Enablers For On-Farm Anaerobic Digestion, Methane Capture and Use

Summary Report

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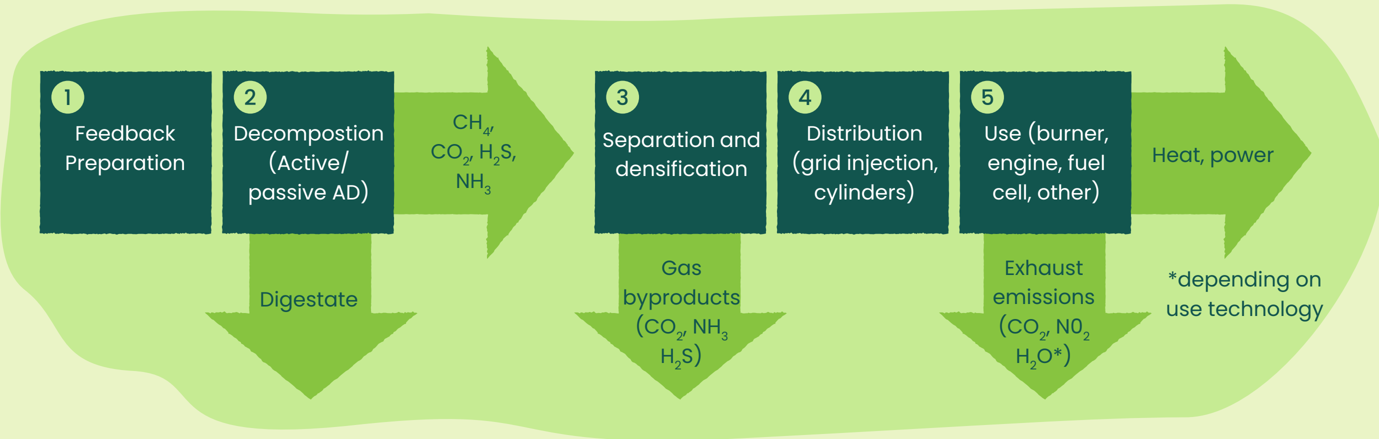
Summary

On-farm methane capture and anaerobic digestion (AD) are vital technologies to treat waste and produce renewable energy for use on site and in the local area. This is particularly important where the feedstock(s) have high water content (e.g. slurry) as transport energy needs are high and rural road infrastructure may not be suitable for large-scale feedstock movements. Additionally, rural gas grid connections are likely to be sparse leading to large gas transport distances to grid injection locations. In this context, on farm methane capture and AD can provide additional income to farmers and reduce methane emissions. Two types of technology are in development and use: small-scale anaerobic digesters and systems to capture emissions from slurry lagoons (referred to as passive AD). The Net Zero Methane Hub promotes the uptake of technology to capture and use methane in Cornwall, funded by Cornwall Council Shared Prosperity Fund, to support local environmental commitments and the rural economy. The Hub has investigated enablers for the uptake of active and passive AD, based on workshops and interviews with key stakeholders, considering technology development, policy and skills. Outputs are summarised in this report and covered in more detail in a full report (https://www.methanehub.co.uk/).

Technology enablers

The biomethane supply chain extends from feedstock preparation to provision of heat, power and transport fuel. Below we summarise the development needs identified for each element.



1. Feedstock preparation

Understanding the energy and emissions benefits of pre-processing feedstocks can help to optimise production methods (e.g. energy/carbon required for a specific pretreatment vs the additional biogas energy that is produced). Bioresource mapping is also needed to match demand for feedstocks with gas production locations.

2. Decompostion

For active anaerobic digestion, development to improve digestion efficiency is needed, alongside work to increase the range of useable feedstocks. In passive digestion systems, development is needed to increase the flexibility of covering systems to deal with different source configurations. For both types of system, reducing fugitive emissions from the process is vital to maximise environmental and economic benefits. Measures to support digestate valorisation, including reducing water content, nutrient removal at small scale and optimising nutrient use can reduce artificial fertiliser consumption and improve the business case.

3. Gas Processing

To maximise GHG reductions, development of CO_2 separation equipment at a suitable scale, efficiency and cost for smaller on-farm use is needed alongside development of the value chain and business case for CO_2 use at this scale, including appropriate purity requirements for different uses. Cost-effective small-scale technology to liquefy and store methane is required to increase methane energy density and thus better promote the use of liquid methane.

4. Distribution

High gas pressures increase the mass of storage tanks, increasing transport energy use and cost. Additionally, the cost of small-scale refuelling technology can be a barrier where methane is used to fuel vehicles and machines.

5. Use

Power and heat can be generated using biogas/biomethane powered engines, and development of systems with a suitable power output (<100kWe), electricity output (single or three phase), life and price is needed. Solid Oxide Fuel Cells (SOFC) can generate power at a higher efficiency than methane engines, and demonstration of SOFC at suitable power output on farm is required to confirm durability and performance. Biomethane can also be used for refrigeration.

6. System level enablers

Development of data systems can accelerate uptake: commercial data is needed to support a credible business case, including gas production volumes and wider implications (fertiliser, water, operations); AI and Internet of Things technology can support efficient operation of a distributed system, coordinating production and use. Energy systems integration on farm can improve overall efficiency, and life cycle analysis can support assessment and optimisation of overall environmental benefits.

Policy enablers

Uptake of AD is strongly linked to the degree of policy support. The following were identified as key UK policy enablers for on farm AD activities:

- Grants or favourable loans for plant installation (e.g. increased subsidy for lagoon covers or inclusion of gas processing equipment and AD in the slurry infrastructure grant).
- Subsidies for gas produced, e.g. for gas the Green Gas Support Scheme (GGSS), for heat, the Renewable Heat Incentive (RHI) and electricity, the Feed in Tariff (FiT). GGSS subsidies currently only support gas injected into the grid and the RHI and FIT have been discontinued.
- Tax breaks for supply chain investment in biomethane production.
- Floor prices for green energy produced: for example, currently the Renewable Transport Fuel Certificate prices are low, reducing investor confidence.
- Taxation on livestock emissions and/or support for avoiding fugitive emissions.
- Measures which recognise the wider benefits of AD: emissions reduction, waste processing, CO_2 supply, digestate handling.
- A robust carbon market, noting the need to clarify ownership of carbon credits within the supply chain (farmer, processor, retailer).
- The costs and complexity of planning and permitting remain significant hurdles, including environmental permitting, planning and digestate standards.

Skills

A wide range of skills are required for successful development and roll out of on farm AD, including electrical engineering, gas handling, cryogenic engineering, bioenergy engineering, civil engineering, system engineering, instrumentation and data systems, fabrication, health and safety, permitting, quality assurance. The ability to work in a multi-disciplinary environment, combined with practical skills and familiarity with an agricultural environment are vital.

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