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Anaerobic Digestion (biogas) – an NFU Vision

INTRODUCTION

Climate change is driving policy and regulations on reducing greenhouse gas emissions at international, national and regional level. Challenging targets have also been set for renewable energy, and a number of incentives have been put in place in the UK for renewable electricity and transport fuels (and anticipated for renewable heating from April 2011). In a dramatic shift of national energy policy, a 2008 government consultation outlined a new Renewable Energy Strategy. Due to be published in July 2009, this proposes a massive increase in the contribution of renewables from 2% today to 15% by 2020. See the NFU consultation response on the following web page:

<http://www.nfuonline.com/x31186.xml>

Anaerobic digestion (AD) is one of a number of renewable energy technologies becoming commercially available to agriculture. A key attribute of AD is that it offers multiple environmental and economic benefits, particularly for UK livestock farms. On-farm AD plants also appear to be the most promising mitigation option for reducing greenhouse gas emissions from manures and slurries, alongside the potential to deliver low carbon energy.

WHAT IS ANAEROBIC DIGESTION?

AD is the controlled breakdown of organic matter in a closed 'digester' vessel. The air supply is restricted to stimulate 'anaerobic' decomposition (as opposed to composting, which takes place in the presence of air). After some 20 to 60 days, depending on the configuration and internal temperature of the digester, a methane-rich 'biogas' is produced. This gas can be used for electricity and heat generation, and possibly upgraded for other applications. The remaining organic matter comprises an odour-free 'digestate' rich in N, P and K which can be spread on the land as a fertiliser.

Feedstock suitable for use in the AD process can include:

- animal manures and slurries
- energy crops such as silage from maize or perennial grasses and fodder beet
- food processing by-products and pack-house residues
- food waste from retailers
- biodegradable household waste

AD AND THE ENVIRONMENT

Apart from its potential contribution towards improved energy security, on-farm AD offers multiple environmental benefits, including:

- reduced emissions of methane from manures and agricultural residues, helping farmers and growers to achieve climate change mitigation commitments;

- air quality benefits through the control and reduction of odours such as ammonia
- water quality benefits from improved management of nitrogen and other nutrients present in manures and slurries
- replacement of increasingly costly manufactured fertilizers with digestate containing known amounts of N, P and K

In July 2008 the Government announced its plans to revise Nitrate Vulnerable Zone (NVZ) designations and the NVZ action programme. The requirement for individual farms to increase slurry storage capacity over the next few years could mean that farmers look to AD as an alternative option for manure management. Rather than each investing up to £50,000 in upgraded slurry tanks, a group of farmers might choose to collaborate and invest/borrow a total of around £1 million for an income-generating AD project.

POLICY ISSUES

A key priority for the NFU at present is to ensure that smaller, farm-based biogas proposals are not disadvantaged by being labelled as “waste management”. Many farm systems will use farm-derived inputs only, and under these circumstances the NFU is pressing to ensure that the AD process is exempted from Environmental Permitting, or subject only to simple Standard Permits. Together with other industry stakeholders we have been working with the Environment Agency and the Waste and Resources Action Programme (WRAP) on making a clear distinction between low-risk on-farm digesters and larger centralised waste-licensed ‘merchant’ plants.

On-farm digesters utilise only manures, slurries and farm-based feedstocks, and with income only from the sale of energy, they should be subject to ‘light touch’ regulation and ought to be welcomed by local planners (subject to the usual planning process and conditions). Based upon NFU’s knowledge of current and likely future developments, such facilities are most likely to be between 250 and 1100 kilowatts (kW) electrical generating capacity, producing the electricity needs of several hundred homes or a village.

Larger so-called ‘merchant’ plants accept multiple biodegradable wastes, and receive income from both energy sales and gate fees. Centralised AD plants may be located on a farm, on a rural industrial estate or close to food processing facilities. These are likely to be larger facilities, with electrical output (or equivalent) from about 500 kW to as much as 10 MW, will require higher-risk or bespoke environmental permitting, and may be expected to progress more slowly through the planning process.

OUR VISION – 1000 BIOGAS PLANTS ON FARMS

AD has been widely used in Germany, Sweden, Austria and Denmark and the technology is well proven and established. However, to date there has been little development of agricultural AD plants in the UK - there are currently only about 15 to 20 on-farm systems operational, with less than 0.1% of UK livestock manures treated by AD. There are also presently a handful of centralised systems, with more under development. The AD industry is now expected to grow rapidly, given the enhanced support for electricity generation since April 2009 (a double allowance of tradeable Renewables Obligation Certificates), the potential income from gate fees for wastes, and the availability of (limited) capital grant support from the Rural Development Programme for England and other funding sources.

Government analysis of the energy supply potential of AD in the Renewable Energy Strategy is 10-20 TWh (terawatt-hours) - equivalent to the output of about 1250 to 2500 megawatts (MW) of installed capacity. The NFU believes that at least one-third of this could be located on farms, and recommends that the government sets a national target of 1000 farm-based AD plants (typically 500 kW), and around 200 larger waste-linked AD facilities (typically 1.5 MW) by 2020. Between them, these could account for around 800 MW of electrical generating capacity, contributing about 6 terawatt-hours (TWh) of

electricity and potentially another 6 TWh of heat – together, the equivalent of roughly one million tonnes of oil per year, or 4.5% of the UK's renewable energy target.

