Case Study

# Biomass boiler installation at Gay Dawn Farm, Oncoland ltd.

## Project highlights

The installation of a 100kW biomass and district heating system at Oncoland near Dartford, Kent. The project replaced a number of oil fired heating and hot water systems with a central biomass boiler and optimised district heating system and has the potential to save 56 Tonnes of $CO_2$ per year. An additional benefit to this system is that during the summer months the biomass boiler can be used as a heating source to assist grain drying which was previously carried out by a gas fired system.

## Introduction

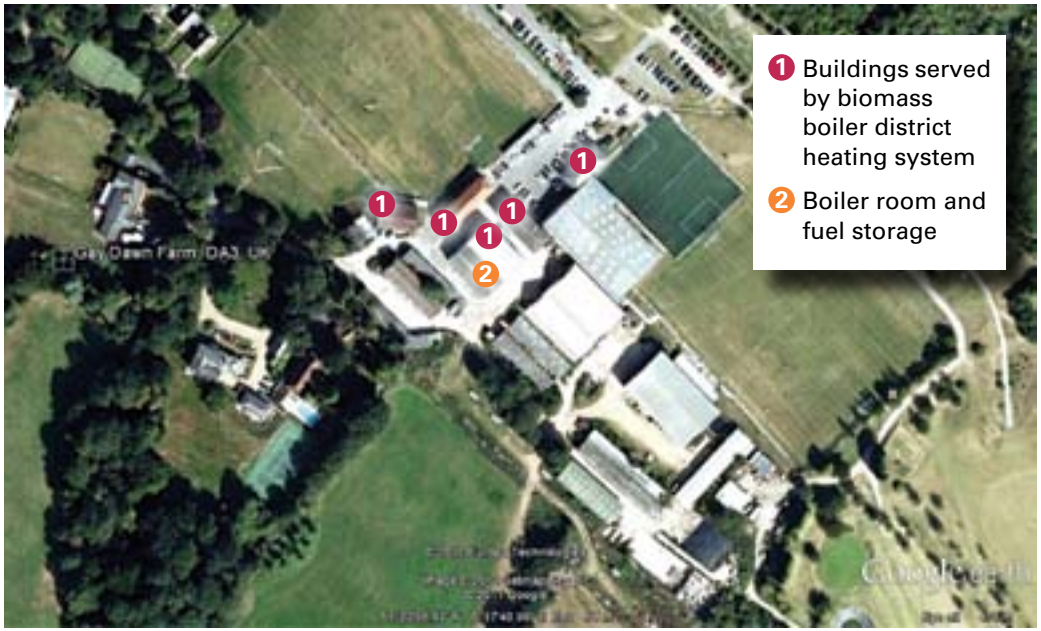
Located in Kent, Gay Dawn Farm is home to an amateur football club, golf course, sports centre, business centre and a significant farm, all of which is owned and operated by Oncoland Ltd. The owner had a keen interest in sustainability and is a successful business man.

Gay Dawn Farm consists of six main buildings two office buildings, a sports hall, shop and social club and a sports pavilion with caretaker's flat above.

## Project aims

Oncoland wished to explore the potential for replacing all of its four oil-fired boilers that served low temperature hot water systems and an air source heat pump with a district heating system and a centralised boiler arrangement. At the same time Oncoland wished to explore the options of incorporating a biomass Combined Heat and Power (CHP) system and moving its gas fired grain drying capability to a biomass-fired arrangement.

Oncoland were considering a biomass boiler to contribute to its sustainability aspirations with the potential advantage of being able to grow their own fuel and obtain Renewable Heat Incentive loans or tariffs.




