink – given the amount of research that has gone into brewing processes and water efficiency in recent years, there is a real opportunity to rethink traditional methods, and apply the latest scientific thinking. This has already resulted in substantial gains for some companies – such as reducing water usage. Whereas previously around 12% of water might be evaporated to remove the alcohol, it can now be as low as 1-2% thanks to improved processes.

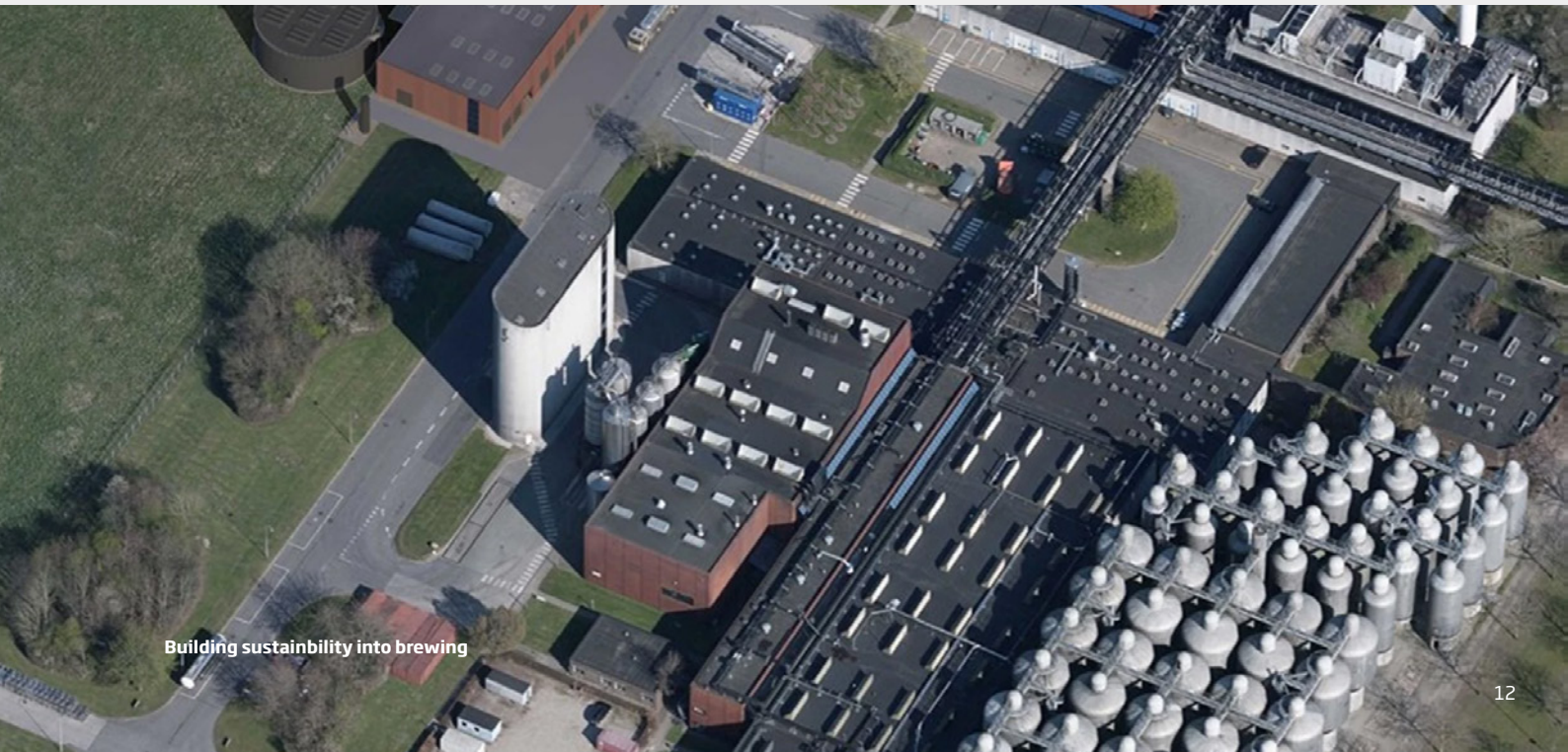
Case study

Spotlight on Carlsberg

Carlsberg Brewery in Fredericia, Denmark, is now recycling 90% of all process water and has halved its overall water usage – making it the most water-efficient production plant in the Carlsberg Group.

As part of its ambition to achieve zero water waste at its breweries, Carlsberg has invested in a water recycling plant – which is reducing average water consumption at the brewery from 2.9 hl of water per hl of beer to 1.4 hl of water per hl of beer.

At a global level, Carlsberg's aim is to halve its water usage from 3,4 hectoliters to 1,7 hectoliters pr. hectoliter of beverage produced. The plant was finished in the spring of 2021. Carlsberg opened Fredericia Brewery on September 25, 1979. NIRAS was involved in the construction of the brewery through the company DanBrew which is now part of NIRAS.



Building sustainbility into brewing

Challenges to sustainability – and how to overcome them

Nick Hickman,
Vice President, Projects,
NIRAS

Modern building and engineering methods can help breweries become more energy and water efficient by design – but major transformation in infrastructure, processes and products requires significant investment, and must satisfy the interests of multiple stakeholders.

