Working together for a world without waste

Case Study: UK Drink Sector

Organic arisings

Beverage production creates organic arisings, the bulk of which is classed as a by-product. The majority of this material is used as animal feed but different recovery options are available. This case study in document highlights some of the environmental and economic factors to consider when deciding how to make best use of spent grain and other organic material.

WRAP's vision is a world without waste, where resources are used sustainably.

We work with businesses, individuals and communities to help them reap the benefits of reducing waste, developing sustainable products and using resources in an efficient way.

Find out more at www.wrap.org.uk

Front cover photography: Barley and shovel - Image courtesy of SWA

Contents

Current Practice

The table below shows the most significant organic arisings that result from brewing and distilling.

Organic materials

Spent grains are the most significant organic arising by volume, from both the brewing and distilling sectors, though other organic arisings include:

- pomace (the pulpy material remaining after fruit has been pressed – from fruit juice and cider production);
- marc (from grapes pressed for wine);
- spent botanicals from gin production;
- brewers' yeast and spent yeast;
- brewers' hops;
- high COD (chemical oxygen demand) effluent;
- pot ale; and
- spent lees.

Traditionally, over 80% of this material (particularly spent grain and pomace) is used as animal feed. However new technologies and facilities are increasing the range of options for using spent or brewers' grain including gas production in anaerobic digestion (AD) plants.

Animal feed

Spent grains contain cellulose, hemicelluloses, lignin, sugars and amino acids, making them suitable for both livestock and ruminant feed. In the Scotch whisky industry in particular, farming and whisky production have evolved alongside each other, with several distilleries created by the farmers themselves as a way of getting value out of surplus grain and spent grains utilised on site for feeding animals. This is still important for both industries, though the distilleries have become more independent with growth in production and international demand.

Approximately 1.2 million tonnes of organic by-product from drinks production in the UK is sent for animal feed every year. Pomace arisings

are lower, but much of this is also sent for animal feed: around 31,000 tonnes[1], or 86% of arisings.

Recipes for animal feed vary with a wide range of alternative products including silage and soya widely used for example. Spent grain could be readily substituted if it was diverted for AD or to other alternatives.

However, the financial implications of switching end use may be significant because the source stock is related to the location of specific plants that traditionally supply local farms. Additional transportation will affect the environmental impacts associated with the by-product, though to determine this accurately, a life cycle analysis for the individual site would be required.

Anaerobic digestion feedstock for energy production

Launched jointly by the Departments for Environment, Food and Rural Affairs (Defra) and Energy and Climate Change (DECC), the Anaerobic Digestion Strategy an Action Plan is an England-wide strategy to help promote the increase in energy from waste generated through AD. According to the Strategy:

"AD can play an important role as a means of dealing with organic waste and avoiding, by more efficient capture and treatment, the GHG emissions that are associated with its disposal to landfill. The technology also offers other benefits, such as recovering energy, producing valuable biofertilisers, and using the nutrients.'"

[1] *Industry input 2011*

Image 1: Anaerobic digestion plant

Scotland Food and Drink report (May 2011) that six AD sites are in operation across Scotland, with a combined capacity of 207,500 tonnes. Many more are in the planning process or in construction.
There are already two distilleries in Scotland that have installed their own digesters.

For Scotland AD plants are exempt from a waste management license from the Scottish Environmental Protection Agency (SEPA) if they accept waste from a distillery (or agricultural waste).

Waste streams likely to arise from this process include spent lees, pot ale, maltings effluent and draff. As the exemption covers both agricultural and distillery wastes, it is acceptable to use either waste stream separately or both these waste streams together under the terms of the exemption. If the process accepts other wastes not arising directly from agriculture or distillery wastes, the activity will not fall under the terms of the exemption.

Case study

BRUICHLADDICH

The 130-year old Bruichladdich whisky distillery on the island of Islay is using Anaerobic Digestion (AD) to generate energy from its waste.

Using pot ale, the watery waste product left over from distilling, the AD plant generates enough power to produce electricity for the distillery.

As well as the biogas, draff (spent barley) is taken by local island farmers to feed cows, whose in turn spread slurry on fields growing the distillery's barley.

The owner of the plant, Mark Reynier, has also replaced his diesel vehicle with an electric car, which he will also power from the AD plant.