*Aerial view of gay dawn farm and surroundings*

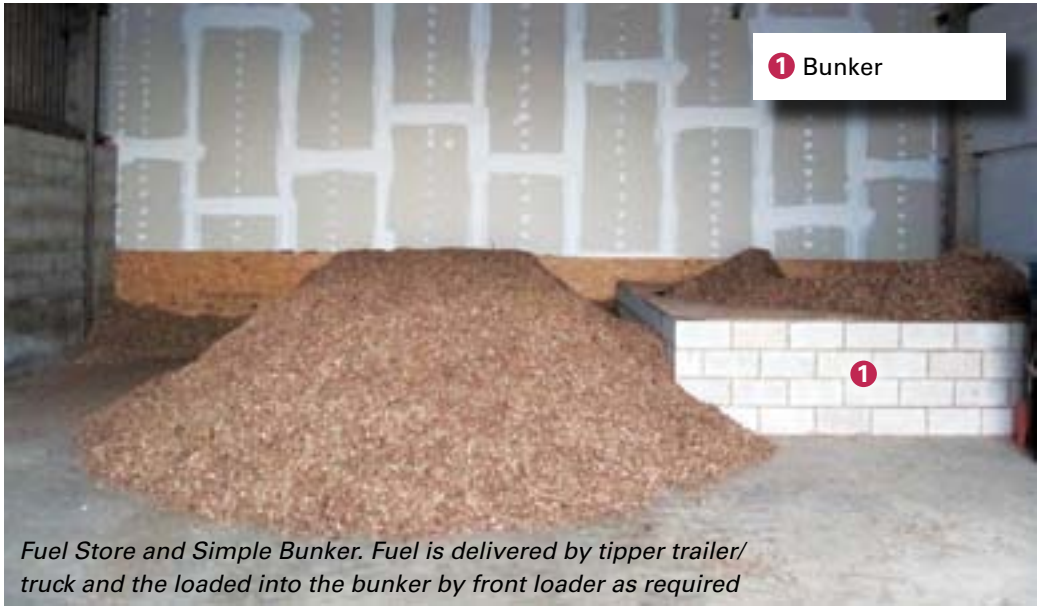
## Project development

Having been identified by the Carbon Trust's Biomass Heat Accelerator as a site to take advantage of biomass heating, Oncoland Ltd were provided with a feasibility study to assess the viability of a number of different options in terms of plant location, specification, heating medium, size and cost. After a feasibility review between Oncoland and the technical consultant (Appleyards Ltd.), it was concluded that the optimum solution for the site would be one centralised biomass boiler with a thermal store and a back up oil-fired boiler to serve the offices and sports club with capacity to assist in grain drying for three months of the year. At the time of the feasibility it was estimated that a 215kW boiler was required to provide low temperature hot water to provide 100% of both the existing heat and hot water demand. A smaller auxiliary oil boiler was to be relocated to provide back-up heat if required in the event of biomass boiler shut down.

The feasibility process provided Onocoland with sufficient information to make an informed decision to invest further resources to develop the project. In order to ensure that the installation was delivered at lowest optimal cost and at very high levels of technical performance, the project was progressed to the next phase of development through the Carbon Trust's Biomass Heat Accelerator which covered the following activities:

- Detailed survey.
- Procurement strategy that concluded that a Design and Build procurement process would be adopted.
- Performance specification.
- Technical specification of all plant items.
- Assistance with tendering for boiler supplier and main contractors.
- Ongoing project management of the delivery.
- Role of 'Client's Engineer' to provide technical support throughout construction, evaluation and handover.

With technical assistance provided by Appleyards Ltd supported by the Carbon Trust, the scheme was tendered on a JCT Design and Build basis. At the feasibility stage the annual heating load was based on fuel oil consumption but then at the commencement of the detailed design stage, and following a survey of the buildings and a hevacomp heat load model process, it was found that the predicted heat load was significantly less than the feasibility had considered. With the contractor employed, the team were able to optimise the controls to provide a sequenced heat demand which enabled the biomass boiler to be optimised to a 100kW boiler rather than the 250kW boiler proposed at the feasibility stage.




*Fuel Store and Simple Bunker. Fuel is delivered by tipper trailer/ truck and the loaded into the bunker by front loader as required*

During the course of the project delivery the main contractors' mechanical and electrical sub-contractor went into administration and project had to be paused whilst the main contractor found another suitable subcontractor. Fortunately the biomass boiler supplier was retained as a sub-contractor to the main contractor.

Construction began in January 2011, and the biomass boiler and main elements of the district heating mains were commissioned in March 2011. Although the system has been operational since March 2011 and has been providing heat to the grain drying shed and district heating system, during the course of the year significant works have been carried out on the secondary side of the systems which have had a consequential impact on the full hand over of the system which is now planned for March 2012.