Current AD industry opinion is that the entire feedstock needs of a 1 MWe plant can be met from 1000 acres (400 ha) of maize silage. With co-digestion of slurry, manures and silage crops, the extra land requirement for a 500 kWe plant may be 100-125 ha (4-5000 tonnes, based on silage yield of 35-40 t/ha). The land area required to fuel 1000 x 500 kW AD plants is therefore about 100-125,000 ha – quite moderate in comparison to former set-aside area and the potential land requirement for other forms of bioenergy. Existing pasture and grassland may also be managed for silage, although the yields will be lower than for maize.

Likewise, with co-digestion of silage crops, the typical annual throughput of manures and slurry may be estimated at about 36-45,000 tonnes or cubic metres per megawatt (MW) of digester generating capacity. The amount of manures and slurry processed by 1000 x 500 kWe AD plants would therefore be 18-22.5 million tonnes. This represents between one-fifth and one-quarter of total UK arisings of 90 million tonnes – again, a reasonable and attainable requirement.

Unlike agricultural feedstocks, the food waste resource for AD is more limited. Based upon a typical model of 1.5 MW utilising 50,000 tonnes/year, 200 waste-linked plants could account for 10 million tonnes of organic feedstocks by 2020, some 50% or more of total UK food waste arisings.

OUTLOOK – A RANGE OF OPTIONS

The NFU's vision for 1000 on-farm AD plants by 2020 is quite modest compared with the achievements of German farmers, who have installed 4000 on-farm AD plants in the last 10 years. Through consultation with the AD industry and our members already active in this area, the NFU can foresee four broad models for biogas development, varying according to size and complexity.

(a). Large single farm

In this simple model, a single substantial farm enterprise would supply its own farm-based inputs to the digester (manures, slurries, silage crops) and the resulting digestate would be spread only on the farm's own land.

(b). Multi-farm cooperative or subcontracted operation

Essentially similar in principle to Model (a), but with typically three or four farms within a locality supplying farm-based inputs to a digester optimally sited on one of the farms. The resulting digestate would be shared and spread among these farms, but only moved a few miles at most.

(c). Centralised or merchant AD facility

Likely to be larger than Models (a) or (b), a facility utilising some agricultural inputs but also receiving gate fees for processing organic wastes diverted from landfill, including food processing wastes and local authority wastes. In some cases this might be based on a farm, but utilisation of the digestate will be subject to stricter regulation than for Models (a) or (b).

(d). Large materials reclamation facility

Probably operated by a conventional waste processing company, a large-scale facility accepting a wide variety of organic wastes. Here, the AD process would be integrated into an overall waste management system, and subject to stringent environmental regulations.

A key concern is that Models (a) and (b) should be subject to the minimum regulatory burden. NFU HQ advisers have been working behind the scenes with Defra, WRAP and the Environment Agency to facilitate a regulatory framework on Environmental Permitting and use of digestate that promotes on-farm AD rather than discourages it.

There is an urgent need to raise awareness of AD across all agricultural sectors, the food chain, and with local government and regulators. It is disappointing, therefore, that the Government's £10 million demonstration programme announced in 2008/2009 targeted just 5 large projects rather than a geographical spread of more, smaller developments. Although four of these do concern the food chain and food waste, the NFU believes a demonstration programme should focus more on project development funding to bring forward a wider range of projects.

OTHER APPLICATIONS – THE POTENTIAL OF BIOMETHANE

There is also significant future potential for the upgrading of biogas to 'biomethane', for motor vehicle use, as a tradeable low-carbon fuel, or for direct injection into the natural gas distribution network. Small scale equipment for biogas upgrading and pressurisation is available from Germany, where pipeline injection is growing. A number of NFU members are already exploring the possibilities of such installations, linked to filling stations for dedicated or dual-fuel vehicles adapted for compressed biogas (CBG) or cryogenic liquefied biogas (LBG). Biogas upgrading is more likely to be an option for larger AD systems (equivalent to 1-3 MWe or 3-10 MW thermal).

RECENT DEVELOPMENTS

In February 2009, Defra launched its own Vision Statement "Anaerobic Digestion – Shared Goals" and an AD Task Group, on which agriculture is represented together with the food chain, water and waste management industries and the energy sector. The group reported back in July with some headline priorities among a list of 46 recommendations – the government is due to respond later in the year. Consultation on environmental permitting closed at the end of August on separate Standard Permits for AD based upon farm feedstocks, and AD using a wider range of inputs. This sends an important message from the Environment Agency to local communities and planners that on-farm AD is a very low-risk activity.

Revision of the Renewables Obligation in April 2009 introduced an enhanced rate of payment for electricity production from AD, and an alternative government-backed fixed feed-in tariff is expected in April 2010 for renewable electricity projects up to 5 MW capacity. A renewable heat incentive mechanism is anticipated from April 2011. Together, these incentives further enhance the economic viability of farm-based AD. Forthcoming policy developments in other countries (notably Germany) may soon increase the commercial availability of smaller AD plants (typically 150 kWe, with digester volume down to about 1000 cubic metres) although some economic drawbacks remain with smaller-scale AD, such as relatively high operating and maintenance costs.

FURTHER INFORMATION

See also the NFUonline web pages on the subject of biogas:

<http://www.nfuonline.com/x33881.xml>

as well as information from the Renewable Energy Association:

<http://www.r-e-a.net/biofuels/biogas/anaerobic-digestion>