1 2ND VISIT DEMONSTRATION FARM

NFUScotland

Balring Farm: Biomass and Gasification

Balring Farm
Mintlaw
Peterhead
AB42 4JN

Farmer – Hamish Watson
Date of Event -12 November 2014

Hamish Watson has installed Scotland's first on farm woodchip gasification plant to produce heat and electricity, he also has two woodchip boilers at Balring farm.

Background

Balring Farm extends to 325 hectares of arable land and comprises 400 acres of winter barley, 200 acres of spring barley, 100 acres of wheat, and 100 acres of rapeseed. The farm also supports 100 suckler cows and Mr Watson recently purchased a 100 acre wood which is located approximately two miles from Balring Farm. Hamish has installed two woodchip boilers, a 200kW Froling and a 500kW Kalvis, to supply heat to his grain dryer, workshop, and residential properties.

He has also recently installed Scotland's first on farm gasification system (130kWe/200kWth) and has plans for a new grain store and two 600 tonne tray dryers that will be powered by a new Kalvis boiler.

Boilers

When the RDI previously visited Balring Farm in November 2011 Hamish had a 400kW Glenfarrow batch boiler that he has now replaced with a 500kW woodchip boiler. He has found that the woodchip boiler is approximately twice as efficient (fuel demand) and is far less labour intensive. When the drying floor is running the woodchip store needs to be filled every two days compared to the batch boiler which had to be filled every 6 hours (requiring a night shift). The batch boiler served its initial purpose and paid for itself in less than two years and has now been sold on for a resale value of £9,000.

Generally a batch boiler will have a faster payback period than a woodchip boiler because of its low capital cost. However this advantage has to be weighed against the efficiency and labour issues in comparison with a woodchip boiler. At Balring farm the batch boiler played an important role in building Hamish's understanding of biomass systems and the RHI subsidy and gave him the confidence to invest in the more costly woodchip and gasification systems.

500kW wood chip boiler

The larger of the two existing boilers on the farm is a 500kW Kalvis biomass boiler. This boiler is directly linked to a tray type grain dryer which dries both grain grown on the farm and also woodchip fuel that is used for the boilers and sold to third parties. This boiler was installed in 2014 at a capital cost of £90,000 (excludes the boiler house) and received the RHI at 5.1p/Kwh.

200kW wood chip boiler

The second boiler on the farm is a 200kW Froling woodchip fuelled biomass boiler. The boiler was installed in June 2013 for a £100,000 capital cost which included a cost of £12,000 for the district heat distribution pipe network.

The boiler receives the RHI subsidy at a tariff rate of 8 pence per kWh (higher than last year due to RPI). The higher rate compared to the 500kW boiler is due to the boiler being installed before RHI degression was applied and because it is in a lower banding of boiler size which received more support.

Drying Floor

Balring dried 2500 tonnes of grain in 2014. By running the dryer with a wood chip boiler he is able to harvest his crops when they are at their best, rather than waiting for a dry spell. He also dries

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savills

700 tonnes of wooduel each year, but this is increasing as more land is bought and more customers want woodchip.

Previously Mr Watson was drying grain using an oil fuelled boiler and spending approximately £15,000 on oil annually.

District Heating Network

There is a total of 430m of heat transporting pipework, which Hamish dug the trenches for himself to keep costs down.

Heat is sold to the two houses that are tenanted by upping the rent by £100 per month resulting in an income of £2,400 per year. The houses previously cost £1,200 pa each to heat by diesel, while Hamish's cost £3,000 pa by LPG. Hamish expects a payback on the 500kW boiler in 3 to 4 years.

Gasification Unit (130kWe/200kWth)

Gasification

Gasification is the process of converting carbon based products such as coal, biomass and petrol into carbon monoxide and hydrogen. This is done by creating a chemical reaction between the product and an amount of oxygen in a gacifier to produce a gas mixture known as synthetic gas, or syngas.

The gasification unit at Balring came about from various personal connections bringing together Hamish who has an interest in biomass (and the woodland resource and space to house and run a system), with Garth Way and Duncan Paterson of Biosus who have the technical expertise in gasification but needed to develop a prototype to advance their company. The project is opperated as a joint venture between Hamish, biosus and other parties.

The Gasifier's parts arrived in November 2014 and the Cummings k910 19 litre engine arrived in summer 2014. The system has only been operational for a few months and once accredited the system will receive incomes from RHI, ROCS and export tariffs as well as providing electricity and heat savings. The engine can output 130kW of electricity and 200kW of heat. The join venture plans to sell the waste product, bio-char, as BBQ charcoal although if this was produced in greater quantities it could be used as a soil enhancer on the farm.

Bio-Char

Biochar is a name for charcoal when it is used for particular purposes, especially as a soil amendment. Biochar is under investigation as an approach to carbon sequestration to produce negative carbon dioxide emissions.

Independently, biochar can increase soil fertility of acidic soils (low pH soils), increase agricultural productivity, and provide protection against some foliar and soil-borne diseases

As this gasifier is a prototype at this initial stage the development is been taken one step at a time. The main objective currently is to improve the quality of the gas by minimising the particulate matter (PM) and tar content. PM and tar create operational and maintenance issues in the gasification unit and the engine. The original cyclone that removes the PM was computer modelled before the plant was constructed and has not performed as well as Biosus had hoped, as such a new one is required. Methane Hydrogen and carbon monoxide contribute to the calorific value of syngas, although methane is an indicator of other impurities such as tar.

Syngas's components

1-2% Methane • 15% Hydrogen • 22% Carbon Monoxide • 8% Carbone Dioxide • 44% Nitrogen

Storing syngas is theoretically possible however biosus advise against it. An option they have looked at is to liquefy the gas, once a liquid it is possible to separate the carbon monoxide and the hydrogen which are the components that would react together if stored as a gas. The technology to do this however, is also in the development stage.

Biosus believe that once the technology is commercially ready a similar system would cost half a million pounds. The aim for the system at Balring is to run it 20 hours a day (83% capacity factor), the table below shows the theoretical outputs and returns this system would receive if it was accredited and reached it optimal running time. The system is currently only operating at 50% capacity, which is represented in the table below.

	83% capacity factor	50% capacity factor
Capital cost	£500,000	£500,000
Heat generation	1454160 kWh	876,000 kWh
Electricity generation	887037 kWh	534,360 kWh
Maximum RHI income (@ 7.5 p/kWh)	£66,528	£40,077
Maximum ROC income (@ 9 p/kWh)	£79,833	£48,092
Maximum Heat sales (@ 6 p/kWh)	£87,250	£52,560
Maximum Electricity export (@ 4.77 p/kWh)	£42,312	£25,489

> "Although RHI rates have dropped, I expect costs to comedown as the biomass boiler installers gain experience."
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> *Hamish Watson, November 2014*