Helpu Cymru i leihau ei Hôl Troed Carbon
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Case Study 13

Greenhill Primary School

Developer:
Caerphilly County Borough Council (CBC)

Architect:
Building Consultancy, Caerphilly CBC

Location:
Gelligaer, Wales

Building Types:
Education

Project Description

The new Greenhill Primary School replaces former 1960s school buildings on a site in Gelligaer, Hengoed. The new school is a state of the art single storey building and has been designed as an exemplar project in terms of energy efficiency.

Key Drivers

Caerphilly CBC has developed a Carbon Reduction Strategy which targets Authority owned buildings for carbon impact reduction via replacement or improvement. Accordingly all new or refurbished schools or school extensions are designed to be highly thermally efficient with the minimisation of running costs, and consequential reduction in carbon footprint a key consideration. A BREEAM 'Excellent' standard is also regarded as a minimum, and is bettered wherever cost effective.

As part of their 2008 Sustainable Development Strategy "Living Better, Using Less ", Caerphilly CBC stated an aim of "utilising new technologies in order to minimise energy use and to ensure where possible that energy is from renewable sources." The new Greenhill Primary school, therefore, provided an excellent opportunity to lead by example in terms of the use of renewable technologies.

Key features

- 490m^2, 66 kWp poly–crystalline photovoltaic solar array;
- Four 1.5 kW wind turbines; and
- A micro gas fired CHP unit supplemented by high efficiency gas condensing boilers;

Other sustainable features of the school include:

- A highly insulated building envelope;
- Rainwater harvesting to meet 50% of total water demand; and
- High efficiency lighting with PIR and daylight sensing controls.

Greenhill Primary school
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Renewable & Low Carbon Technologies

- Passivhaus
- Photovoltaic array
- Solar Hot Water collectors

Procurement

The main contractor for the scheme, Vinci Construction UK Ltd, procured the photovoltaic array from Cleaner Air Solutions (CAS) Limited, following a price based tender process involving several potential suppliers. CAS use BP and Sharp as their solar product companies.

The four wind turbines are Swift Turbines, developed by Renewable Energy Devices Limited, based in Edinburgh.

Scheme costs and finance

The overall build cost for the school was approximately £4 million.

The capital cost of the PV array was approximately £185,000 which was funded entirely by Caerphilly CBC through their carbon budget. Annual income generated by the Greenhill PV array through the Feed In Tariff (FIT) scheme is estimated to be approximately £15,500. Additionally, savings are made through reduced energy bills, and the Carbon Reduction Commitment (CRC) carbon abatement tax making total savings at approximately £19,000. The anticipated payback period for the PV array has been estimated to be approximately 10 years.

Greenhill Primary School is the first UK school to achieve an EPC rating of A+.

Technology selection process

As part of the BREEAM process for the development a renewable and low carbon feasibility study was undertaken covering a number of technologies including biomass boilers, ground source heat pumps (GSHP), solar thermal collectors, PV and wind turbines.

Wind turbines were initially selected as the sole electricity generating renewable technology. This was partially due to a survey of a number of Caerphilly CBC owned sites which identified the Greenhill Primary School site as having the greatest wind harnessing potential due to its exposed location. Additionally, the clearly visible nature of wind turbine operation was considered to be a beneficial learning resource for the students of the school. Four smaller 1.5 kWp turbines were selected in preference to a large single turbine due to the opportunity to aesthetically integrate these into the building design to strengthen the visual link between the turbines and the school building.

Swift Turbines are integrated into the building design
Reproduced with permission of Caerphilly CBC

The PV array was not part of the original design, although the orientation of the building and pitch of the roof were optimal for integration of roof mounted PVs.

At the time of the project development, there was a demand for roof space by a number of photovoltaic providers who were looking to partner building owners and provide funding. Consequently, the initial option of purchase, installation and maintenance of a PV array by the private sector was pursued. The school would receive cheaper electricity bills, while the provider would take the Feed in Tariff

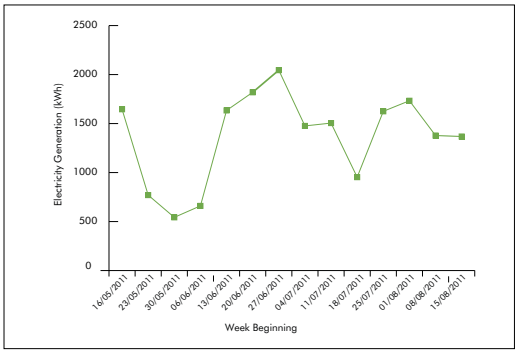
(FIT) income. While several potential project funders were identified, the tendering process was unsuccessful due to lack of commitment from funders. However, in September 2010, legislative changes were made to existing FIT schemes such that local authorities could benefit. The local authority had by this time bought into the potential to develop Greenhill as an exceptionally energy efficient, exemplar building which would significantly reduce the Authority's carbon footprint. On this basis, the PV array was funded wholly by the Caerphilly CBC carbon budget. Income generated by FIT is fed back into the Caerphilly CBC carbon budget.