## Projected biomass savings

With an average biomass boiler efficiency of 85%, the delivered heat cost via biomass is 3.0p/kWh. The biomass plant will generate over 167MWh of renewable heat per year; based on this, the annual income from the Renewable Heat Incentive will be over £11,092 per year, using the latest Medium Biomass tariff guidelines – this is calculated as shown below, right:

| Project Costs for 100kW Biomass Boiler Plant | |
|---|---|
| 100kW Wood chip boiler and fuel feed | £33,030 |
| Fuel feed system | inc. above |
| Accumulator tanks | £3,470 |
| Flue system | inc. above |
| District Heating Mains | £13,006 |
| Boiler house, Wood chip bunker and civils works | £57,328 |
| Mechanical installation inc adaption of secondary systems | £60,025 |
| Electrical installation | £13,686 |
| Controls including secondary systems integration | £33,855 |
| Contractor's design & prelims | £25,600 |
| Design and project management | £61,875 |
| Total project costs | £301,875 |

## Technical details

The biomass boiler solution comprises a 100kW moving grate boiler with 3,000 litre thermal storage, sized to maximise the operational efficiency of the biomass system. The thermal store can be charged up in periods of lower site demand and then used to supply low and peak heat demands that are outside of the operational range of the boiler, in order to 'even out' the demand on the biomass boiler.

The 9m$^3$ fuel store comprises rotating sweep arm with feed auger to fuel the boiler; adjacent to the fuel store containment bunker wall there is sufficient space for two to three trailer loads of biomass to be tipped directly on to the floor of the store. The owner then loads the fuel bunker with his own front loading tractor. The owner has made some modifications to the simple blockwork enclosure by sectioning off the corners of the bunker with plywood to avoid having redundant fuel in the corners of the bunker.

An auxiliary oil boiler is fully integrated into the heating system. Although the system is designed so that the biomass boiler and thermal storage can supply 100% of demand, the auxiliary oil boiler can be brought online as required in the event of biomass system failure.

The biomass heating system and auxiliary boiler are fully integrated via a bespoke automatic control and monitoring system, which ensures that the temperatures supplied to the heat distribution network are as required for buildings, whilst minimising heat losses and maximising the seasonal efficiency of the biomass plant. The control system also has remote monitoring capabilities to allow the system performance data to be accessed, analysed and stored via an internet connection. The information recorded includes site heat consumption for RHI payments, and instant notification of system alarms, which are also sent via SMS to notify the operators that attention is required.

A breakdown of the project costs is shown left.

| Technology | (kWh) | Tariff (p/kWh) | RHI Value per year |
|---|---|---|---|
| Small scale biomass boiler | Tier 1 heat generation = 1,314hours x boiler Maximum Continuous Rating 100kW) = 131,400kWh | 7.9 | £10,380 |
| Small scale biomass boiler | Tier 2 = Annual heat generation less Tier 1 = 167,000kWh – 131,400kWh = 35,600kWh | 2.0 | £712 |
| | | | £11,092 |

A summary of the main project facts are tabulated below.

| Component | | Unit | Note |
|---|---|---|---|
| Biomass Boiler Installation | 1 no. 100kW | | Installed by Wood Energy |
| Auxiliary Plant | 1 no. 50kW | | Using heating oil |
| Biomass Fuel Source | Local Supplier | | Bertie Wood Suppliers |
| Biomass Fuel Consumption | 45.6 | tonnes/yr | At circa 21% moisture content |
| Biomass Fuel Expenditure | £4,500 | £/yr | Supply price £100/tonne |
| Fuel Store Size | 9 | $m^3$ | $9m^3$ bunker is situated in large barn which stores fuel with capacity for a least 3 trailer loads |
| $CO_2$ Emissions Saved | 56 | t/yr | |
| Installed | 2011 | | |
| Capital Cost | £240,000 | | Original contract value £183,570 increases to contact value have been primarily down to BMS control enhancement £20k and repairs and improvements to the secondary systems around the site. |
| Design & Project management Fees | £61,875 | | |
| Carbon Trust Contribution to Fees | £46,400 | | |
| Annual Savings of Fossil Fuel | 17,800 | litres/yr | |
| Estimated Annual RHI Income | £11,000 | | |
| Payback | 9 | years | |

“As a business and with thanks to the Carbon Trust, we saw an opportunity to move from oil to biomass which would help us achieve carbon savings, provide savings in fuel cost and it gave us an option of sourcing local fuel or in the long term growing our own fuel. We have had teething problems in commissioning the systems but we have already made significant savings and in due course we will be able to receive income from the RHI scheme”

**Bonze Billings**
Managing Director of Oncoland