Case study

Adnams Bio Energy is the first of 25 AD facilities to be developed over four years by the Bio Group. The facility takes brewery process waste along with local business and household food and packaging waste, converting it to biogas and digestate. The plant is built and run by Bio Group, but located on Adnams' land and takes 20% of feedstock from Adnams' business practices.

Steve Sharratt, Group Chief Executive of Bio Group, believes AD offers a huge opportunity for the drinks industry, but needs a considered approach. He stated:

"AD is not a panacea, it is important to consider many factors to ensure it is the most sustainable solution for the specifics of the site in question. It is critical to consider feedstock supply and local infrastructure, and to ensure that current sustainable end uses of materials are not disregarded. Adnams Bio Energy is a great example of success, as feedstock is available from waste arisings in both the hospitality and brewing sides of the business, without the need to divert animal feed from community farms. Adnams are able to cut their carbon footprint by 50% over five years, generating cheap and independent energy, and also offering a sustainable solution to neighbouring businesses and local authority household food waste."

Biogas produced at the site is converted to biomethane, currently for injection into the National Grid, though Adnams hope to convert all their fleet vehicles to run on the gas directly.

Production of biofuel and alternative uses

There are numerous alternative innovations available for utilising organic matter from brewing and distilling processes. The majority of these have fairly niche markets, or are only suitable for either very small volumes, or large joint aggregated collections, so are not currently suitable for many manufacturers. There is continued research into these options and with the ongoing drive towards alternative fuel sources and efficient sourcing of materials, these markets may develop in the future.

Alternatives

- Biofuel. On a large scale, biofuel production from various arisings from alcohol production is feasible, and is carried out by some distilleries, producing butanol. This is an area of substantial research, with EU regulations stipulating 10% of vehicle fuel from biofuel by 2020 creating a strong drive for alternative sources to crop grown for fuel. The Biofuel Research Centre at Edinburgh Napier University has produced a fuel from pot ale and draff which can be used in cars with no further treatment needed. According to Patrick McFall at Napier, the research is at too early a stage to compare costs and environmental benefits in comparison to animal feed, yet the potential is considered substantial.
- Compost. Spent grain is nitrogen-rich and acts as a good composting material. Other organic arisings, where smaller volumes are being handled (for example, botanicals from gin production), are very well suited to composting, and these materials are currently often sent to landfill.
- Absorption of heavy metals and pollutants. The hydroxyl, carboxyl and amine groups present in spent grains have a high affinity for metal ions. This makes them a useful medium for use in treatment of wastewater high in these pollutants, such as textile and dye

industries. Whilst there is currently little demand for this in the UK, there is a potential opportunity for other wastewater streams.

- Bricks. This is a niche market with limited uptake in the UK at present.

Case study

DIAGEO

Diageo is the world's largest spirit manufacturer, producing brands such as Johnnie Walker, Buchanan's and Bushmills whiskies and many others. In the UK alone, it operates over 25 distilleries. Being located throughout the UK, and therefore situated in areas of varying infrastructure and geography, use of waste and by-product differ substantially between sites. Decisions on which pathway to use for organic arisings are site specific, rather than being a 'blanket' company selection, to ensure the most sustainable option for each particular circumstance is achieved.

Examples of both innovative technology utilisation and traditional, efficient feed routes are described below.

The Cameronbridge distillery in Fife, Scotland, integrates both biomass conversion and AD on a commercial scale by generating renewable energy from 'spent wash' - a mixture of spent grain, yeast and water, as well as rootlets from the malt production.

The spent wash is separated into liquid and dried solids, with liquid converted - via AD - into biogas and the dried solids processed into a biomass fuel source. Around 90,000 tonnes of organic material, which would have required transport off-site by road, is converted into bioenergy, providing 80% of required electricity and 98% of the thermal steam for use at the distillery.

Due to the large volumes of by-products generated on site, previous use as animal feed had to be distributed via a third party after transport to a centralised point several miles away, resulting in high fuel costs. By investing in new technologies, onsite energy costs and transport costs have been significantly reduced. Annual CO_2e emissions have decreased by 56,000 tonnes.

Bushmills distillery in Northern Ireland sends spent grain to local farms as animal feed. The smaller volume of spent grain being generated reduces the feasibility (both commercially and environmentally) of developing an onsite AD plant, without the intake of third party feedstock, which adds regulatory complications, as well as transportation requirements and organisational barriers.