What to consider

Greenfield vs brownfield:
Land acquisition is expensive – but retrofitting an existing brewery with modern technology is extremely challenging, especially if the buildings are old.

Supply chain:
Movement of materials and products is a major contributor to carbon and other emissions. Choosing the right location is critical to keeping mileage down – but must be balanced with labour supply and land costs.

It's not just about reducing mileage either. The type of packaging plays a part in reducing fuel consumption too (for example, cans are lighter than bottles). But there are other new innovations being trialled, like Carlsberg's green fibre bottle.

What sustainability means:
There is a growing number of sustainability metrics so should you be working towards net-zero, carbon neutral, zero waste, or a combination? The Science Based Targets initiative (SBTi) can be helpful in answering that question. It helps organisations to reduce the impact of climate change by showing them how much and how quickly they need to cut their greenhouse gas (GHG) emissions. This year, Heineken became the first global brewer to have its net-zero and FLAG (Forest, Land and Agriculture) targets approved under the SBTi scheme.

How to optimise existing plants:
Identify the small improvements in production and waste management that could reduce the overall environmental footprint.

Managing different stakeholders' demands:
Any plans for new or existing sites must align with wider strategies and focus areas. It's worth noting that, within groups that also operate pubs, manufacturing might not be the focus area for sustainability initiatives because their pub estate is bigger and has a bigger environmental footprint.

Solution

Every brewery and project is different – the key is to be realistic about what is achievable.

Whatever your goals, a good master plan ensures that sustainability is built into the design of any new facility from the start. With careful planning, it's possible to reduce both the cost and environmental footprint of beers, without diminishing the quality – by choosing the right location, energy sources, and applying the Four Rs framework.

The benefit of choosing a greenfield site over a brownfield is that they tend to be closer to infrastructure, including logistics networks, which can reduce the impact of the supply chain. There are still numerous challenges to overcome; heat pumps, for instance, are not yet technically advanced enough to boil the wort. Sometimes it's about finding a solution for now, while waiting for new and more innovative solutions to come along.

To build or not to build?

Chris Sparrow, Director of Architecture, NIRAS, ***explains what breweries need to consider when weighing up whether to build a new facility or retrofit an existing one.***

Breweries with a long history might have a number of ageing assets – including ornate listed buildings that are part of their own heritage and that of the town or city where they stand.

The problem, of course, is that these buildings may not be suited to modern manufacturing. There could be large parts of the site where buildings aren't being used or have become dilapidated. Production might take place across different sites, which is inefficient from a transport perspective. All-too-often, there aren't the in-house engineering resources to properly assess what assets there are and how they could be used more effectively.

That said, moving to a new site isn't always the most suitable option. A greenfield site might offer room for expansion and more modern facilities but it needs to be balanced against other factors, such as the impact of transferring integrated processes and jobs to a different site. The reputation of the business depends on making the right decision, especially when a brewery is the lifeblood of the community.

Every business is different, and the decision about whether to build a new facility or retrofit an existing one can only be determined via a strategic master plan.

When it comes to sustainability, a master plan will help decision-makers understand where the opportunities lie, what the risks are, and ultimately future-proof their site for the next five to 10 years. This plan, which includes a full site appraisal, and assessment of building materials, production processes, and infrastructure, guides breweries towards a solution that supports sustainability and longevity.

As part of this, a full lifecycle carbon analysis of the facility can show the impact of different types of construction materials, energy sources, waste and transport. This is the starting point for better decisions around sustainability.

Where in-house resources are limited, we can support breweries with a unified team of engineers and planners with experience not just in brewing but across the food and beverage industry. We have our finger on the pulse of new technologies, and work from first principles to ensure that every part of the plan delivers benefits and isn't a costly mistake. When a microbrewery scales up, for instance, it can suddenly find that it is producing excessive amounts of waste. Unlike the big breweries, with extensive R&D departments, smaller breweries don't always have a strategy in place to keep waste to a minimum, but it's something we'd factor into a master plan.

"A greenfield site might offer room for expansion and more modern facilities but it needs to be balanced against other factors, such as the impact of transferring integrated processes and jobs to a different site. The reputation of the business depends on making the right decision, especially when a brewery is the lifeblood of the community."

Conclusion

Brewing might date back to ancient times – but with the transition to a green economy now well underway, traditional practices are being upended by the need to be more sustainable, and the availability of new technologies. Linked to corporate and marketing strategies, and new regulations, the big breweries are setting ambitious targets to reduce their environmental footprint, and their manufacturing plants and supply chains will play an important role in helping them to achieve them.

There are numerous challenges linked to sustainability, not least the cost and feasibility of transforming existing production processes, and the interests of multiple stakeholders must be managed carefully. Technologies are advancing rapidly, so breweries will need a good master plan to ensure that solutions are optimal in the short, medium and long-term. But, as we have seen, the challenges around sustainability are also an opportunity to engage the next generation of talent – ensuring the industry is sustainable in every sense of the word.

Realising your sustainable potential

Jonas B. Borrit
Vice President
jbbo@niras.com

Nick Hickman
Vice President, Projects
nihi@niras.com