5 3RD VISIT DEMONSTRATION FARM

NFUScotland

# East Knockbrex
# Anaerobic Digestion and CHP

*East Knockbrex,*
*Newton Stewart,*
*DG8 6QE*

*Farmer – Iain Service*
*Date of Visit – 12th November 2015*

## Background

East Knockbrex Farm was a new-build dairy unit completed in 2014 with capacity for 600 cows, located to the south west of Newton Stewart. The farm currently holds 600 cows with about 500 currently being milked.

The AD plant at East Knockbrex has a designed electrical output of 150kWe and a heat output of 130kWth. The new build dairy has been designed to work in harmony with the AD unit; allowing the maximum use of slurry as a feedstock and using the heat and electricity on site.

**Key changes since the second visit in December 2014**

- Second engine is in place (in addition to the initial 75kWe engine)
- Iain has far better understanding of how to run the system
- Iain is in the process of optimising the feedstock inputs

## The Scheme (150kWe / 130kWth)

The plant equipment was designed, supplied and installed by Fre-energy, a specialist technology provider who builds small AD plants specifically designed to process farm manures and wastes.

The AD plant was energised on the 14th October 2014 and the commissioning took approximately three months.

At present, mainly cow slurry is used for feedstock. Other feedstocks such as grass silage and cereals have been introduced when gas production is low and needs boosting. Heat is used on site for hot water in the dairy and heating the calf shed. When the plant is running at full output (approx. 130kWth after parasitic loads) there is additional heat available.

At present the scheme is in the final stages of receiving FiT accreditation. The RHI has not been applied for yet as Iain is still to determine what heat uses will be eligible under the RHI scheme's rules.

## Supply of Feedstock

Currently the scheme is being fed mainly slurry from the cattle sheds and bit of farm yard manure. This has been supplemented from time to time with cereals, due to the current low prices, as well as grass silage. This additional feedstock helps boost gas yields.

Over the year, the team at East Knockbrex have been getting to know the system and how to treat it. Iain describes it as being similar to a new born baby, as there needs to be someone continually on-site just in case it needs some attention.

Iain is currently trying to figure out what the right balance of feedstock is against the energy output they need for on-site use. They would prefer to run it purely on slurry as bringing in energy crops is expensive and taking waste requires stringent licensing.

Each head of cattle will produce around 450 litres (or kilograms) of slurries per week, which equates to approximately 12,800 tonnes of slurry feedstocks annually.

This is lower than the amount stated in previous case sheets as Iain no longer intends to keep the whole herd indoors over the summer.

The Scottish Government
The European Agricultural Fund for Rural Development: Europe investing in rural areas
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## Operating the Plant

One of the main issues over the last year has been handling the creation of hydrogen sulphide within the digester. This has caused a number of issues:

1. Contributes to foul odors
2. Contributes to sulphur dioxide emissions when combusted
3. Creates a corrosive environment when present with moisture, especially for the CHP engine.

The production of hydrogen sulphide is common in AD plants and there are a number of ways of tackling the issue, most commonly by either adding oxygen into the digester tank or iron chloride to the digester's feedstock. At East Knockbrex they are using the later.

The acid production has partially contributed to one of the CHP engines being down for part of the year. However, having two 75kWe engines allows for energy production to continue during engine down time, something that is important for the dairies operation but it does add to maintenance costs.

Over an average day the plant requires two or three ten minute checks, which can compete with other duties at busy times of the year, such as when the cows are calving, but in general it is straight forward to monitor. The main challenge has been getting used to how the plant runs and what to do if something isn't quite right. This has been a learning curve over the last year.

In the future Iain intends to install gas meters to monitor the quality of the gas being produced. This will allow them to adjust the feedstock with better accuracy to produce the quantity and quality of gas required. In digesters that are fed with energy crops, often the VFA/TA ratio (also known as the FOS/TAC ratio) is used for monitoring the AD plant. This involves testing the digestate using a tritator. This is important in ensuring the digester has the right amount of feedstock and also in maintaining a stable biology, although other factors need to be monitored to ensure the biology is healthy. The level of fatty acids in the digester can also be seen in the digestate; if it looks greasy and smells metallic then generally there is an abundance of fatty acids. Fre-energy monitor the tank off-site and can adjust settings remotely or give the farm warnings if something needs manual adjusting.

**VFA/TA ratio**

Is the result of dividing the amount of the acid concentration and the buffer capacity in the fermentation substrate.

VFA stands for Volitile Fatty Acids, and is measured in mg HAceq/l, while TA stands for total Alkalinity (alkaline buffer capacity), and is measured in mg CaCO3/l. In Germany, it is known as the FOS/TAC ratio.

## Financial Figures

Over the past year the scheme has produced approximately 400,000 kWhe (30% cf); the majority of this was from January through to now, with very little for the first few months when the scheme was being commissioned. Running just from the slurry and FYM produced on site the scheme should be able to produce 600,000kWh (46% cf) per year. One of the challenges over the coming year will be to establish what is the optimum level for the scheme between the 600,000kWhe base load and the max output of the scheme of at least 1,180,000kWhe. The table below compares the two scenarios, at the time of writing the tariffs have not yet been secured.

| Estimate Capital Costs | £900,000 | |
|---|---|---|
| Capacity factor (cf) | 46% | 90% |
| Tonnes of slurry | 12,800 tonnes | 12,800 tonnes |
| Tonnes of energy crop (grass silage) | 0 tonnes | 2,700 tonnes |
| Electricity produced | 600,000 kWhe | 1,180,000 kWhe |
| Heat produced | 550,000 kWhth | 1,020,000 kWhth |
| FIT income at 12.46p/kWh | £75,000 | £145,000 |
| RHI income at 7.5p/kWh (assumes 100,000 kWh used p.a.) | £7,500 | £7,500 |
| Electric export (after 477p/kWh) | £10,000 | £35,000 |
| Electric savings | £25,000 | £25,000 |
| Heat savings (replacing LPG) | £6,000 | £6,000 |
| Total revenue | £120,000 | £220,000 |
| Operation costs (based on 6% cap EX plus £25 tonne for energy crops) | £54,000 | £121,500 |
| Income | £70,000 | £100,000 |

Assumes: • 20kW electric parasitic load
• 2014 tariffs

The table details the headline figures associated with the project. These figures do not account for the value of the digestate as a fertiliser. The table also shows the potential returns if the project was to run at 90% capacity factor which could be achieved if energy crops were introduced to the system.

> If you want to be in the dairy business in a serious way, I think it is short sighted not to look at AD.
>
> *Iain Service, November 2015*