

# Anaerobic Digestion



MANNVIT

# What is Anaerobic Digestion?

Anaerobic digestion (AD) is the conversion of organic material such as slurry, energy crops and food waste by micro-organisms in a sealed airtight container. Organic waste is retained in a digester tank for 20 and 40 days, and the digester is fed continuously.

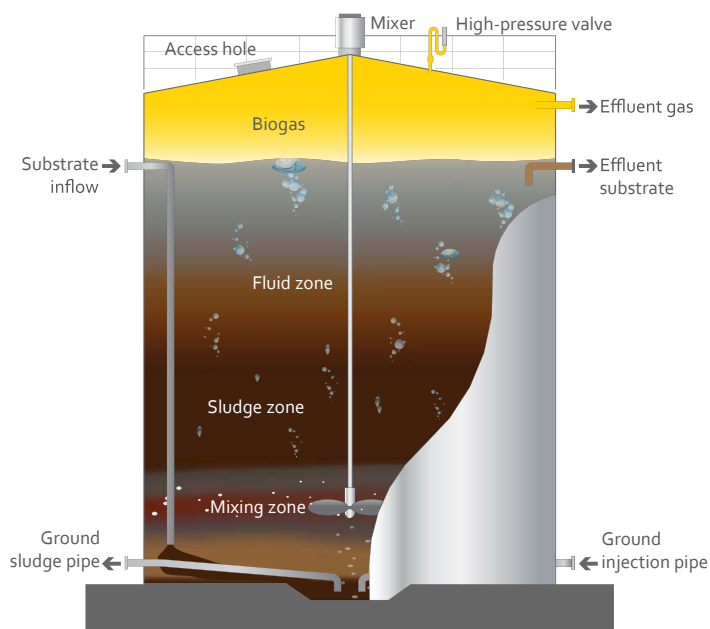
Digesters produce biogas which is 60% methane and digestate which has low odour and is valuable plant nutrients. The biogas is cleaned and used as a fuel in a combined heat and power plant to produce renewable electricity which can be used locally or exported to the grid.

AD can be adopted by farmers and food processors to generate revenue and reduce waste disposal costs. Revenue from AD can be achieved through:

- Selling electricity to the National Grid
- Offsetting electricity and heating bills
- The Government Feed in Tariff (FIT) incentive
- Gate Fees for waste intake and landfill tax savings

## How does the AD process work?

- Waste is collected in a reception pit and pumped into a buffer tanks.
- Water is added to achieve between 12 and 15% dry solids.
- The waste is macerated to reduced particle size to 12mm
- Waste is transferred to the digester with is mixed using paddle stirrers from the top where it is heated and retained for 20 – 40 days.
- The biogas is extracted and treated to remove Hydrogen sulphide moisture and then is used by a combined heat and power gas engine to produce electricity.



## Biogas yield

Maximising biogas yield depends on getting the moisture content, pH, carbon: nitrogen ratio, blend and retention time in digester right. Typical on-farm feed-stocks are slurry, vegetable waste, grain and meal, silage and dairy waste. Gas yield will depend on the calorific value of feedstock.

## Selection of AD technology

There are several AD system configurations, which need to be taken into account when selecting suitable technologies for your project:

### Wet verses dry processes

- A wet AD process treats waste with solids content < 15% dry solids (ds), for use with for example manures and sludge. A dry AD process treats waste with solids from 15 – 40% ds for use with for example energy crops.

### Mesophilic verses Thermophilic Digestion

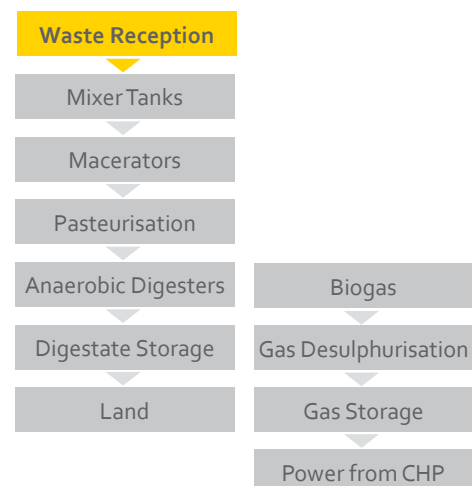
- Increasing temperature in a digester increases the biochemical reactions. Mesophilic digesters operate at temperatures of about 35°C with feedstock retention between 15 – 30 days, while thermophilic digesters operate at temperature of about 55°C with feedstock retention between 12-14 days.

### Single verses Multi stage Digestion

- Multi-stage reactors are generally split into 2 stages, the hydrolysis, as the first and the methanogenesis as the second, so that better control of digestion kinetics can be maintained and thus increase the biogas yield.

### Batch verses Continuous

- Biogas production can also be maximised if continuous processes are adopted in AD rather than simple and less expensive “batch” processes.





