NFU Briefing

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Anaerobic Digestion: can we attain NFU's aspiration for 1000 on-farm plants?

INTRODUCTION

Climate change is driving policy and regulations on reducing greenhouse gas emissions at international, national and regional level. Challenging European targets have also been set for renewable energy, and a number of policy measures implemented in the UK for renewable electricity, heat and transport fuels. In a dramatic shift of national energy policy, the 2008-2009 Renewable Energy Strategy proposed a massive increase in the contribution of renewables from 2% in 2009 to 15% by 2020. In 2010, the incoming Coalition Government promised to be the "greenest ever" and committed to a "huge increase" in energy from waste resources through anaerobic digestion.

Anaerobic digestion (AD) is one of a number of renewable energy technologies that have become commercially available to agriculture. A key attribute of AD is that it offers multiple environmental and economic benefits, particularly for UK dairy and livestock farms. Alongside their potential to deliver low-carbon energy, on-farm AD plants also appear to be the most promising mitigation measure for reducing greenhouse gas emissions from manures and slurries. However, the development of AD in Britain has been relatively slow compared to other renewable energy options, with about 125 plants operational at the end of 2013 and a pipeline of up to 300 by 2015 – so could we approach 1000 AD plants on farms by 2020?

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 20 to 60 days, depending on the configuration and internal temperature of the digester, a methane-rich 'biogas' is produced. This gas is commonly used for electricity and heat generation, and may also be upgraded for other applications.

The residual co-product is an odour-free 'digestate', which is rich in plant-available N, P and K and may be directly spread on the land as a fertiliser. Alternatively, digestate may be further separated or "dewatered" into a solid fraction (typically 25-35% dry matter, enriched in P) which can be used as a soil improver, and a liquid biofertiliser containing much of the ammonium and potassium that can be pumped or transported for landspreading.

Feedstock suitable for use in the AD process can include:

- animal manures and slurries
- energy crops such as maize or ryegrass silage 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
- more efficient 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 May 2013 the Government revised Nitrate Vulnerable Zone (NVZ) designations and the NVZ action programme. NVZs cover around 58% of England and the regulations require farmers to have sufficient storage for 6 months in the case of pig slurry and poultry manure, and 5 months storage for other livestock slurries. The requirement for individual farms to increase slurry storage capacity 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 has been to ensure that smaller, farm-based AD plants are encouraged, and not mistakenly labelled and shunned as “waste management”. Many agricultural digesters will use inputs from the farm or its near neighbours only, and under these circumstances the NFU has lobbied for on-farm AD plants to be exempted from Environmental Permitting, or subject only to simple low-cost Standard Permits. Together with other industry stakeholders, we have been working with Defra, 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.

With income only from the sale of energy (and some additional benefits from the replacement of purchased fertilisers), on-farm AD plants 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 experience, most such plants are sized between 250 and 1000 kilowatts (kW) electrical generating capacity, producing the electricity needs of several hundred homes or a village. However, a new size class of small-scale AD plants is starting to emerge, between 25 and 250 kW, which may be particularly well-suited to medium-sized dairy and livestock farms.

Larger so-called 'merchant' AD plants accept multiple biodegradeable wastes, and receive income from both energy sales and gate fees. Such 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 large facilities, with biosecure reception areas and electrical output (or equivalent) from about 500 kW to as much as 10 MW. They require higher-risk or bespoke environmental permitting, and may be expected to progress more slowly through the planning and project development 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, growth of AD in Britain so far has been modest – according to the official AD Portal web site, there are 125 recently-constructed plants operating outside the wastewater treatment sector. About one-third of these are on-farm systems, and presently only around 1% of UK livestock manures are treated by AD. The AD Portal team estimates there is a substantial ‘pipeline’ of

AD projects under development in agriculture, industry and the waste management sectors, with 300 plants expected to be in operation by 2015.

Government analysis of the energy supply potential of AD in the 2009 Renewable Energy Strategy was 10-20 TWh (terawatt-hours) - equivalent to the output of about 1250 to 2500 megawatts (MW) of installed capacity. The NFU previously called for at least one-third of these to be located on farms, and recommended that the government set a national aspiration 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. In 2011, the present government's AD Strategy set a more modest ambition of 3-5 TWh of electricity by 2020.

Current AD industry opinion is that the entire feedstock needs of a 1 MWe plant could be met from 1000 acres (400 ha) of maize silage. With co-digestion of slurry, manures and silage, 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 may be lower than for maize. Government policy tends to favour the use of crop feedstocks to supplement manures, discards, outgrades and residues, rather than as the principal input to AD plants. However, banks and investors often require an initially assured supply of 'starter' crop feedstocks, which may be gradually replaced with discards and residues later in the project lifetime.

