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Developments in the UK Biomethane Industry

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The Carbon Plan, published in 2011, aims to reduce UK carbon emissions by a quarter from 1990 levels. With the current policies in place, the UK is on target to reduce emissions by over a third by 2020 and with the introduction of new technologies this should increase to an 80% reduction by 2050. However, currently around half the UK's carbon emissions result from heat related processes and the latest analysis shows up to 52% of emissions from heat are from gas use. The greatest proportion of this is domestic gas use. Furthermore, with UK Continental Shelf (UKCS) resources in decline, the UK is becoming increasingly reliant on imports of gas and is more exposed to higher and more volatile fuel prices in the future. In light of this, developing technologies to decarbonise the gas grid and the production of heat is important.

At the end of 2012, the UK's first commercial-scale Biomethane plant became operational, pumping renewable energy directly into the UK gas grid network. The Prince of Wales attended the official opening at Rainbarrow Farm, Poundbury, which represented the launch of a new renewable industry in the UK, with a key role provided by Southern Gas Networks (SGN) in converting the biogas into biomethane and injecting it into the SGN grid.

John Baldwin explaining the benefits of the Rainbarrow Farm Project to Prince Charles

Green Gas Certificates

The Rainbarrow Farm project has also helped to develop a market for the Green Gas Certificates received for each kWh of biomethane injected into the grid. The REAL GGC scheme (www.greengas.org.uk) is a not for profit scheme designed to allow tracking of biomethane from the AD plant to gas consumers. A new gas shipper, Barrow Shipping Ltd (BSL), has been formed to provide gas shipping and Green Gas Certificate trading services to biomethane producers and the first sales have been made to The Duchy of Cornwall, Gas Bus Alliance and Brit European Transport Limited (BET).

John Baldwin, Barrow Shipping Ltd, presenting the UK's first Green Gas Certificates to Andrew Phillips of the Duchy of Cornwall

BET provide logistics services for JCB, so it is fitting that most AD projects have had extensive civil works using JCB plant. BET take out gas at the CNG Services CNG station in Crewe and use this to fuel a new fleet of 36 dual fuel tractors, with the CNG linked to the Rainbarrow Farm plant via the GGCS. This is a great example of the circular economy.

Brit European Trucks run on a Bio-CNG - diesel blend

Vale Green

BSL is providing the same services to the next biomethane project that will be completed, Springhill Farm's Vale Green project near Pershore. This is expected to start injecting around 400m³/hr biomethane into the Wales & West Utilities (WWU) grid from August 2013. What is particularly innovative about this plant is that it is uses a new combined membrane and cryogenic technology, made by Dutch company Haffmans. This produces biomethane for injection into the gas grid and a by-product of liquid CO_2 which is then fed back into the greenhouses to grow more tomatoes, the waste from which goes back into the AD.

Membranes used to separate the CO_2 from the CH_4

Any AD operator that is located close to a large CO_2 user is now able to utilise this technology to improve their overall carbon footprint and generate additional revenues. In addition, the gas grid owner, WWU, have allowed Vale Green to procure all the equipment necessary to allow entry into their gas grid, which has resulted both in substantial capex savings and a significant reduction in project timescale and complexity.

Elster Grid Entry Unit and Remotely Operated Valve packages

Note: the Grid Entry Unit contains pressure control, odorant addition, propane injection system, flow metering, CV measurement, gas quality monitoring, and telemetry unit.

Both Rainbarrow Farm and Vale Green utilise some energy crops as part of the overall feedstock mix but both also use waste and illustrate the highly sustainable outcomes possible from biomethane projects.

BSL have also established a Biomethane Producers Club, with initial members Rainbarrow Farm and Vale Green. The purpose of the Club is to share operational information to improve performance and lower costs and to work together to share spares and reduce the cost of buying such things as activated carbon and propane.

Overcoming Barriers

The most significant barrier to biomethane injection to the grid in the UK was the level of oxygen allowed in the gas. Until recently, the oxygen specification was set to 0.2% in the final gas, which was problematic for many potential projects, particularly if oxygen or air

dosing was needed to reduce the level of hydrogen sulphide in the biogas. However, thanks to Wales & West Utilities (WWU), the HSE have now issued a class exemption to Gas Safety Regulations (GS(M)R) to allow network conveyance of gas with an oxygen content of up to 1% (molar) at pressures up to 38 barg.

Elster Gas Chromatographs for Biomethane CV, Ofgem C6+ analysis and GS(M)R compliance

At present, biomethane has to meet the Flow Weighted Average Calorific Value (FWACV) of the gas grid which, in most cases, requires the addition of around 10% propane energy. 100% methane has a CV of 37.8 MJ/m^3, a typical FWACV is 39.2 MJ/m^3 and hence propane is added to enrich the CV and ensure that customers who receive biomethane are not disadvantaged. Around 10% of projects have the possibility to blend the biomethane into the existing gas stream which reduces the propane required and the Renewable Energy Association is working with the Gas Distribution Networks to develop the rules for blending.

Propane storage at Vale Green

A remaining issue relates to capacity in the gas grid, with estimates of approximately 40% of potential projects constrained by lack of network capacity. Northern Gas Networks and National Grid have carried out an Innovation Funding Initiative (IFI) project to prove the viability of using a small compressor to reverse flow within the grid, creating capacity for biomethane. Following a successful pilot study, this method is now being rolled out across the UK to enable more projects to go ahead. The timing for this development is good as in many places solar farms are taking the capacity in the electricity grid and hence using biogas to generate electricity is not an option.

Compressor at the Skipton Pilot Project

CNG Trucks and Buses

Another stimulus for the biomethane market is the market for CNG trucks and buses. This year, four new CNG filling stations are being built (Reading, Darlington, Beccles, Runcorn) by the Gas Bus Alliance to supply CNG to Scania and MAN buses. These represent the first new buses to come to UK since the 1990s and are as a result of air quality and CO_2 drivers. The buses may be given additional financial support if they use biomethane via the GGCS.

Arriva CNG bus at the CNG Services Crewe CNG station

There are now three companies working closely with truck manufacturers to convert a new diesel tractor into a dual fuel CNG-diesel one. Clean Air Power are working with Volvo, Hardstaff with Mercedes Benz and Prins with DAF. Whilst grid CNG is the fuel of choice with biomethane via the GGCS, the likely abundant UK shale gas resource means it may now possible for all trucks and buses to shift to natural gas by 2030. This will produce around a 25% CO_2 reduction compared to diesel as well as major benefit in terms of balance of payments given that gas only costs 40% of the cost of oil. We will know this by 2015 once shale gas drilling and fracking has taken place.

Dual fuel CNG-diesel tractor filling with CNG in Crewe

Market Forecast

The Renewable Heat Incentive, which is the renewable premium for biomethane injected into the grid, is set at a level of 7.3 p/kWh. Whilst there could be some reduction in this tariff in 2014 under the degression rules, the tariff is attractive and is sufficient to create a new renewable market, driving down costs through competition and establishing UK supply chains.

There are now around fifteen biomethane projects under development with three starting to inject their gas during summer 2013. The long term commitment by the Government to reward Biomethane production has made it attractive to many AD operators who previously would have chosen electricity generation, and the development of solar farms is also taking electricity grid capacity so it is no longer available for biogas electricity generation projects.

The Energy Networks Association (ENA) are also supportive and are working with the biomethane industry, including the REA Biogas Group, to reduce the costs and complexity associated with biomethane injection projects.