



Setting up an anaerobic digestion project

Anaerobic digestion is probably the only waste-to-energy technology that a community could look at getting involved in. And if you're interested in this, it's probably because you're an agricultural community with a large number of dairy farms or pig farms in the area.

Anaerobic digestion, as a form of waste disposal only, is not new and can work at a very small scale. The digester is basically a large tank that breaks down organic materials in an oxygen-free environment producing methane gas and a liquid, called the digestate, that can be used as a fertiliser. If you want to generate significant amounts of energy as well, then you'll need to add to the mix organic materials that have not already been digested, such as grass silage or cereal-crop by-products like straw.

The economics of setting up anaerobic digesters for energy production have, to date, not been very favourable in the UK, and as a result there are very few anaerobic digesters operating at scale at present.

The government's introduction of the feed-in tariff has helped this slightly, so larger dairy farms may now find this a somewhat attractive investment, down as low as 350kW capacity systems, but the best economics are still to be found at a scale that requires more slurry and silage than even the largest farms can produce. As a result, it's probably better to consider anaerobic digestion as a cooperative endeavour to get the best returns.

Really attractive economics can be achieved with plants of about 1 MW capacity and above.

How much slurry and other organic material do we need to produce?

To keep a one megawatt anaerobic digester plant going, you'd need about thirty thousand tonnes of organic material each year. Some of this has got to be slurry, because it's the bacteria in the slurry that makes the process work, but much of the energy has already been extracted from slurry by the cows who ate it, so you'll need to add other materials too to get the best energy

outputs. Grass silage and cereal wastes are great for this, as are fats and oils, but, as in our own diets, not too much fat please!

You could work on about a third each of slurry; grass and cereal silage; and other material such as waste from chicken farms or cheese-processors. While you could actually get away with less slurry, these sorts of quantities would optimise the environmental and economic benefits to your farming community. You would be helping to reduce the amount of methane, a powerful greenhouse gas, emitted from slurry. At the same time you will be creating a valuable soil improver, and helping to deal with the excessive costs of slurry storage.

Given that the average cow produces just over 17 tonnes of slurry per year, you need a group of farmers which have between them around 530 head of cattle to run a 1MW plant, as well as enough land to produce the silage.

How much energy would we produce?

Such a plant would operate almost all the time, providing a regular supply of enough electricity for about 1,500 homes, which you would feed into the grid. Importantly, it would also generate heat which could be used on site or distributed via a district heating network. Thinking through how to use this waste heat will be an important part of your plan, and could help you secure finance, as there may be businesses with large heat demands that would be willing to invest in your plant in return for significantly reduced heat costs – horticultural nurseries or bakeries for example.

Planning permissions and consents

You obviously need planning permission for the plant itself. For this, you will need to provide the local authority with details not only of the plant's structure and design, but also on how you intend to mitigate potential 'nuisance issues' such as smell and increased transport. The planning department will probably require an environmental statement to assess impacts on local eco-systems, and it's very likely that you'll also need to discuss your plans in some detail with the highways department. Anaerobic digesters are not common in the UK and so

few planning authorities have experience of dealing with them. Be prepared as well for some misunderstanding, among the local community, particularly confusion between *digestion* and *incineration*.

You'll also need various permits from the Environment Agency to operate the plant itself, and to cover the use of the biogas and the digestate (see below). Environment Agency permitting can seem completely impenetrable, but it's really a question of ensuring that they have properly logged all waste streams and that watercourses and sensitive environments are not being put at risk. Don't be put off by the apparent complexity, it's actually quite a standardised procedure, but do make sure you enter into discussions with them early on as acquiring these permits can be quite time consuming.

Costs and income generation

The capital costs of an anaerobic digester development will vary. One factor in cost is ground type and ease of excavation. This is because, where possible, the tanks are built partially or completely below ground in order to minimise visual impact and stabilise temperatures. Where the water table is very high, the tanks may have to be above-ground and well insulated, which can be more costly. A 1MW plant would probably cost in the region of £3-4m to develop and install.

There are currently no UK manufacturers of anaerobic digester plants, but the technology is well-proven on the continent, particularly in Germany, and it is possible to get consultancy support from abroad.

While you need to take into account the capital costs of the equipment and costs of getting planning permission, you need to offset against that the various other expenses that you will no longer have to pay as a result of using anaerobic digestion for energy production. You should calculate such costs as accurately as possible because these 'avoided costs' form a significant part of the overall economics of the system.

Firstly, the digestate can be used as a fertiliser, which reduces the cost of buying synthetic fertiliser.

Secondly, producing electricity through anaerobic digestion will create waste heat – you can utilise this to heat barns and other farm buildings, or even supply heat to neighbouring properties.

And finally, the costs of disposing of, or storing slurry, can

be very high. If your farm is in a Nitrate Vulnerable Zone then you are not allowed to spread slurry on the land all winter. Providing 26 weeks of slurry storage on such farms can be very expensive.

All of these costs could be significantly reduced through the use of anaerobic digestion for energy production. In addition to these avoided costs, your cooperative will receive income – payments from selling electricity to the grid, additional payments from the Renewable Obligation Certificates or feed-in tariff, and potentially some income from selling metered heat to neighbouring properties.

After the capital installation costs, the main cost to the farmers involved will be the transport of slurry to the digester, and the collection of their proportion of the digestate. For this reason, transport distances should be minimised – five miles or less if possible.

Annual operating income for a 1MW plant, assuming that the majority of the heat is usefully employed, could be between £800,000 and £1m.

How long will this take?

There are so few plants like this in operation in the UK that it is difficult to generalise, but the whole process – from exploratory discussions and meetings through to gaining planning permission, and on to completing the installation – is likely to take in excess of two years.

What can we do with the digestate?

The process produces about 10% biogas and about 90% digestate – so if you put 10,000 tonnes of slurry in you will get 9,000 tonnes of digestate back. What you have though, is a much more useful product. Digestate is much less smelly than slurry and is less solid, meaning it is more quickly absorbed by the land, reducing the time that you can't graze cattle on those fields. In addition, because of the temperatures reached in the tank, weeds and diseases such as bovine TB are killed off so it can considerably improve farm hygiene.

There are still regulations to be applied though. The Environment Agency issues permits for the use of digestate as a fertiliser. Speak to them early, and make sure you differentiate between digestate to be spread on your own land and that which you might sell to others; the permit regime is not necessarily the same.



PlanLoCaL is designed and run by the Centre for Sustainable Energy (CSE) and funded by the Department for Communities and Local Government



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