Biomethane Enters the Gas Grid

Article for *Energy World*

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 come from gas use. The greatest proportion of this is from domestic gas use (see chart). Furthermore, with UK Continental Shelf (UKCS) resources in decline, the UK is becoming increasingly reliant on foreign imports of gas and is more exposed to higher and more volatile fuel prices in the future. In light of this, creating an efficient and sustainable low carbon economy is crucial, and developing technologies to decarbonise the gas grid and production of heat is key to achieving this.

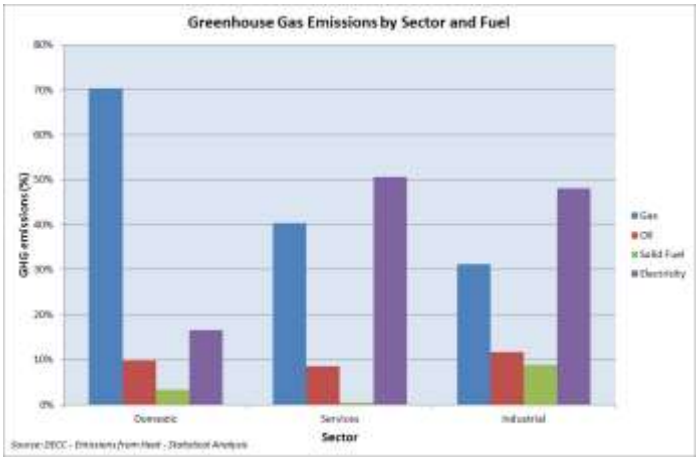

Chart 1: Greenhouse Gas Emissions by Sector and Fuel

Biogas is a mixture of methane, carbon dioxide, water and hydrogen sulphide with

<1% oxygen/nitrogen and is produced in the UK at more than a hundred sewage works.

Usually, biogas is used to generate electricity at an efficiency of around 35% with limited use for waste heat. However, there is a more efficient way of utilising this gas – injecting it into the UK gas grid.

In April 2009, CNG Services Ltd (CSL) identified that biogas was being flared at the Thames Water (TW) sewage treatment works in Didcot, Oxfordshire. Recognising that flaring biogas to atmosphere is both harmful to the environment and a waste of a valuable resource, CSL made a proposal to TW and Scotia Gas Networks (SGN) to carry out a feasibility study to review the technical and commercial aspects of BtG. TW were keen as this would deliver significant environmental benefits and SGN wanted to show that their network could transport biomethane.

Prior to grid injection, the biogas must be cleaned up and upgraded to meet the gas grid specifications. There are a number of clean-up technologies available for this, including pressure swing adsorption, chemical scrubbing, cryogenic and water wash. For the Didcot project, a water wash system was installed which uses the chemical properties of water to separate CH_4 from the biogas stream, giving up to 98% CH_4. This is biomethane. However, as well as methane, fossil natural gas in the gas grid contains other hydrocarbons such as butane, propane and ethane. This gives grid gas an energy content, or calorific value (CV), that is higher than biomethane. To meet grid specification, the CV of biomethane must be increased to match the CV of the grid gas which is done by adding around 6% (by volume) of propane to the gas prior to injection.

The Didcot project was approved by the end of 2009 and the first biomethane was injected into the UK gas grid on 3rd October 2010.

Waste from the town of Didcot is processed at the TW sewage treatment works and the biogas is cleaned, upgraded and injected as biomethane into the local gas grid. This 'green gas' is then used to fuel homes in Didcot. The waste to energy cycle demonstrated at Didcot is an innovation that is truly sustainable and applicable to many more sites across the UK.

The Didcot is the first BtG plant in the UK and has proved to be a major success. Having designed and project managed this venture, CSL proved that it is possible to take biogas derived from sewage, clean and upgrade it to make biomethane and inject it into the UK gas grid. The success of the project demonstrated that technology previously only seen in Germany and Sweden can work in the UK, which has eliminated much of the scepticism that surrounded it. The biomethane being injected into the gas grid is being used to fuel the homes in the town of Didcot, so as long as Didcot continues to create sewage and waste water, the Didcot BtG plant can continue to create biomethane to inject back into the grid and fuel homes. The Didcot project proves that using biogas from waste in this way is applicable to many more similar sites across the UK. As a direct result this has generated a massive increase in interest in BtG, with a number of new projects now in planning and constructions stages.

As the appointed project designers and managers for the Didcot project, CSL secured the required commitment of the three project partners for the design process to commit resources when needed, and to attach the correct priorities against competing demands for time and finance. This was a ground breaking project and there was a need to secure understanding of the new plant, how the components integrate to form a working whole and deliver the desired outcome. In particular, issues arose in compliance with the various company standards, different working practices and hierarchies. Of special note was the need to enable the people involved, who were more accustomed to the demands of traditionally conservative industries, to embrace engineering needs beyond their previous experience. This was overcome by a combination of background explanation and detailed training.

CSL provided technical evaluation of the available technologies and the initial feasibility study and developed the project management structure, governance procedures, and delivered financial, technical and programme reporting. During the initial design, probable and actual technical challenges were identified so specific steps were taken to engage with the partners to first propose, and then facilitate the development of resolutions. An example was the practical management of the product gas quality, where failure to meet exacting requirements would mean cancellation of the project. This issue required liaison with Ofgem and the HSE, and input from all the partners and the main plant suppliers. As a direct result of this project DECC and HSE are now considering a change in oxygen specification for UK gas grids from the current level of 0.2% to 1%. Ofgem and the gas industry are also reviewing opportunities to change the gas quality monitoring protocols for biomethane to reduce costs from £600,000 to around £200,000 and the Environment Agency are developing an `End of Waste' test for biomethane.

Prior to the Didcot project, CSL got involved in biomethane in 2006 by carrying out a feasibility study in relation to making compressed biomethane (CBM) for vehicles from local authority organic waste. CSL showed that this had potential but at the time, with no outlet for excess biomethane, it was not a practical proposition. BtG was also found to be possible, but with no financial

incentive it was not economic. However, in November 2011 the Government introduced Renewable Heat Incentive (RHI) scheme to provide financial support for renewable heat generators and producers of biomethane. The RHI aims to increase the uptake of renewable technologies by providing incentive payments to eligible generators and thereby reduce the UK's carbon emissions. Technologies eligible for the scheme include on-site biogas combustion (CHP) and injection of biomethane to the national gas grid. Biogas installations must be less than 200 kWth, from anaerobic digestions, gasification or pyrolysis. Biogas from landfill and heat from solid biomass is not allowed. However, for biomethane injection to grid there is no limit on capacity. The initial RHI tariff for biomethane injection to grid is set at 6.8p/kWh (or 199p/therm) but any heat used that is not from a renewable source is deducted from this.