



Helpu Cymru i leihau
ei Hôl Troed Carbon

Help Wales reduce
its Carbon Footprint



Llywodraeth Cymru
Welsh Government

Case Study 16

Canolfan Rheidol Offices

www.cymru.gov.uk

Owner:

Ceredigion County
Council/
Welsh Government

Architect:

Powell Dobson

Contractor:

Willmott Dixon
CMB Engineering

M&E Consultants:

Hoare Lea Atkins

Location:

Aberystwyth, Wales

Building Types:

Offices
Public

Project Description

Completed in July 2009, the new Ceredigion County Council and Welsh Government (WG) offices in rural Aberystwyth accommodates 475 staff and was designed to provide the public with an improved range of County Council services in one location. Comprising two open plan office buildings, with a floor area of 7,300 m², the development achieved a BREEAM 'Excellent' rating. The offices form the anchor load for part of a biomass fuelled district heating network, and also incorporate other forms of renewable energy in the form of solar thermal collectors and a wind turbine.

At present, the district heating network only supplies the two office buildings, but the intention is to connect to a leisure centre (with two swimming pools – ideal loads for a biomass system) and a school, at a later date.

Key Drivers

In addition to consolidating their property assets, Ceredigion County Council were keen to develop a new headquarters which provided improved public access to County Council services. Key sustainability objectives of the project were to:

- Provide a green, efficient, functional office space for the Council; and
- To achieve a BREEAM 'Excellent' rating and maximise the use of passive design features.

Key Features

- 1,650 kW biomass boiler fuelled by locally sourced woodchip;
- 6 kW vertical axis wind turbine;
- 2 No. 11 m² solar thermal flat plate collectors; and
- Site wide district heating system.

The office was designed to achieve a 49% reduction in CO₂ emissions when compared to a compliant building built to 2006 building regulations.

LZC Technologies

- Biomass boiler
- Wind
- Solar thermal

The building also incorporates several passive design and energy efficient features including the following:

- Exposed thermal mass to assist with thermal regulation and provide 'free' cooling;
- Main building facades are orientated in a southerly direction to optimise free solar gains in winter;
- Vertical brise soleil are used on east and west facing facades;
- Mixed mode ventilation system – passive stack natural ventilation (exploiting the natural buoyancy of air), and mechanical ventilation with heat recovery (MVHR) using a displacement ventilation approach; and
- High efficiency lighting with a central atrium, maximising the use of daylight.

In addition water saving features have been incorporated; rainwater harvesting for WC flushing, and sustainable urban drainage systems (SUDS) to minimise surface water runoff.

Procurement

The overall project was procured using a design and build target price contract. The overall budget, including the district heating energy centre, was £16.5 million. The three components of the biomass system (district heating system, boiler house and fuel store) were procured separately. The biomass boiler is a Binder woodchip boiler procured from Wood Energy Limited and fuel for the boiler is locally sourced from Machynlleth and Corris area through Spencer Environmental Care Associates (ECA).

Scheme costs and finance

The total cost of the renewable and low carbon technologies was in the region of £780,000. The majority of this cost (approximately £700,000) was due to the biomass boiler (approximately £310,000) and associated plant for the district heating system. The "Quiet Revolution" vertical axis wind turbine was a further £55,600 with the solar thermal collectors and thermal store taking up the remainder of the cost.

The building obtained a grant of £313,000 from the Carbon Trust's Low Carbon Building Programme (LCBP). The biomass boiler and district heating scheme is currently not registered under the Government Renewable Heat Incentive although financial support from this scheme will be sought as the district heating scheme extends to include other local loads such as the Plascrug Leisure Centre and Penweddig Secondary School.

Technology selection process

Due to the remote location of Aberystwyth, there is a limited availability of mains gas. Consequently alternative fuels such as LPG and solid fuels are prevalent in the area, and so the Council has implemented a strategy to promote the use of more sustainable fuels.

It has been estimated that commercial forestry in Wales has an annual production of approximately 115,000 tonnes of high quality sustainably sourced woodchip. The availability of a local and secure fuel resource made biomass a suitable low carbon heating option for the scheme (The project required approximately 4,000 tonnes of woodchip per year.)



Importantly when considering biomass, there are a number of issues that must be considered that wouldn't normally be covered in projects where traditional heating systems are used. Ceredigion County Council benefited from having a well-informed in-house facilities team, who were able to manage expectations and were aware of the relevant issues before they arose.

District heating networks are well suited to public buildings such as leisure centres, schools and offices due to their relatively constant heating baseload. Due to financial constraints, it was proposed to develop a district heating network in phases, with Canolfan Rheidol and the new Welsh Government offices to be supplied initially, with the leisure centre and secondary school connected to the network as and when financial support became available.

Design calculations predicted an annual space heat demand of 29 kWh/m²/year for the Canolfan Rheidol. A 'Binder' biomass boiler was selected with an output of 1,650 kW. However, the boiler was oversized for the demands of the office developments to account for future integration of the leisure centre and school into the district heating network. The boiler was set up to operate at 1,200 kW to meet the demands of the new offices and minimise dumping of waste heat, and will then be recommissioned to increase its capacity once the additional buildings are connected. High efficiency condensing gas boilers have been installed to act as back-up supply, and an

additional gas burner is used to pre-heat the biomass boiler. No boiler equipment is actually housed within the Ceredigion or WG offices; instead located in an energy centre.

