OPTIWOOD

Improving the Performance and Efficiency of Biomass Boilers

A joint UK-France Project 2018-2020

Case Study 2 - Community District Heating

Introduction: A 200kW HDG boiler system heats 35 buildings in a 1.2km long community district heating (DH) design. It is linked to twin 5,000 litre accumulator tanks. There is no fossil fuel back-up. The boiler replaced an older 300kW biomass system in order to attract high RHI tariff income levels but it is under-sized for the heat load and some buildings are under-heated in winter.

Significant inefficiencies exist in boiler the boiler room hydraulic set-up and the heat losses throughout the underground pipework system.

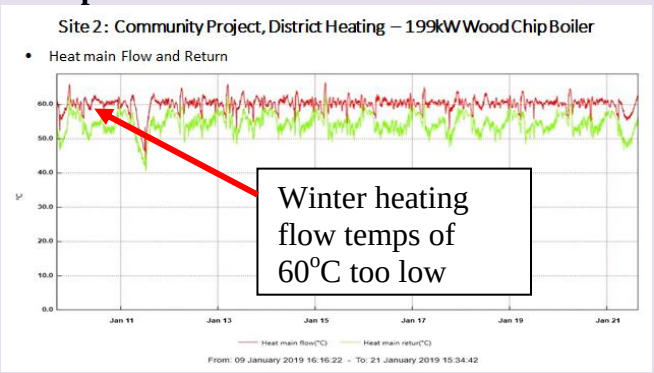
2018-19 Heating Season – Data Results and Recommendations

The data logging equipment showed a number of key issues and problems, including:

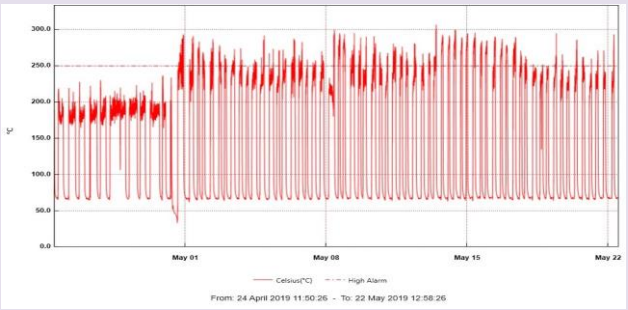
- Low boiler room efficiencies due to poor hydraulic design. Efficiency losses were highlighted as one of the buffer tanks showed a reversal of flow and return temperatures due to excessive mixing of hot water and cold
- An under-sized boiler working very hard and struggling to meet the heat demand. A number of houses complained of low heating temperatures
- Low district heating system efficiencies ranging from 40% in winter to around 25% in summer. This reflects an extensive heating network (1.2km) and a moderate heat demand, especially in summer where hot water demand was erratic and low
- Regular cycling of the boiler
- A rapid build-up of ash in the boiler and a need for more frequent cleaning
- Control parameters for the boiler being incorrectly set and leading to poor O2 and under-pressure levels as well as excessive flue temperatures

After service engineer visits a number of the control issues were improved and O2, under-pressure and flue temperature levels moved closer to those expected.

Example Data Trends – Boiler is Under-Sized and is being worked too Hard



Winter Heating Flow Temperatures are too low



Erratic Flue Temperatures/Under-Pressure

2019-20 Changes and Improvements

Modest though useful improvements (+3%) occurred through changing some of the boiler control parameters, plus increased servicing and cleaning. Much bigger efficiency improvement potentials of 15-20% would require greater intervention by the owners, including shutting down the DH system for 3-4 months in summer when the heat load is very low at times and almost entirely hot water. Another area worth of additional time and money for the client is changing the hydraulic layout in the boiler room to better integrate the twin 5000 buffer tanks. The client was not prepared to take these steps.

In summer the overall heating system up to each building is of the order of 25%. Hence the fuel costs of 3p/kWh are actually more than 12p/kWh. This contrasts to the RHI income of 8.2p/kWh. We estimated that closing the DH system in summer would improve the annual system efficiencies by 15-20%.

