



Anaerobic Digestion Basics

Turning organic matter into biogas for heat and power

Key Points

- Anaerobic digestion (AD) turns organic waste into three useful resources:
 - Methane rich biogas
 - Valuable liquid fertiliser
 - Concentrated fibre soil conditioner
- AD neutralises wastes, reducing odours by up to 80%
- Food processing waste and domestic kitchen/green wastes can be diverted from landfill into digesters.
- AD reduces emissions of methane (CH₄), which is a powerful greenhouse gas

Why is it important?

Anaerobic Digestion (AD) uses locally available organic waste products to produce a biogas, which can in turn provide heat and power. When upgraded, it can be used as a green vehicle fuel or even injected into the gas grid.

The biogas represents a renewable energy source, and its usage offsets CO₂ emissions and allows local communities become more self-sufficient in energy.

AD greatly reduces the emissions of methane, a greenhouse gas with a global warming potential twenty times greater than CO₂, from slurry and other organic wastes. It can also divert food and green waste away from limited landfill resources.

How does it work?

- An anaerobic digester is a large vessel, where substrates are mixed and warmed in the absence of air, creating the ideal environment for breaking down organic matter into an odour free, methane rich *biogas*.
- A separate pasteurisation tank, operating above 70°C, is often used to kill pathogens—this can be before or after the digester stage—but is not always necessary.
- This biogas can be collected, contained and burned to create electricity and/or heat; or in some cases upgraded, cleaned and compressed for gas grid injection or to produce a vehicle fuel—*biomethane*.
- The other by-product of the process is fertiliser; this can be separated out into a fibre *digestate* and liquor; this can be re-applied to the farm land, recycling nutrients.
- Higher gas yields are obtained from co-digesting a mix of fatty and liquid wastes.
- Typical wastes include animal slurries, food processing waste, kitchen waste and bulk grass cuttings.



The Holsworthy biogas plant in north Devon

How much energy can it generate?

Energy generation depends on the size of the digester, which in turn depends on the available resource. Differing sizes of system are available, from single on-farm digesters to much bigger Centralised Anaerobic Digesters (CAD), which collect waste from multiple sites in the surrounding area.

The Holsworthy digester in Devon (pictured above) is an example of a large CAD system, collecting material from a diverse range of sources (formerly farm slurries, but now commercial food wastes) to produce 11 GWh of electricity annually (enough for over 2,800 homes) and heat for a health centre, hospital, swimming pool, school and offices.

A single small on-farm AD unit using on farm waste, rated at 30 kWe (electrical capacity) would produce around



Digester tanks at a large AD facility in Austria

160,000 kWh (enough for around 40 homes) of electrical energy and provide heat that can be used locally on the farm for space and process heating.

AD is already a very common technology on other parts of Europe, with Germany having installed thousands of plants since the 1990s.

What does it look like?

The components of an AD system can be seen below; when sited sensitively the visual impact on the countryside can be minimal. Farms, waste processing plants and industrial locations are generally the best sites, where AD systems can blend in with assorted plant and structures already on these sites.

Digester tanks can sometimes be partially buried, both to reduce their visual impact and to help insulate the vessel.



A pilot / research AD plant built by Greenfinch

Where can it be sited?

The key factors for a viable anaerobic digestion facility are the requirements for:

- **Supply of feedstock** - both the quantity, quality and security of feedstock are essential.
- **Sustainable outlets** for demand for fertiliser (fibre and liquor) - either through sales or on-farm use.
- **Outlets for energy** - a secure demand for biogas or the electricity and heat that is generated.
- **Transport** - impacts, cost and logistics for transport of feedstock (inbound) and fertiliser (outbound).

For a CAD system, siting must be considered carefully with the source of feedstock and transport impact in mind. Any visual impact should be considered, and proximity to sensitive neighbours (e.g. schools and housing) avoided. However, a well-designed system should have minimal impact.

Environmental effects

There are several environmental benefits from using AD systems, some of the key ones are:

- **Climate change** - energy produced from AD plants contributes to cutting CO₂ emissions by offsetting electricity and heat from non-renewable energy sources.
- **Other emissions** - AD plants also prevent the direct release to atmosphere of large quantities of methane.

- **Reducing demand for peat** - the fibre by-product of AD systems can be used as a peat substitute.
- **Production of a nutrient rich fertilizer** - this fertilizer can replace expensive and harmful chemicals.
- **Destruction of pathogens and parasites** - the pasteurization and digestion processes destroy 98% of pathogens and parasites, so fertilizers can be spread safely on the land.

Funding and economics

The cost of an AD system varies hugely depending on the size and type of system, and the type of energy production.

A small digester of 40 kWe capacity, using slurry residues from 250 head of cattle, is likely to cost around £120,000. A larger CAD plant of 1 MWe capacity is likely to cost £3.0-£4.0 million to install.

Running costs (staff, insurance, transport, license fees, operation and maintenance) will be between £20,000 and £30,000 per year for the smaller project and up to £120,000 per year for the larger CAD projects.

Projects can be more cost-effective if considered as part waste management plans (for farms, food processors or Local Authorities). There are multiple potential revenue streams for AD, including waste disposal charge 'gate fees', sales of electricity and heat, and sales of digestate fertilizer that meets the **PAS110** quality standard—for more on this, see www.wrap.org.uk

Anaerobic digestion is supported by both feed-in tariffs (FITs) and the forthcoming renewable heat incentive (RHI). Electricity generation is supported at 9.0-11.5p/kWh, guaranteed for 20 years. The heat proposal is for payments of 5.5 p/kWh for units up to 200 kW in size. Larger units may also be covered later. Finally, there is also a proposal to support direct grid injection of biomethane (upgraded biogas), so AD plants are not restricted only to generating on-site heat and power.

Further Information

Biogas Regions IEE project

www.biogasregions.org

REA Biogas Group

Sub-group of the Renewable Energy Assoc.
www.r-e-a.net/REA/sector-groups/biogas-group

Anaerobic Digestion and Biogas Assoc.

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