Animal feed is a high value end use, and this was considered to be the best option for by-product, featuring high on the waste hierarchy – preventing the arising of waste and reducing the need for virgin resources to feed animals. In addition, Diageo receives payment from farmers for their by-product, rather than having to pay for third party AD offsite. To improve efficiency, an onsite evaporator was installed, both allowing for greater transport efficiencies and increasing shelf life of grain before distribution.

The recently built RoseIsle distillery, which produces 10 million litres of spirit per annum is the only major distillery to be created in the UK for 30 years.

Sustainability was ingrained into the design of the site. This incorporated traditional production methods, including best practice found at Diageo's 27 existing malt distilleries, and innovative new techniques. An onsite treatment plant for spent grain was developed to generate both steam and electricity, in a similar manner to the Cameronbridge plant, reducing CO_2e emissions by 13,000 tonnes per year.

"Diageo have always been at the forefront of sustainable innovation, but do not overlook the efficiency of traditional practices which have been effective for many years. Our RoseIsle and Cameronbridge plants are state-of-the-art, but these are only sustainable where production is on such a large scale. Local farms benefit from the spent grains produced from our smaller distilleries, and this is considered more effective when the infrastructure is not in place to support bioenergy facility creation."

Ian Smith,
Senior Corporate Relations Manager at Diageo

Making the decision

Many factors need to be considered when deciding on how best to use spent grains and organic matter arising from the production process – and these need to be evaluated on a case by case basis.

AD is likely to be an attractive option if the generation of by-products on site is sufficient to run a biomass or AD plant, as this would be an efficient way of converting organic materials into a sustainable and cost-effective source of energy. However, if businesses are currently sending by-product to animal feed, continuation of current practice may be the most beneficial option.

Factors to consider

- Revenue – income received for the by-product if using a third party (typically short distances will equal greater price for animal feed over AD at present, if it is high in nutritional value, such as spent grain).
- Other financial considerations – can Renewable Obligation Certificates be obtained? What is capital expenditure required?
- Volume produced – will investment in onsite AD or biomass be beneficial, what would the pay back period be?
- Location – isolated and island distilleries have different opportunities available than city based sites, for example. Clustered distilleries (e.g. Speyside) have opportunities for amalgamation.
- Local infrastructure/geography - urban production sites may have difficulty gaining value from animal feed, whilst remote sites may be difficult to access for collections.
- Transportation – distance from accessible markets. Limited number and capacity of facilities such as an AD plant. Growth in the number of AD plants in the next five years is likely to be significant and future re-evaluation may be useful.
- Treatment – Will the third party take by-product wet, or does it need drying onsite? If there are large enough volumes, it may be worth considering investment in an evaporator.

- Impact on farmers who have relied on by-products as source of animal feed. But digestate is a valuable, nutrient rich product which can be used by farmers as a bio-fertiliser.

WRAP has a Anaerobic Digestion Loan Fund (ADLF) designed to support the development of new AD capacity in England. The fund aims to support 300,000 tonnes of annual capacity to divert food waste from landfill by 2015.

The ADLF will offer direct financial support to organisations that are interested in building AD capacity in England in order to provide digestate of sufficient quality for a variety of UK markets and to generate renewable energy in the form of biogas through the diversion of food and other organic resources.

Companies investing in onsite treatment facilities and using liquid and solid by-products or waste to produce energy increase their energy self-sufficiency. This is increasingly important in a world with rapidly rising commodity prices

It is important to also consider other feedstock if this pathway is chosen, and to remember that more than one pathway can be utilised. In the case study, Adnams brewery invested in an AD plant in 2010, yet only use beer ullage and food waste from their hospitality sites, having determined that brewers grains held more value as animal feed. Additional feedstock is obtained from local authority municipal waste, nearby institutes and various retailers, also provide Adnams with a source of income, as well as an energy supply.

Images 2 and 3: Images of barley and hops, courtesy of BeerGenie.co.uk

Conclusions

The use of distillation and brewing by-products as animal feed is a long held tradition with the alcohol and farm industries which have evolved alongside each other in certain regions. This has resulted in an efficient and effective localised infrastructure with high value use of by-product. In certain circumstances, particularly with high volume production on site, other uses for by-products may be valued equally or more highly and should therefore be considered as feasible alternatives to animal feed. Where production is in urban environments and transport distances to farms are significant, biofuel production or anaerobic digestion are useful markets for by-product, with AD being the main opportunity currently: an opportunity which is likely to increase with the growth in facilities in coming years.

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