SUSTAINABLE PROCESSES

Distilleries embrace the spirit of sustainability

The processes of brewing and distilling have been practiced for centuries, but some operators have initiated a green energy makeover in the age of industrial sustainability, reports *Andrew Williams*.



odern consumers are used to thinking about the environmental impact of their shopping habits. Many are conscious of plastic food packaging or the high carbon footprint associated with eating red meat. But your average shopper probably isn't losing sleep over the carbon emissions associated with making their favourite alcoholic beverages.

However, there's no escaping the fact that brewing and distilling are energy-intensive processes, requiring large quantities of heat and power. This is why a number of breweries have undertaken improvement projects that see alternative energy sources installed at their production facilities. Among the most ambitious of these initiatives is the HySpirits hydrogen technology project at the Orkney Distillery in Kirkwall, Orkney.

Hy(drogen) Spirits

As part of the Orkney scheme, partners from the European Marine Energy Centre (EMEC) and Edinburgh Napier University teamed up with the Orkney Distillery to carry out a feasibility study that looked at how hydrogen technologies could replace liquefied petroleum gas (LPG) as a fuel for distilling. The researchers also examined the use cases for other processes and fuels, including kerosene, which is commonly deployed in distilleries that are off the gas grid.

The project also aimed to

The Orkney Distillery aims to pair traditional distilling practices with modern sources of process energy. *Photo: Orkney Distillery* quantify the potential carbon dioxide (CO2) reductions that fuel switching could achieve, as well as to provide metrics for cost, efficiency, safety and logistics.

According to Jon Clipsham, Hydrogen Manager at EMEC, the project team looked at capital and operating expenditures to assess the suitability of hydrogen. In particular, they wanted to get an idea of the costs of retrofitting the existing plant and switching to what is currently a higher cost fuel. Clipsham reports that the owner of the Orkney Distillery, Stephen Kemp, has been an advocate for renewables and energy efficiency for many years.

Shortly after establishing the distillery, Kemp engaged Professor John Currie of Napier University to assist with identifying ways to operate the process using minimal fossil fuel input. 'Concurrently, we at EMEC were expanding our hydrogen capabilities, and the three parties came together to submit a successful bid to the BEIS-funded Industrial Fuel Switching Competition,' explains Clipsham.

Kemp says that his background in construction means that a concentrated focus on energy and resource efficiency sits at the forefront of everything the distillery develops and designs. Another of the companies Kemp is involved in, Orkney Builders, was one of the first in the UK to adopt heat pumps universally for new-build housing, and it installed the country's first large commercial ground source heat pump system in a local care home in 2004. Over time, Kemp also observed that, despite being a very intensive user of heat, the distilling sector remained far behind other sectors in terms of innovation relative to energy

'I'd therefore always thought that when the time came to expand the Orkney Distillery to produce a wider range of spirits, that we must seek out a new and more carbon efficient means of production,' he says. 'I know the local team at EMEC well and had various discussions with them about the potential to use the hydrogen they generate from renewables to provide a heat solution to produce Scottish malt whisky and gin.'

CHP and anaerobic digestion

Elsewhere, a number of other breweries and distilleries have either completed – or are engaged in the development of – innovative alternative energy projects at their facilities. One example is the US bourbon producer JW Rutledge, which is currently involved in the process of building a facility that it claims will utilise a wide range of low emission technologies such as geothermal heating and cooling, solar energy, and biomass energy.

Meanwhile, Suffolk-based Adnams Brewery has successfully operated a groundbreaking anaerobic digestion (AD) plant - the first of its kind in the UK - at its Southwold facility for several years. The plant, operated via the company's Bio Energy arm, converts brewery and local food waste into biomethane before injecting it into the national gas grid as part of an ongoing partnership with British Gas and National Grid. A portion of the gas produced is also set aside for use as vehicle fuel. The company initially estimated that the facility could generate up to 5 GWh per annum.

Ultimately, it's hoped that the facility – made up of three sealed digesters containing naturallyoccurring bacteria capable of breaking down up to 12,500 tonnes of waste per year – will produce enough biomethane to keep the Adnams brewery, as well as its fleet of lorries, running. After this, the company also hopes to have some 60% of the facility's output left over for injection into the gas grid.

