Case Study 4

Adnams Brewery Anaerobic Digestion Facility

Report for ZWSA

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Case Study 4: Adnams Brewery Anaerobic Digestion Facility

Overview

In 2010, Adnams Bio Energy opened an Anaerobic Digestion (AD) facility which processes up to 12,000 tonnes of food waste and brewery waste each year. Food waste is sourced from local businesses and brewery waste is produced by Adnams Brewery at which the plant is located in Suffolk, England. The AD process breaks down the organic waste stream into a biogas. The resulting gas is injected directly into the national gas grid and is considered a renewable fuel. In addition to biogas, the AD process also produces a liquid fertiliser.

Outcomes

- Anaerobic Digestion of approximately 5,000 tonnes of Ullage from the Adnams Brewery (Ullage is waste beer in kegs returned to the Brewery)
- Anaerobic Digestion of between 7,000 and 10,000 tonnes of food waste from a number of sources including pubs, hotels, household kitchen waste and commercial food waste sources.
- 600,000m^3 of biogas supplied to the national gas grid each year
- Produces enough energy to power the brewery and run its fleet of delivery vehicles

Benefits

- The plant will generate enough renewable gas to power t of delivery lorries, while still leaving up to 60 per cent of the output for injection into the grid.
- Diversion from landfill of up 12,500 tonnes of organic waste
- Reduction in carbon emissions from the avoidance of methane emissions in landfill, and the substitution of fossil fuels for power and transport fuels
- Production of fertiliser rich in nutrients

Success Factors

- Strong partnership formed between Adnams Brewery (feedstock supplier and energy user), Bio Group (technical expertise and track record) and National Grid (facilitation of the export of biomethane to gas grid)
- Closed ó industrial ecology ô as di Adnam ô s brewery
- Grant funding was received from European, national and regional sources
- Gate fees from feedstock, energy sales and income from subsidies

Background

The Adnams bioenergy plant is the first of its kind in the UK built to inject green gas to grid, producing biomethane from food and brewery waste. The anaerobic digestion (AD) plant, which opened in July 2010, supplies 600,000 m^3 of biomethane to the grid per year. The facility was designed, built and is operated by Adnams Bio Energy Limited, a company set up by a partnership between Bio Group and Suffolk-based brewery Adnams plc. The plant is located on adjacent to the Adnams distribution centre in Reydon, Suffolk, and

a few miles from the Adnams Brewery at Southwold, The facility takes 20% of its feedstock from the A d n a m s ô brewery practices.

The AD plant br e a k s d o w n t h e b r other organic waste and generates energy in the form of biogas, which is upgraded to biomethane.

The facility comprises of a new build mesophilic[1] AD plant with the capacity to treat around 12,500 tonnes per year of organic feedstock.

In addition to the feedstock provided by Adnams Brewery, the AD plant operates as a merchant facility, treating wastes from a variety of third parties.

The Adnams Bio Energy plant produces 9.6 giga watt-hours per year, enough to run an average family car for nearly 14 million kilometres or remove 120,000 tonnes from landfill every year, and will help Adnams Plc. reduce its carbon footprint by up to 50% over five years. Bio group installed solar thermal panels and photovoltaic cells, which will combine with the AD facility to form a fully integrated energy park.

Feedstock

The AD plant uses beer ullage and food waste from A d n a m s ô h o s p i t a l i t y s i t e s ô s g r a waste yeast sludge, as it was determined that they hold more value as animal feed. Therefore, the AD plant receives feedstock from the following sources:

¶ **Ullage** (waste beer in kegs returned to the Brewery) ï the plant produces approximately 5000 tonnes per year of ullage from Adnams Brewery. The by-product used to be thrown away, and the company had to pay a third party to take it.

¶ **Food waste** ï the plant processes between 7,000 and 10,000 tonnes of food waste from a number of sources including:

- Pubs and hotels within the Adnams estate
- Household kitchen waste collected by Waveney District Council
- Commercial and industrial food waste from a variety of third parties.
- Sourcing food waste feedstock may be challenging. The cost of transporting food waste to the AD plant versus the value of the biogas needs to be taken into consideration.