The typical annual throughput of manures and slurry (co-digested with silage) may be estimated similarly 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 – a reasonable and attainable goal.

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 farmers in Germany, where nearly 8000 AD plants have been installed over the past 15 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 NFU concern is that Models (a) and (b) should be subject to the minimum regulatory burden. Model (b), which may enable smaller livestock farms to consolidate resources and operating a single digester collaboratively, still requires enabling regulatory changes to permit feedstock and digestate transfer between nearby farms. There remains an urgent need to further raise awareness of the potential of AD across all agricultural sectors, the food chain, and with local government and regulators.

THE POTENTIAL OF BIOMETHANE

Although the vast majority of AD plants burn the biogas on site in a combined heat and power unit, there is a growing trend towards upgrading 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 about 100 biomethane projects have been implemented – so far, the UK has about 5 (some on farms). Installations may be linked to filling stations for dedicated or dual-fuel vehicles (agricultural or road vehicles) adapted for compressed biogas (CBM) or cryogenic liquefied biogas (LBM). By 2015, Britain could have as many as 40 pipeline or vehicle installations, and the industry ambition is for as many as 150 projects by 2020, equivalent to 3% of domestic natural gas demand. Gas upgrading is more likely to be an option for larger AD systems (equivalent to 1-3 MWe or 3-10 MW thermal).

POLICY HISTORY AND RECENT DEVELOPMENTS

In February 2009, Defra launched its own Vision Statement “Anaerobic Digestion – Shared Goals” and an AD Task Group, on which agriculture was represented together with the food chain, water and waste management industries and the energy sector. This group reported back in July 2009 with some headline priorities among a list of 46 recommendations – and the previous government then released its AD Implementation Plan in March 2010.

Following the present Coalition Government commitment to a “huge increase” in energy from waste resources through anaerobic digestion, the NFU and other stakeholders worked closely with Defra officials on the development of a new joint industry/government AD Strategy and Action Plan published in June 2011. A Steering Group oversees the implementation of the 56 actions identified in the plan, and is committed to meeting regularly until 2014.

Two kinds of Standard Permits for environmental permitting of AD plants were introduced in April 2010; one for farm-based feedstocks, and one for AD using a wider range of waste inputs. Small-scale on-farm AD plants (maximum capacity of 1,250 cubic meters of manures and crop feedstock) are exempt from environmental permitting altogether. The Environment Agency has also confirmed recently that it regulates ensiling of AD crop feedstocks in the same way as other agricultural activities, in order to reduce the risk of causing water pollution: amendments to the SSAFO Regulations in 2013 require prior notification of construction work on any new or improved store, whether inside or outside an NVZ.

Revision of the Renewables Obligation in April 2009 introduced an enhanced rate of payment for electricity production from AD (2 ROCs per MWh), and an alternative government-backed range of fixed feed-in tariffs commenced in April 2010 for renewable electricity projects up to 5 MW capacity. The introduction of the Renewable Heat Incentive scheme in November 2011 offered support for biomethane upgrading and biogas heat up to 200kW, and new heat tariffs for medium and large scale heating are expected from April 2014. Business plan development grants of up to £10,000 were launched in October 2013 for small-scale on-farm AD.

Together, this range of incentives greatly enhances the economic viability of farm-based AD, although serious concerns remain that Feed-In Tariffs policy may trigger a 20% reduction in support for the smallest scale of plants in April 2014. The government has promised a review of FITs for small-scale AD in January 2014.

Policy developments in other countries (notably Germany) are increasing the commercial availability of smaller AD plants (typically 75 kWe and 150 kWe, with digester volume of less than 1000 cubic metres) although some economic drawbacks remain at smaller scales, such as relatively high operating and maintenance costs.

New technological developments in AD plant configurations include 2-stage digesters that can process up to 80% straw-based manure feedstock, as well as dual-purpose variable-volume digesters that also function as slurry stores.

Despite a slow start in Britain, it looks like the AD industry is robust, innovative and set for further rapid growth, putting it well on track for the widely shared ambition of 1000 plants by 2020.

FURTHER INFORMATION

Government Information Portal on AD: http://www.biogas-info.co.uk

NFU pages on renewable energy: http://www.nfuonline.com/science-environment/renewables/

NFU Farm Energy Service – members should call 0870 844 5700 and consult Business Guide No. 842:

http://www.nfuonline.com/membership/farmer-grower/member-services/farm-energy-service/

Through its reciprocal exchange of membership with the Renewable Energy Association (REA), which has a specialist biogas sector group, the NFU participates in joint communications, lobbying and publicity activities. We also work closely with the Anaerobic Digestion and Biogas Association (ADBA).

REA biogas sector group: http://www.biogas.org.uk/

Anaerobic Digestion and Biogas Association: http://www.adbiogas.co.uk