## Environmental Considerations:

The following need to be considered:

- **Wastewater:** is generally re-circulated back to the digestion process.
- **Emissions to Air:** some AD plants could suffer from a degree of odour that could require proactive abatement.
- **Digestate:** in order for digestate to be used as a fertiliser the process would have to comply with UK Animal By-Products Regulations (ABPR). This can be achieved through a pasteurisation step.

## Planning:

Planning consent may be required but not in all cases. If the facility is going to use feedstock from the farm and the digestate will be spread only on the land of that farm, then it could be treated as permitted development. If AD plants require environmental permits then planning will be required.

## Environmental Permitting

Environmental Permits for AD plants are generally classed as standard. An exemption can be granted for simple situations e.g. digesting slurry and energy crops

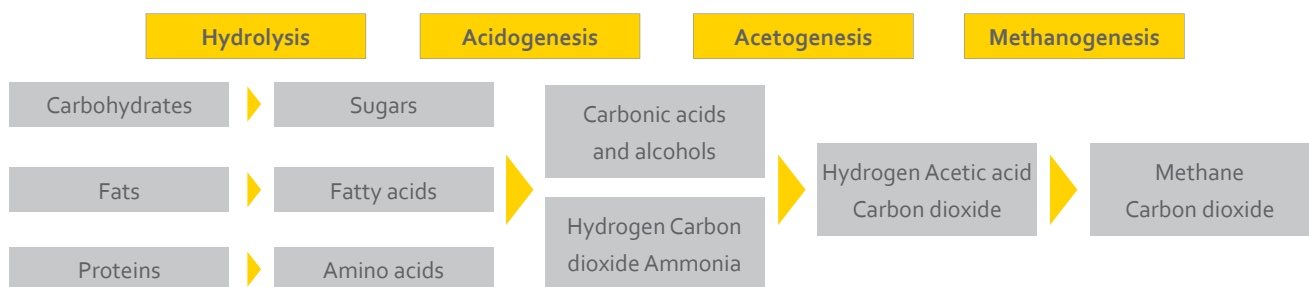


Figure 1: Stages of Anaerobic Digestion

## Feed in Tariff (FIT) (table 1)

Payments to anyone who owns a renewable electricity system, for every kilowatt hour they generate. The tariff applies for 20 years and is index linked.

The "generation" tariff is paid on the total output of the renewable generation system whether you feed it into the grid or use it yourself.

The "export" tariff is a bonus payment for every kilowatt-hour (kWh) your system exports to the electricity grid.

AD Size	Generation Tariff p/kWh	Export Tariff p/kWh
<500kWe capacity	11.5	3.0
>500kWe capacity	9.0	3.0

Table 1: FIT: AD Generation / Export Tariff over 20 year

## Landfill Tax Escalator (table 2)

Implemented by the UK in response to the EU Landfill Directive. The landfill tax element of gate fees will rise by £8 per year until 2013 in a drive to reduce waste volume.

Year	Landfill Tax (£/tonne)
2010/11	£48.00
2011/12	£56.00
2012/13	£64.00
2013/14	£72.00

Table 2: Landfill Tax Escalator

## Programme

AD usually takes circa 12 months or more to construct and commission once a feasibility study is complete or planning permission has been granted.

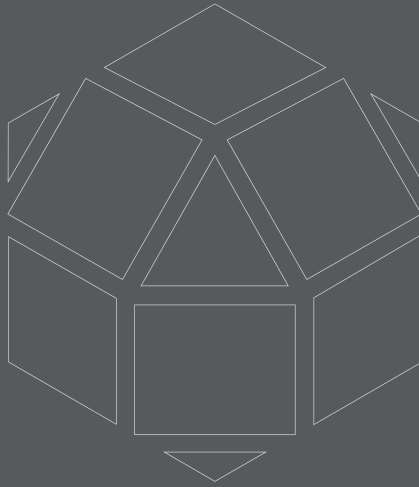
## Grid connections

- It is likely that electricity will be exported to the 11kV distribution system which is extensive in rural areas and can support between 1–3 MW.



**Additional information:**

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# Mannvit Engineering

Mannvit UK are an independent renewable energy consultant, dedicated to the development of renewable energy, energy efficiency and other efforts to reduce the effect of climate change. We design and manage the development of renewable energy solutions for our clients to capitalise on financial incentives, reduce carbon emissions and fuel costs. We are proud of our heritage and draw on 40 years of renewable energy experience from our operation in Iceland where 72% of electricity and almost 100% of heat is generated from renewable sources. Since the 1970's Mannvit has been actively designing and project managing Hydroelectric Power plants, Geothermal Power Plants and Bio Energy projects. We offer a broad range of services in renewable and alternative energy consulting from our UK offices and offer a multi-disciplinary approach to ensure the success of every project we run for our clients.

#### The Mannvit **website**

Mannvit's corporate web site, [www.mannvit.com](http://www.mannvit.com) contains further information and project examples for hydroelectric and geothermal power plants as well as contact information.



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