

Cultural landmark becomes an energy saving icon



Although only 5 years old, Wales Millennium Centre in Cardiff, which was officially opened by Her Majesty Queen Elizabeth II in November 2004 - a mere 33 months after construction had begun - has justified its vision to be an internationally significant cultural landmark and centre for the performing arts. Due to energy saving initiatives undertaken by The Centre's energy management team a saving of 15% in 2009 compared to our benchmark year of 2006 has been realised. A projected £65,000 plus of further savings will be realised from energy initiatives commenced within 2010.

Renowned for its inspiration, excellence and leadership, visitors come to the Centre to enjoy the full gamut of entertainments and arts participation from blockbuster West End musicals to modern music and standup comedy, from art exhibitions to free daily foyer performances. The building which comprises shops, bars and restaurants, is home to the Welsh National Opera, National Dance Company Wales, Urdd Gobath Cymru, and other prominent Welsh cultural companies.

Not only though is Wales Millennium Centre the hub of cultural life in Wales, but it has now become one of Europe's most sustainable cultural buildings. Earlier this year the Centre achieved ISO 14001 and is recognised as an exemplar by the Carbon Trust and is on track to reach or exceed the 2010 target of 21% energy use reduction compared to the benchmark year of 2006. Now thanks to a thorough air conditioning inspection, culminating in an improvement project carried out by leading HVAC energy saving specialist Efficient Air the Centre can again demonstrate best practice.

The project was managed by David Bonney, Technical Manager, Maintenance at the Centre, and Efficient Air's Energy Assessor Eric Agbozo, a CIBSE fully accredited complex Air-conditioning Energy Assessor. It was undertaken as an 'Article 9' Air Conditioning Inspection Survey of the HVAC systems and controls in line with the EPBD (Energy Performance of Buildings Directive) using the TM44 methodology.

The accompanying survey covered the Inspection of HVAC systems, capturing the performance and powers of fans, and associated heating and cooling electrical loads. The results gave David Bonney and his team the necessary data to compare the site's performance against industry standards, and to identify crucial energy savings, whilst maintaining their minimum performance requirements.

From the quick win and low cost energy saving initiatives that were identified, Efficient Air calculated an energy reduction of 80,350kW/hrs. This equates to a cost saving in the region of £7,254 per annum and a CO2 reduction of around 44.6Tonnes.

The second part of the Survey looked at capital investment opportunities, of which when implemented would yield an energy reduction of 644,800kWh, equating to a cost saving in the region of £58,032 per annum, and a CO2 reduction in the order of 354.6Tonnes.

Implementing all of the energy saving opportunities outlined in the report has the potential to improve the HVAC energy performance of the Centre by 28.3 per cent. This equates to energy saving of 725,150kWh's, a cost saving of £62,286 and a Carbon Dioxide reduction of 400 Tonnes. With a payback period of between 3.3 and 6.5 months, David Bonney had little difficulty in receiving authorization to commence the work.

Investigations

The first step in the process, and a pivotal aspect of Efficient Air's proven methodology, is to thorough investigation of every aspect of the building's structure, its operational characteristics and the HVAC services. The building has a total floor area of 32,3750m², with a conditioned floor area of 21,222m². The areas are conditioned by 37 AHUs, air delivery is provided via 72 off 4-pipe fan coil units.

Primary heating medium for the building is via a Low Temperature Hot Water (LTHW) system. Chilled Water is provided through 2 chiller units with a combined capacity of 2,236kW. In addition to the central equipment, there are dedicated LTHW and cooling systems serving AHUs and Fan Coil Units (FCU) located in the Dance House and the Urdd's 150 bed accommodation centre. These are centrally controlled with localised override.

Humidification provision is via electric steam humidifiers to the main auditorium and orchestral practice room. In the case of the main auditorium, humidification is required to maintain optimum condition for performers, musical equipments and the internal building fabric (which is mostly treated wood for acoustic purposes). All units are centrally controlled via the BMS with appropriate set points to ensure optimum efficiency.

Easy wins

Within a short space of time, Efficient Air's Energy Assessor was able to make some general observations. For instance, the majority of units on this site are providing greater levels of airflow than recommended CIBSE guidelines with significant saving achievable by recommendation of airflow reduction down to the required level as indicated in the quick wins. This can be done either by reducing the motor speed on the variable speed drives (VSD) to the systems.

The electrical energy required for ventilation fans and air-handling units plays an increasing role in the energy demand on buildings. The Specific fan Power (SFP) value (expressed in kW/m³. i.e. the energy required by the fan per unit volume of air) indicates the power efficiency of supply and extract air fans in a building. Recent studies have

shown that the electrical energy consumption of existing air-handling unit fans can easily be reduced from a level of between 5 and 10 kW/m³s to a modern recommended level of between 2 and 2.5 kW/m³s through better design and more efficient components.

Now for the detail

Eric Agbozo's report goes into great detail on every recommended action, supported by all the relevant calculations. In that regard it is a blueprint for energy saving in a building of this type. Below we summarise some key recommendations listed in his action plan which offer excellent energy saving improvements and contribute towards the carbon reduction of the building.

1. Reducing airflow to the Foyer area.

A reduction in air volume to AHU serving the foyer area provided an energy reduction of 53,100kWh's, carbon dioxide reduction of 29.2 Tonnes with payback less 1month. This was achieved via a fan speed "setback" on the installed inverter.

2. Overdoor heater review.

The installation of an effectively sized electric over door heater will maintain the required thermal barrier and minimise cold draft unto the concourse during winter periods.

3. Energy efficient humidification installation

Currently humidification provision is via electric generating steam humidifiers which operate at peak electric tariffs during performances. Recommendation was given to replacing electric humidifiers with other energy efficient humidifiers.

4. Valve replacement

Detailed inspection of AHU08 indicated valves were letting-by. Measured temperature readings of 35⁰C and 14⁰C were recorded though both control valves indicated a closed position. Valve replacement will provide an energy reduction of 1,500kWh's, carbon dioxide reduction of 8.3 Tonnes with payback period under 3 months

5. Inverter installation

Recommended installation of inverter on the primary LTHW circuit will provide an energy reduction of 40,000 kWh's, a carbon dioxide reduction of 22Tonnes with payback period under 7Months

6. Critical Areas DX Unit Installation

Cooling provision to business critical areas is via fan coil units fed from the main chillers/ice bank. Recommendation was given to isolate the fan coil units and install an independent (stand alone) split system controlled via the BMS. This will ensure that the chillers are switched off during winter periods resulting in an energy reduction of 604,800 kWh's, carbon dioxide reduction of 332.6Tonnes with payback period under 4 Months

With all the measures outlined in the Report now in place, Wales Millennium Centre can claim, alongside its growing cultural reputation, a new status as a beacon of sustainability. This achievement has not come about through rocket science, but by sensible, methodical and professional investigation creating an awareness of the value of quick low cost wins and strategic capital investment. It has made a welcome and immediate impact on energy and carbon savings.

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