As a priority, the heat demand of the building was reduced as far as possible through a highly insulated building envelope, with building fabric U values making a 60% improvement on requirements of Building Regulations 2006. The residual space heating demand, in addition to the hot water supply, was met using a micro gas fired CHP unit supplemented by high efficiency gas condensing boilers. CHP was selected on its high performance under BREEAM. The CHP has been sized to provide hot water provision in summer months and consequently gas condensing boilers are required for winter space heating.

Monitoring and operation

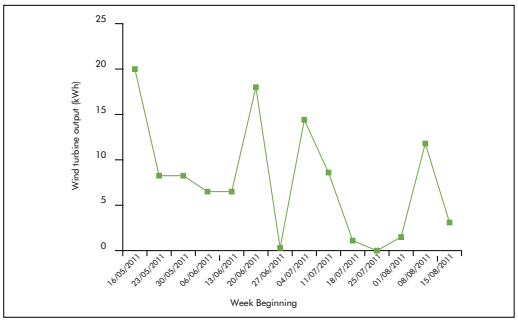
Since the building was occupied in May 2011, monitoring of the energy generation by the LZC technologies has been undertaken on a weekly basis.

There has been a high level of satisfaction with the PV array, the integration of which improved the schools EPC rating to A+. Over a three month period, between 16th May 2011 and 15th August 2011, the 66 kWp array generated a total of approximately 19.1 MWh of electricity. Based on the success of the PV installation at Greenhill Primary School, Caerphilly CBC now plan to integrate PV arrays in four other existing buildings, including three schools.



Weekly electricity generation of PV array (May – Aug 11)
Data provided by Mark Williams of Caerphilly CBC

The combined electricity generation total of the four 1.5 kWp turbines over the same monitoring period (16th May – 15th August 2011) was less impressive at 105 kWh. The graph below shows these findings. In some instances no electricity was generated where windspeeds were insufficient.



Weekly electricity generation of wind turbines (May – Aug 11)
Data provided by Mark Williams of Caerphilly CBC

Monitoring of the CHP heat generation has been undertaken although results to date are not representative of typical operation; a significant proportion of the monitoring period occurred within the academic summer vacation where occupation of the school was minimal and so demand on the CHP unit was very low.

A display screen has been installed in the reception area of the school to provide pupils with a real time indiction of how the renewable and low carbon technologies are offsetting demand on grid electricity and mains gas.

It has been estimated that over the course of a typical year, the school will import electricity equivalent to 9.5 tonnes of carbon. However, electricity generated onsite each year is likely to equate to – 4.1 kg CO_2/m^2/annum. These figures correspond to a 119.7% improvement on the Building Regulations 2006 Target Emission Rate (TER) of 20.92 kg CO_2/m^2/annum, and as such the development can be classified carbon neutral i.e. zero CO_2 emissions from regulated electricity (lighting, pumps and fans).

Lessons learnt

Technological supply issues:

- If wind turbines are to be utilised, careful sizing and sourcing calculations and decisions should be made at an early design stage. From client experience, there is also a need for post–installation monitoring data demonstrating the performance of wind turbines in associated developments.

Occupant involvement:

- The handover process to end users should be a thorough process in order to ensure maintenance, housekeeping and management of a building is undertaken correctly to facilitate optimal operation of the building and renewable/low carbon technologies.

Financial lessons:

- The funding of PV systems by the private sector is a developing area and whilst the sector promises much, confirmation that there is a suitable funder should always be assured at an early stage of a project.

Awards and Achievements

- Low/Zero Carbon Award at Constructing Excellence in Wales 2011;
- First school in Wales and England to achieve A+ energy rating; and
- The school is likely to achieve a BREEAM score of more than 85% and a BREEAM rating of 'Outstanding' is possible (pending confirmation of the final credits).

References and Acknowledgements

Mark Williams
Building Consultancy Manager, Caerphilly CBC

Paul Rossiter
Energy & Water Conservation Officer, Caerphilly CBC

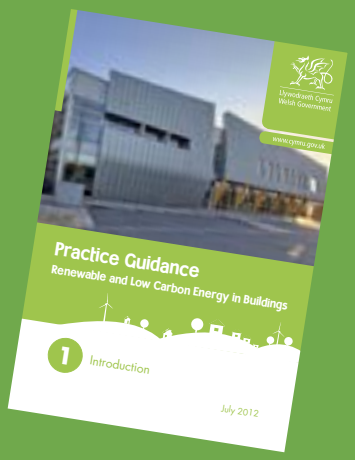
Further information

Cleaner Air Solutions
www.cleanerairsolutions.co.uk/

Renewable Devices Limited
www.renewabledevices.com

Carbon Reduction Commitment (CRC)
www.carbonreductionmanagement.co.uk/carbonreductioncommitment.htm

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



WG14120 ISBN 978 0 7504 7714 7