Anaerobic Digestion (Biogas)

Practical Guide

Biogas is produced when bacteria break down organic matter in an atmosphere with little or no oxygen. This will occur anywhere that there is decomposition, including in the soil. It also occurs in slurry stores and, under controlled conditions, in an anaerobic digester.

Biogas comprises about 60% methane and 35% carbon dioxide, as well as some other gases including the noxious hydrogen sulphide. Methane and carbon dioxide are both greenhouse gases that are damaging to the environment. However, methane is a much more potent greenhouse gas than carbon dioxide, its impact on climate change being over 20 times greater over a 100 year period. The anaerobic digestion process captures these gases, which normally would be lost to the atmosphere as slurries and plants decompose.

Once captured, the biogas can be burned in a boiler to produce heat, or in a combined heat and power generator to produce both heat and electricity. The biogas can also be cleaned to use as a road fuel for converted vehicles or could be used for mains gas.

This Practical Guide focuses on anaerobic digestion and how it can help to reduce greenhouse gas emissions.

Biogas Facts:

A single dairy cow can produce around 50 kg of slurry per day

- Each cow's slurry will yield about 1 m^3 of biogas per day, around 6 kg CO_2 equivalent.
- 500 dairy cows could yield enough biogas to give savings of up to 1000 tonnes CO_2 equivalent each year
- After digestion, the resulting digestate has:
  - ⇒ Same fertiliser value
  - ⇒ More plant-available nutrient
  - ⇒ Lower dry matter
  - ⇒ Less odour
  - ⇒ Fewer viable weed seeds
  - ⇒ Considerably fewer pathogens

Biogas Top Tips

- Consider all feedstocks potentially available from on-farm enterprises.
- Evaluate the cost effectiveness and sustainability requirements of feedstock options, especially growing crops for AD.
- Identify any off-farm waste streams including food-processing and catering wastes.
- Aim to use all heat and power onsite to maximise viability through offsetting purchased energy.
- Keep up to date with changes in regulations and payment schemes.

Farming for a Better Climate

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4. Making the best use of nutrients
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www.microgenerationcertification.org

www.soilassociationscotland.org

www.biogas-info.co.uk

www.wrap.org.uk

www.agrecalc.com

The European Agricultural Fund for Rural Development: Europe investing in rural areas
Scottish Government | Riaghaltas na h-Alba | gov.scot
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Why consider AD?

Stored slurry will emit both methane and ammonia gases, which can accelerate climate change.

By using AD, the methane is captured and can be used on-farm to produce electricity and heat.

The resulting digestate is nutrient-rich and less smelly than slurry, reducing odour problems.

Anaerobic Digestion for farm slurries can:

Reduce your fertiliser bills
+
Generate electricity and heat to offset your use or to create an income
+
Reduce Greenhouse Gas emissions

Biogas Yield (m^3/tonne)

15-25	Pig slurry
15-25	Dairy slurry
30-100	Poultry manure
190	Whole-crop wheat
160-200	Grass silage
200-220	Maize silage
560	Maize grain
610	Wheat grain
620	Rape meal
580-1000	Crude glycerine
Up to 1000	Fats

Maximising Viability

Biogas plants are widespread across Europe and can use a variety of feedstocks.

Manure or slurry from livestock is usually used and this reduces gaseous releases compared to conventional storage and field application. However, as the material has already been digested by the livestock the biogas potential is relatively low. To boost gas production, energy crops such as maize or silage have often been added to the mix.

Other organic wastes including food processing or catering waste can also be added. This not only boosts the gas output but could also generate a gate fee, which will provide additional income. However, this will increase the administrative and financial complexity of the site and can add to the capital cost of the plant.

Any feedstocks used must comply with government sustainability regulations to gain any incentive payments. Requirements vary depending on whether the feedstocks are classed as wastes, residues or products. Slurry or manures are classed as wastes and are therefore deemed sustainable.

The Feed-in Tariff (FIT) scheme closed to new applicants on 1st April 2019. However, other potential income streams are available and maximising use of the generated electricity and heat on farm to offset energy bills can all aid the financial viability of sites.

Crops grown specifically for AD are no longer as viable a feedstock option as they once were. Criteria and feedstock restrictions apply to all new AD installations from May 2017, limiting payments on biogas and biomethane not derived from waste and residue feedstocks to 50% of the total biogas yield on an annual basis.

Around a third of the heat produced from the biogas is used to maintain the digester temperature and a small amount of the electricity will be required to run the plant. However, the remaining heat and power are available for:

- Electricity for export
- Electricity for use on farm
- Generating heat for the farm or a district heating scheme

Finding a use for the heat generated is often important for the project to be financially viable. Instead of a boiler or CHP, the biogas could be used for:

- Road vehicle fuel (after scrubbing)
- Mains gas injection (after upgrading; capital intensive, viable only on large scale plants).

Renewable Transport Fuel Obligation (RTFO) payments may be available if supplying fuel for the transport sector.

Points to Consider

Stability - the digester needs careful management to keep the bacterial population stable. The plant can be time-consuming and costly to get back on track after a crash.

Automation - plants that are fully automated are easier to manage. Automation needs a high gas output and low feedstock costs for best payback.

Waste Streams - high-yielding feed streams improve viability. Note that over-reliance on a non-guaranteed alternative feed stream could be commercially risky.

Maintenance - biogas can be corrosive to pumps and valves. Feedstock contaminants can build up in the digester. Regular maintenance is essential for efficient operation.

Access to Finance - capital requirements will depend on the scale and feedstocks. Farm scale plants can be in the order of £300k to £1.5M and beyond.

Scale - large-scale plants are likely to be more viable than small-scale ones. Collaborative ventures are an option and using more than one source of feedstock also spreads the risk.