In order to achieve the mandatory requirements to qualify for a BREEAM 'Excellent' rating, and to meet Ceredigion County Councils target of reducing building annual carbon dioxide emissions to a level below 50 kg CO₂/m² further renewable energy technologies were considered. Two 11 m² solar thermal flat plate collector arrays were selected to provide 40% of the domestic hot water demand for Canolfan Rheidol (with a design output of approximately 14,800 kWh per annum). The solar thermal collectors feed hot water to a 1,000 litre thermal store, which acts as a pre-heat cylinder for the domestic hot water. A 6 kW wind turbine was installed in the car park to the north of the building to generate approximately 10,000 kWh per annum of renewable on-site electricity, equivalent to an annual carbon saving of around 4.5 tonnes.

Monitoring and operation

The offices have had relatively few problems since operation. The Council retained their controls specialist to visit the site regularly after handover, and the ongoing relationship has meant the building has been fine tuned, contributing to its good performance.

Energy metering has been a problem since occupation. While the office is comprehensively metered, with sub-metering for all major energy using plant and other



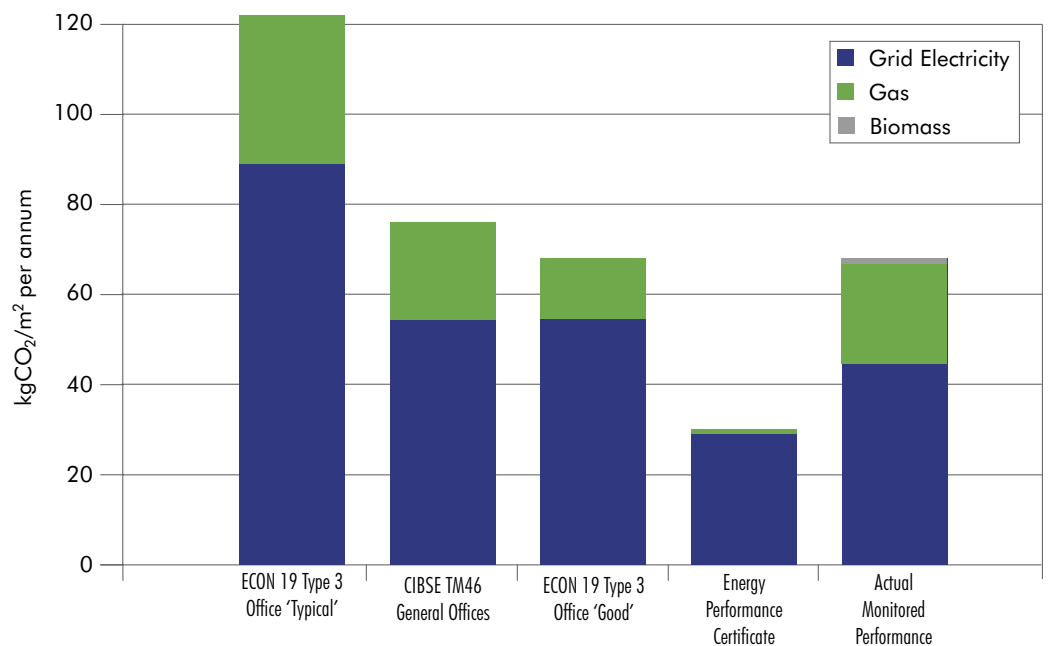
equipment, the meters weren't accurately labeled, which meant faults have been hard to pinpoint. For the biomass district heating scheme, the gas supply to the burner used for pre-heat purposes was not installed with a meter, so the gas used here could not be separated from the main gas boilers. This meant the facilities team couldn't accurately monitor their energy usage and so were unable to determine whether the gas burner in the biomass boiler was running excessively.

In addition, although heat is metered as it enters the office from the district heating network (enabling overall heat demand to be determined), only a single meter is provided on the biomass boiler, which doesn't capture the heat input from the standby boiler. It is therefore difficult to determine the heat loss associated with the district heating network pipework, as the standby boilers would be used to meet losses.

Energy consumption over the first 12 months has been monitored as part of a Display Energy Certificate (DEC) rating. The results indicate that heat loss from the district heating system is significant. A 280 m pipework run from the biomass energy centre to Canolfan Rheidol has a system loss of around 37% during low loads (May to August) and 22% during the peak heating season (November to February). The heating demand, as a result is significantly higher than anticipated (as shown in the figure below), when the buildings EPC was calculated.

It is important to point out that the results are not representative of the buildings long term performance, once the district heating network is developed and commissioning issues have been resolved. These have been highlighted as key areas to focus on optimising performance.

Key Facts



Comparative performance of Canolfan Rheidol's design EPC and actual monitored performance against relevant standards
Data source from xxx

Lessons learnt

Technological supply issues:

- Siting of a biomass boiler relative to the development is key to minimising heat losses associated with heat distribution;
- Be aware that complicated systems (e.g. BMS) do not work perfectly on 'day one' of operation, and a period of fine-tuning should be allowed for before systems will become reliable. 'Fine-tuning' is not a faults issue and is therefore not covered by defects warranties; and
- Where sub-metering of energy is undertaken, be careful to ensure meters are clearly labelled as to which system they monitor, and that a robust metering system is developed.

Occupant involvement:

- AAA and;
- AAA.

Financial lessons:

- AAA;
- AAA and;
- AAA.

Awards and Achievements

- BREEAM 2008 Offices 'Excellent' Rating (73.7%);
- BREEAM Awards Wales 2010 winner.

References and Acknowledgements

Bunn. R. (2011) Canolfan Rheidol article www.building.co.uk

Carbon Trust Guide – Taking the heat – Lessons learned from using biomass heating in low carbon buildings (CTG061)

Further information

www.ceredigion.gov.uk/

These case studies are presented to show examples of how buildings can be designed and built to be low carbon and incorporate renewable and low carbon technologies. This case study is part of a series of case studies supporting a separate practice guidance document on low carbon buildings. **For further information see www.wales.gov.uk/planning**