Feedstock challenges

In December 2010, the Adnams Bio Energy/Waveney Norse Food Waste Contract commenced, with food waste collections being carried out by Waveney Norse at 5,500 domestic households, schools and trade waste customers within the Waveney area, and a number of schools and trade waste customers in the Suffolk Coastal and Ipswich area. However, a review in 2012 revealed that, while the majority of collections were performing well and were viable in the Waveney area, those being made further afield in the Suffolk Coastal/Ipswich areas were inefficient and unviable, resulting in a first year operating loss of

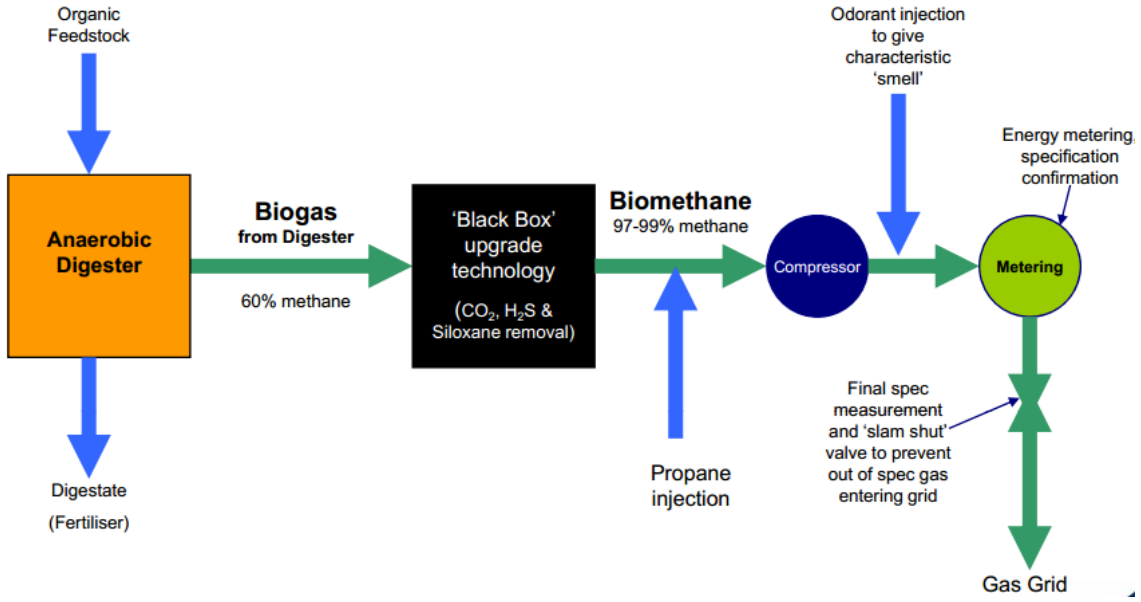
[1] Anaerobic digesters are normally operated at either mesophilic temperatures (30-40°C) or moderately thermophilic temperatures (50-60°C), allowing optimal growth of the bacteria involved in the breakdown of the organic matter (ADCentre,2013)

some £27,000. There were insufficient numbers of additional costumers available in these areas to justify continuing operating these collections from the Lowestoft Depot.

Technology

AD is a process in which bacteria breaks down organic material in the absence of oxygen. The organic matter is broken down in a biogas, which contains methane. The process can be likened to a human digestive system, as the digesters are sealed vessels in which naturally-occurring bacteria act, without oxygen, to break down organic waste. In addition to the biogas, other outputs are a dry and liquid fraction which can be used as a fertiliser.

