

Anaerobic Digestion Briefing

Appendix D - Gas from AD

Strategic and Energy Efficiency considerations

Release 3

Security of Supply and Efficiency Considerations

Within the UK and elsewhere in Europe there is a realisation of the extent to which biogas offers benefits in the areas of both GHG minimisation and national security of gas supplies.

The move towards 'gas to the grid' arises for two main reasons. These are security of supply and energy efficiency. Gas supplies for Europe depend heavily on Russia and gas is used much more energy efficiently in modern gas heating equipment than in a gas turbine driving an alternator. Co-generation (electricity generation with heat recovery or CHP) offers reasonable efficiency only if the heat recovered can be effectively used, and security of gas supply considerations are likely to encourage biogas to grid rather than to local electricity generation except in situations remote from the gas grid. However, efficiency in utilisation is important but not, in all cases, the overriding consideration. See **Transport and Agricultural Plant** below.

Mainland Europe is adopting AD to produce biogas from energy crops as well as for biowaste processing, and the economics of AD plants is enhanced as gas output increases and when gas output per tonne of input is increased. Energy crops subjected to AD produce much more biogas (up to five times more) than biowaste.

Further aspects of the Strategic and technical advantages of BioGas-from-Waste are available in:

http://www.ukwin.org.uk/files/pdf/UKWIN_Welsh_response_July_2009.pdf

The UK National Grid

The UK National Grid argues that (kW for kW) it will be cheaper to produce biogas, process it to match North Sea gas standards and inject it direct into the grid (from which it can be taken for heating or used for electricity generation) than to produce the equivalent electrical power from renewable resources. Moreover, the installation of CHP area heating schemes is costly and impracticable for existing buildings.

The present on-site uses of biogas in combined AD plus CHP (heat and power) plants tend to be wasteful (there is no provision to store the gas for colder periods), so once the NG is ready to take the gas, such plants will be largely outdated. Strategic and sustainability considerations tend towards optimising the production (in large plants) and distributing the gas to users via the existing pipes.

Within the UK, DEFRA published, in February 2009, 'Anaerobic Digestion – Shared Goals' in which is set out the Government's vision for A. See:

<http://www.defra.gov.uk/environment/waste/ad/pdf/ad-sharedgoals-090217.pdf>



The Government is setting up a new Task Group, chaired by the Chief Executive Officer of the Chartered Institution of Wastes Management (CIWM), to lead the development of an Implementation Plan for anaerobic digestion. FoE is now represented on this task group. The Plan will set out the practical measures that Government and stakeholders will take individually and collectively to achieve these shared goals. See:

<http://www.defra.gov.uk/environment/waste/ad/government.htm>

An extensive list of organisations endorsing the shared goals is available via this site. These include National Grid, who have responsibilities for both gas and electricity distribution, and who, in January 2009, produced 'The potential for Renewable Gas in the UK' available via

<http://www.nationalgrid.com/NR/rdonlyres/E65C1B78-000B-4DD4-A9C8-205180633303/31665/renewablegasfinal.pdf>

The executive summary states that '..... in the longer term, with the right government policies in place, renewable gas could meet up to 50% of UK residential gas demand. Produced mainly via a process of anaerobic digestion (AD) Of the UK's biodegradable waste, renewable gas represents a readily implementable solution for delivering renewable heat to homes in the UK.'

Conversion of Biogas to meet North Sea Gas standards

To convert biogas so that North Sea ('natural') gas standards are met, and for other commercial purposes, it is necessary to remove the CO₂ (because it is of no use for energy purposes and is taking up valuable space) and hydrogen sulphide (H₂S), which is highly poisonous and, even in quite small quantities, is damaging to heating equipment, gas turbines and engines.

There are a variety of technologies available. In summary, the CO₂ and H₂S can be removed by

- Scrubbing (absorption by water or other aqueous solution)
- Adsorption (using activated carbon or a molecular sieve)
- Membrane separation (the CO₂ and H₂S pass through a membrane whereas the methane cannot)
- Cryogenic (very low temperature) separation (if biogas is cooled, the CO₂ liquefies at -78°C whereas CH₄ liquefies at -160°C. The liquid CO₂ can then be removed. This method requires that H₂S is removed prior to the cooling process)

There are other technologies specifically for removing H₂S. These technologies convert the H₂S to substances that are either inert or that can be regenerated leaving behind pure sulphur.

http://www.iea-biogas.net/Dokumente/upgrading_report_final.pdf

Transport and Agricultural Plant

Whilst biogas may not be exploited as efficiently in internal combustion engines as it is in modern heating equipment, the requirement for transport and food is no less important to a community than the requirement for heat.

Tractors in Austria

Petrol engines have been adaptable to run on biogas (or pure methane) for nearly 100 years. Recently, however, technology advances mean that methane (derived from biogas) can replace a proportion (50%) of the diesel oil with little loss of power output or efficiency.

A tractor that can run with minimal engine alterations on fuel produced on the farm took a step closer to reality in April 2009 with Steyr's launch in Austria of a standard 200hp tractor powered by biogas.

The company, part of Case IH, showed a prototype that uses a 50:50 mixture of diesel and biogas. It claims that the tractor can cut fuel costs by 40%.

The 400 litres of biogas is stored at high pressure (207bar) in roof tanks and is enough for a 7-10hr working day. The tractor can work just as efficiently (and without adjustment) on a diesel plus natural gas mix or on diesel alone.

As well as cutting fuel costs, the converted tractor is reported to be very environmentally friendly with CO₂ emissions from the 6.6-litre engine reduced by 20% and nitrous oxide emissions by 17%.

In theory, every farm with a biogas plant (3500 in neighbouring Germany alone) now has the key to a large slice of tractor fuel self-sufficiency right on its doorstep.

The gas can be produced from renewable resources with 40% saving on diesel costs Minimal hp loss (6-7%) with no fundamental diesel engine alterations required

The disadvantages include £20,000 additional tractor cost; the biogas must be processed to natural gas standard, the tractor requires a heavy steel cab-top gas storage tank, there is a limited proving period behind the concept and a long (6-7 years) payback period. See <http://www.fwi.co.uk/Articles/2009/04/01/114960/Steyr-launches-first-biogas-powered-tractor.htm>

Developments in USA

Developments are ongoing aimed at enabling diesel engines, whilst retaining most of their efficiency benefits, to run on methane with very small injections of diesel.

Clean Air Power's flagship technology is its patented Dual-Fuel™ system, which enables heavy duty diesel engines to operate primarily on natural gas with injected diesel fuel acting as a "liquid spark plug". By burning up to 90% natural gas, customers benefit from a combination of low emissions and high efficiency. See http://autospeed.com.au/cms/title_Natural-Gas-Fuelled-Diesels/A_108946/article.html