Case Study

Biomass Boiler Installation at National Botanic Garden of Wales

Project Highlights

The installation of a 500kW biomass heating system at National Botanic Garden of Wales contributes significantly to the supply of heat to the site while reducing the site's fossil fuel energy costs and CO_2 emissions.

"This biomass installation demonstrates our continued commitment to the environment. We are grateful to the Carbon Trust and its BHA for their support throughout this process. The professionalism, technical expertise and quality of advice and service we have received from the BHA and Sustainable Energy Ltd. has been absolutely excellent"

Dr Rosie Plummer
Director of National Botanic Garden of Wales

Introduction

National Botanic Garden of Wales (NBGW) is located near to the village of Llanarthney in Carmarthenshire, Wales. The gardens opened in May 2000 and are currently the most visited gardens in Wales. The gardens operate as a registered charity and are reliant on visitor fees, donations and annual funding from the Welsh Assembly Government. The site includes attractions such as the Great Glasshouse – the largest single span glasshouse in the world – as well as various offices, shops and café/tea rooms.

Project Aims

The majority of the site heat demand was provided by oil and gas boilers, with approximately 15% of heat demand supplied by a 165kW boiler that was installed in 2001; this biomass boiler was old and inefficient. Having spent over £70,000 on heating oil and £30,000 on gas over the previous winter NBGW identified the need to look at reducing the amount of fossil fuel used on site. In line with NBGW's environmental commitment, three alternative sustainable heating technologies were investigated; replacing the existing biomass boiler with a larger, more efficient biomass boiler, anaerobic digestion and ground source heat pumps. With support from the Carbon Trust, a feasibility study was carried out, which determined that a 500kW biomass boiler would be sufficient to supply heat to four of the sites glasshouses, the Conference Centre, Administration Building plus shops and the restaurant via a district heating main.

Project Development

Installation of the biomass boiler began in August 2011, commissioning and handover of the plant was completed in December 2011.

View of the Great Glasshouse from within the Gardens

Newly installed 500kW biomass boiler

2 x 15,000 litre thermal stores prior to installation

Projected Renewable Heat Incentive Income

NBGW estimates that the biomass boiler plant will run for 25% of the year; during this time it will generate approximately 1,095MWh of heat. Based on this heat output, the expected annual income from the Renewable Heat Incentive will be approximately £41,000 a year using the published RHI Medium Biomass tariff – this is calculated as shown below:

Technology	(kWh)	Tariff (p/kWh)	RHI Value per year
Medium scale biomass boiler	Tier 1 heat generation = 1,314hours x boiler Maximum Continuous Rating of 500kW = 657,000kWh	4.9	£32,193
Medium scale biomass boiler	Tier 2 = Annual heat generation less Tier 1 = 1,095,000kWh - 657,000kWh = 438,000kWh	2.0	£8,760
Total			£40,953

Technical Details

The biomass boiler installation comprises a 500kW Herz underfed boiler with 30,000litre thermal store, sized to supply 90% of the site heat demand. The thermal storage is used to 'even out' the demand on the biomass boiler and prevent unwanted boiler cycling during periods of low system demand.

The two existing 1MW oil boilers were retained and have been fully integrated into the biomass heating system to supplement heating to the site during times of peak heat demand and back up heat during periods of biomass boiler downtime and scheduled maintenance periods.

The 100m^3 fuel store includes a walking floor extractor which connects to the biomass boiler via a series of screw augers and a stoker auger. It is the long term aim of the site to use coppiced willow and poplar which is currently being grown on site to fuel the biomass boiler.

Technical support for the project was funded through the Carbon Trust Biomass Heat Accelerator Programme – this provided the NBGW with the technical expertise required to ensure that the design, installation and commissioning of the biomass heating plant met the design objectives and conformed to the latest best practice in biomass heating. This technical support was provided by biomass engineering design specialists Sustainable Energy Ltd.

Summary

The 500kW biomass boiler plant at the national Botanic Garden of Wales supplies approximately 90% of site heating demand. The total project costs were approximately £200,000; this was part financed by a £100,000 Carbon Trust interest free loan and partly from the organisation's own reserves. The payback period for the project is approximately 5.3 years, based on annual oil savings.

Component		Unit	Note
Heat output of existing 165kW biomass boiler	300,000	kWh/year	
Heat output of new 500kW biomass boiler	1,095,000	kWh/year	
Increase in heat output from biomass	795,000	kWh/year	
Cost of wood fuel for additional biomass heat	£26,235	£/yr	based on a heat output cost of 3.3p/kWh
Cost of equivalent oil cost	£63,750	£/yr	based on latest oil cost of 68p/litre
Fuel cost savings	£37,515	£/yr	

The biomass boiler plant will offset approximately 130,000 litres of oil per year, which will save the site 366 tonnes of CO_2 emissions per year. The plant is expected to generate an income of £41,000 from the RHI once accredited.