The A d n a m s 6 E n e r g y p l a n t consists of three digesters, inside which the brewery waste and food waste are broken down into around one million cubic metres per annum of biogas. The biogas is upgraded using a cryogenic process to remove the carbon dioxide (CO_2) and other trace gases, including H_2S, creating about 600,000 cubic metres of ~98 per cent biomethane, which is injected to the gas grid. The CO_2 is captured using biomass (which is also used to take the nutrients out of the liquid digestate). The biomethane then has odorant and propane added, to ensure it meets the required specification for fuel gas in the grid, and that any gas leaks can be detected by smell.



Outputs

Biogas

The main output from the bioenergy plant is the biogas produced as part of the AD process.

The plant will generate enough biogas to power the brewery and to r u n i t s þ e e t o f lorries, while still leaving up to 60 per cent of the output for injection into the grid. This is the first facility of its kind in the UK to inject green gas into the National Grid system.

The National Grid was a key partner in the development and installed pressure reduction equipment, odorant injection and gas-control quality equipment, as well as remote-control monitoring equipment. A connection has also been provided to a three-inch gas main that runs close to the site.

In addition to supplying t h e g a s g r i d w i t h b i o m e t h a n e , A d n a m b i o m e t h a n e t o f u e l t h e i r f l e e t o f l o r r i e s . A d n a replacing commercial vehicles with those that can run on biomethane.

Digestate

The residual material from the AD process is known as digestate, and contains both a liquid fraction and any solids from the waste stream that are not able to be digested or broken down during the process. Adnamôs Bio Energy uses a separation process to separate out the water to produce a more concentrated digestate. This has the effect of reducing storage, haulage and spreading requirements, making the digestate a more attractive fertiliser product to farmers and more economical to transport. The liquid digestate is used as a fertiliser on land used to grow barley for Adnams Brewery. Around farms which supply the Adnams Brewery with barley for malting receive the fertiliser free of charge.

The digestate is rich in nitrogen, which is particularly important in a Nitrate Vulnerable Zones such as Suffolk. Nutrients (e.g. nitrates, phosphates and potassium) lost from the land during the harvesting of crops can be returned to the soil through the application of the digestate. The need to procure and apply expensive, artificial, fossil fuel-derived fertilisers is reduced by the use of digestate from the AD process.

'Being able to convert our own brewing waste and local food waste to power the brewery and vehicles is very exciting. The industrial ecology cycle is completed when the fertiliser produced from the anaerobic digestion process can be used on farmland to grow barley for Adnams beer,' said Dr Andy Wood, Chief Executive of Adnams.

Costs

The development and construction of the facility was funded by grants from the European Regional Development Fund (EDRF), East of England Development Agency (EEDA) and the Department of Energy and Climate Change.

The EEDA is a seven-year investment programme part financed by the European Union. Its objective is ótowards low carbon ecoú110.9 million has been allocated to the region.

Adnams Bio Energy Total Project Cost: £2,968,493

Funding received from:

- **European Regional Development Fund: £806,241**
- **East of England Development Agency: £480,000**
- **Department of Energy and Climate Change: £480,000**

Whilst these investments provided vital financial contribution to the construction of the facility, it is understood that the business model would still have worked without grant funding. Grant funding accounted for 55 per cent costs, with the remainder of financing from bank debt and equity from the project partners.

The facility makes a 20 per cent return, and in order to attract the investment needed a combination of gate fees, energy sales and subsidies such as the Renewable Heat Incentive.