Beyond the immediate utility in terms of energy use, the Suffolk outfit also cites a number of additional benefits, including a valuable contribution to the decarbonisation of the UK gas grid through the delivery of renewable heat to households through the existing gas network and central heating boilers. The company also points to the environmental benefits accruing from preventing the release of highly-polluting methane to the atmosphere, through diverting the waste from landfill.

Another novel project – also based in the UK – is a recently installed biomass-fuelled combined heat and power (CHP) facility in Speyside, Scotland. In addition to providing enough renewable energy to supply in excess of 20,000 homes, the plant generates heat energy for the nearby Macallan distillery in the form of steam, a vital component of the distillation process.

The project was backed by construction behemoth John Laing and the then UK Green Investment Bank, which invested a combined sum of £26mn, supplemented by some £48mn of debt finance from bond markets, guaranteed by Infrastructure UK, part of HM Treasury.

In terms of output, Estover Energy, the firm responsible for building and installation, estimated that the CHP facility would be capable of generating an impressive 87.4 GWh per annum of renewable energy, as well as 77 GWh per annum of renewable heat. Taken as a whole, this equates to a carbon saving of 42,000 tCO2e each year, or the equivalent to taking over 18,000 cars off the road.

At the Macallan site itself, the key benefit of the CHP facility lies in its contribution to lowering the cost of energy by providing 90% of all of the steam needed for the process of distillation. Estover Energy claims that the use of biomass to generate heat instead of natural gas also enables the distillery to reduce overall greenhouse gas emissions by over 17,500 tCO2e.

Long-term view

Although detailed figures will not be released until the publication of a forthcoming public report, Jon Clipsham believes that HySpirits will result in significant emissions savings at the Orkney Distillery project. Despite the clear benefits, he admits that the use of hydrogen at the distillery, and other production sites, does not come without challenges. The gas is currently produced in two main ways - from methane reformation (which generates CO2 and needs the addition of carbon capture and storage [CCS] to achieve net zero emissions) and via electrolysis (which needs low cost renewable electricity).

Besides these technical challenges, Clipsham also highlights that the logistics requirements related to the storage and transport of hydrogen are not trivial. In the UK, there is currently only limited infrastructure for either hydrogen production or storage and distribution.

'Compared to current fossil fuels, hydrogen – from whichever source – is also more expensive [but] the phased introduction of carbon taxes and incentives for 'Brewing and distilling are incredibly heat intensive, and hydrogen offers a clean fuel option, with the potential to really efficiently provide heat, without emissions'

Stephen Kemp, Orkney Distillery carbon neutral fuels and policies to support the deployment of hydrogen technologies would help,' he adds.

Commenting on the longerterm prospects for the use of hydrogen at the Orkney site, Kemp observes that the island already has infrastructure in place to utilise excess renewable electricity production and electrolysers to generate hydrogen. Even more promisingly, he reveals that the region also has a unique, trailerised solution for movement of the hydrogen in pressurised storage cylinders to and from the point of use that is already successfully in operation.

If Kemp and his team were to develop a distillery using existing, conventional fuel options, he points out that they would be mainly considering LPG, kerosene or electricity - each of which have considerable downsides, at least in part because of the remote location. For example, Kemp argues that electricity is simply costprohibitive, despite a local surplus from renewable generation, and LPG and kerosene, as imported fossil fuels, would create associated emissions. Taken together, these limitations prompted the distillery to be naturally drawn towards hydrogen particularly in light of its status as a known local proven option.

'Hydrogen is pitched as the fuel of the future, and as projects like ours begin to become more frequent, and its use more mainstream, the costs and accessibility will inevitably improve,' Kemp says. 'Brewing and distilling are incredibly heat intensive, and hydrogen offers a clean fuel option, with the potential to really efficiently provide heat, without emissions.'

Of course, Kemp adds, there are a number of challenges with introducing a new fuel, not least of all the cost of cutting-edge infrastructure. He hopes that with the HySpirits initiative, the Orkney Distillery can demonstrate how to merge modern hydrogen technologies with traditional distillery processes. 'I hope, this provides a small stepping-stone that will encourage other very large industry players to explore hydrogen as a long-term viable fuel option,' he adds.

Soon, climate-conscious consumers will be able to add 'sustainable whiskey' to their shopping lists. And while they might feel better about sipping environmentally friendly spirits, they must still resist the temptation to have one too many.