Pilot Project 2 - Community D Heating (200kW)	Wood Fuel Consumption (tonnes at 30% Moisture Content)	Wood Fuel Coverage (% of total heat demand)	Biomass Boiler Efficiency (%)	Costs of Wood Fuel	Tonnes CO_2 Emissions saved (cf with equivalent heating oil)
Heating Season 2018-19	178	100%	57%	N/A	87
Heating Season 2019-20	164	100%	60%	N/A	86
Gain or Loss	-14	-	+3%	N/A	-1
Estimated Additional Gains if Recommendations Carried out	-30	-	+15-20% (75-80%)	N/A	N/A

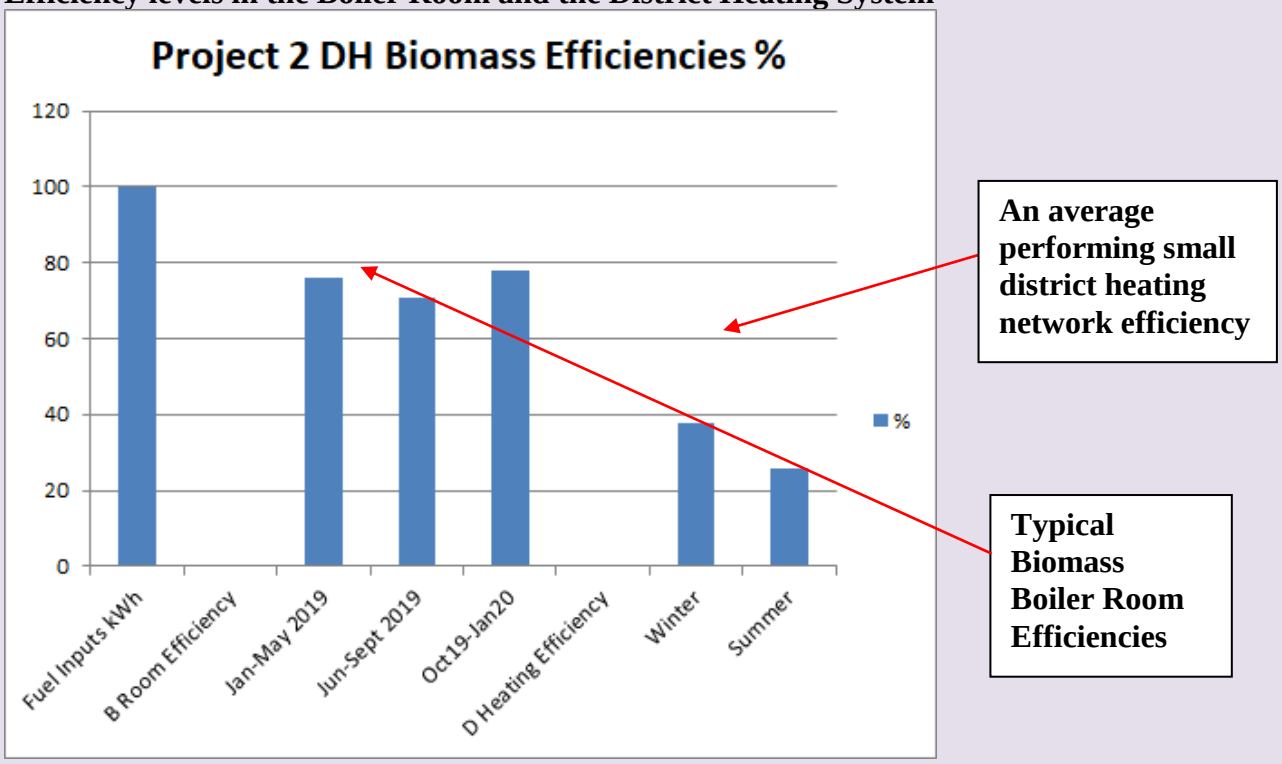
Footnote1: Based on boiler room hydraulic hanges and not running system over summer

Footnote2: No other heating system on site except for some individual electric water heaters

Footnote 3: Mods to hydraulic system in boiler room and switching biomass system off in summer

Footnote4: Lower use of biomass in summer but electic water heating with higher CO2 emissions (not possible to calculate)

Efficiency levels in the Boiler Room and the District Heating System



Key Lessons

- **Design – the boiler is under-sized for the project heat load**
- **The District heating system should be shut down in summer when heat load very low**
- **Hydraulic system changes would improve boiler room efficiencies**
- **More frequent servicing and cleaning needed to maintain boiler efficiencies**