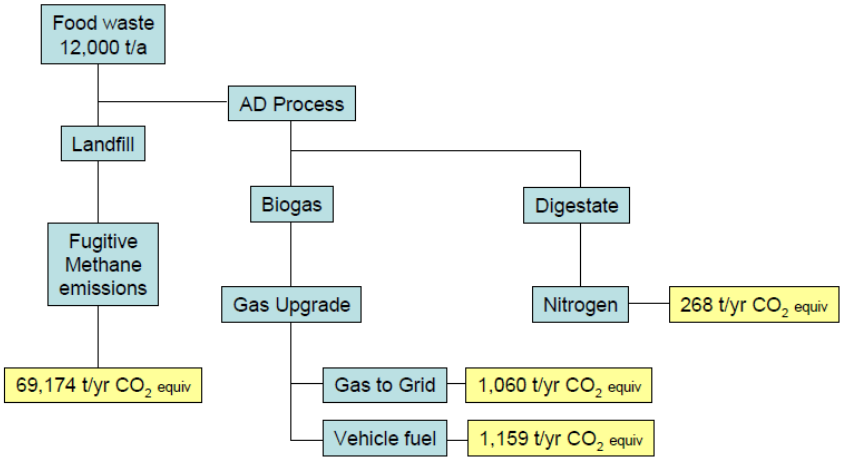
The digester will also have a positive impact on the local economy, saving an estimated 5 per cent in landfill costs for every customer who uses the facility and creating new jobs in the area. Given that this development involves both public and private-sector financing, this model should be regarded as an exemplar of sectors working together for sustainable growth.

Benefits

By using brewery and local food waste to generate biomethane, the plant makes a contribution to decarbonising the gas grid by delivering renewable heat to households through the existing gas network and central heating boilers. Other benefits include:

- Diversion of brewery and food waste from landfill reduces the release of methane to the atmosphere.
- Generation of enough biogas to provide power to the brewery, supply gas to the national grid and use as a vehicle fuel for Adnamôs cor hic
- Production of a natural fertiliser, used on farms supplying barley to the brewery.

Adnams Bio Energy will have a considerable impact on the reduction of carbon emissions in the region. The diagram below outlines some of the carbon benefits realised by using the AD facility to process brewery and food waste. In addition, there will also be a positive impact on the local economy with an estimated 5% saving in landfill costs for every customer who uses the facility.



Adnamôs Bioenergy

A further benefit of the Adnams AD plant is the Green Gas Certification Scheme (GGCS), which may also benefit future projects. The GG through the supply chain to provide certainty for those that buy it. The scheme was founded by partners including Bio Group, and some of the UKôs Centrica (British Gas) and E.ON. The scheme is operated by the Renewable Energy Association and ensures that biomethane energy that enters the grid is tracked and allocated properly to any consumers. Each unit of green gas injected into the grid displaces a unit of conventional gas. The GGCS tracks each unit of green gas from its injection into the distribution grid, to any trades, to its sale to a consumer, or group of consumers. In doing this, it ensures there is no double counting of biomethane between its production and end use.

Any-one involved in the green gas supply chain can take part in the Green Gas Certification Scheme. The key participants are green gas producers who register the gas theyô to the grid, and suppliers and other traders wh The advantages of the GGCS is that it provides certainty for consumers who purchase the gas, confidence in the green gas sector and an incentive for gas producers to inject green gas into the grid instead of using it to generate electricity. Such a scheme was developed as a result of the exemplar projects such as the Adnams Bio Energy AD plant.

Biomethane production is a relatively new industry, so Adnams Bio Energy, together with companies such as National Grid, is working with Government and industry regulator Ofgem[2] to create a framework that allows more facilities to be built without need for special exemptions on biomethane injection. At present, UK regulations are all designed to allow the import of natural gas, not the injection of renewable gas.

Success Factors

A broad number of factors contributed to the success of the Adnams Bio Energy AD plant.

The joining together of different organisations in a partnership was instrumental to the success of the facility.

Adnams brought to the partnership a feedstock from their brewery process, a location for the facility, and a demand for the energy and fuel. Adnams were also able to develop a market for the digestate by supplying if free of charge to its farmers.

Biogroup were able to offer expertise and experience in developing AD facilities. Finally, the partnership with British Gas was vital in facilitating the import of biomethane into the national gas grid. The specially formed company, Adnams Bio Energy Ltd, believes that working with the right partners is essential.

A further success factor was the grant funding made by the European Regional Development Fund and the East of England Development Agency. Although the business model would work without grant funding, securing grant funding was essential in getting the project off the ground and securing further investment.

[2] Office of the Gas and Electricity Markets UK