

Research has shown that metering and monitoring HVAC systems can lead to substantial savings in energy use at little capital cost. Now a new project is inviting hundreds of organisations to participate for free in a major pan-European study to demonstrate the benefits of automatic monitoring when used to complement statutory HVAC inspections. **Alex Smith** reports

# EARLY WARNING SYSTEM

It's a no-brainer. To achieve the energy savings you usually just need a regular update of the systems' performance to prevent them drifting out of control  
*Ian Knight*

**A** Cardiff University administrative building has slashed the energy used by HVAC systems through the use of metering and monitoring. By analysing the performance of its HVAC system, the energy managers at McKenzie House were able to identify HVAC energy saving measures that amounted to a 25% saving in the building's total annual electricity bill.

McKenzie house was part of an EU-funded project called HARMONAC, which monitored and assessed the performance of 42 HVAC systems across Europe to assess their performance and identify energy conservation opportunities (ECOs).

Now the research team is inviting building owners and managers to participate in a new EU-funded project called iSERVcmb that could help see reductions in HVAC energy bills by up to 60%. iSERVcmb, in which CIBSE is a full partner, aims to collect sub-metering data from 1,600 HVAC systems in the EU.

It will analyse and compare this information to enable the benchmarking of individual

HVAC systems within buildings. From these benchmarks building managers can identify the measures required to save energy in the specific HVAC system configurations that are servicing the activities in their buildings.

iSERV will show whether automatic monitoring would offer a better alternative to the inspection of air conditioning systems across the EU, or whether it could be used to complement current statutory inspections. Regular inspection of air conditioning systems with rated output of more than 12kW was required under the Energy Performance of Buildings Directive, but following the findings from HARMONAC automatic monitoring and feedback systems can now be used to reduce the frequency of testing under the recast EPBD.

HVAC systems account for 11% of all electricity consumption in Europe according to the EC's Joint Research Centre. For the EU to meet its target of reducing energy use by 20% by 2020, it must do something to ensure these systems are energy efficient.

There is little information in the public ➤



Common issues identified by continuous monitoring include leaks in compressors, over-sizing and blocked filters  
*Ian Knight*

domain on the measured energy consumption of HVAC systems, says Dr Ian Knight, iSERV project coordinator and reader at Cardiff University. ‘The old adage “you can’t manage what you can’t measure” is very apt for HVAC systems,’ says Knight. ‘There is an absence of publicly available information derived from large-scale datasets on the detail of energy consumption of HVAC systems in buildings.’

HARMONAC revealed that inspections did not always identify under-performing systems. Through monitoring the project was able to identify and analyse 141 different energy conservation opportunities (ECOs), but it concluded that many of them would be missed by inspection. The sub-hourly data from the 42 sites revealed that inspections only identified 37% of the measures that

could have been taken to improve efficiency in those systems.

‘Inspections record a point in time – you see little of the control issues and you can’t see whether the system is consuming more energy than it should or is not running properly,’ says Knight. HVAC systems also tend to be serviced shortly before inspections, says Knight, meaning that systems that would benefit from the inspectors’ knowledge – often those that are not regularly serviced or monitored – are often missing the opportunity to improve their operating and maintenance practices.

Common issues identified by continuous monitoring includes leaks in compressors, over-sizing and blocked filters. It also finds solvable control issues, which are not expensive or difficult to remedy, such as



systems running in unoccupied areas and bad sequencing where, for example, three chillers might be running simultaneously when only one is required.

iSERVcmb addresses all the technical components in the EPBD such as boilers, pumps, fans and chillers. By collecting data from hundreds of HVAC systems, iSERVcmb will be able to provide benchmarks at the components level when serving specified end-user activity, hours of use and areas such as a conference room, kitchen, or server room. These benchmarks will allow energy managers to assess whether the energy being consumed by their HVAC system is reasonable for the activity it serves. Benchmarks will be continually updated during the project.

The researchers will use the project findings to create professional guidance on in-use energy

consumption of HVAC systems. This will, in turn, provide guidance for European member states legislating for automatic monitoring. 'We are attempting to show from live systems the benefits that can be achieved, as well as the practical in-use limits on reducing energy use when servicing specific end-user activities,' says Knight. 'iSERVcmb provides evidence-based data to inform the regulations that will be used to try and achieve near zero carbon buildings from 2019.'

#### How it works

For end users adding HVAC information to iSERVcmb there are two main sections to address. The first section requires them to describe the physical assets of the HVAC system, the spaces and activities served, the meters used to record the energy consumed,



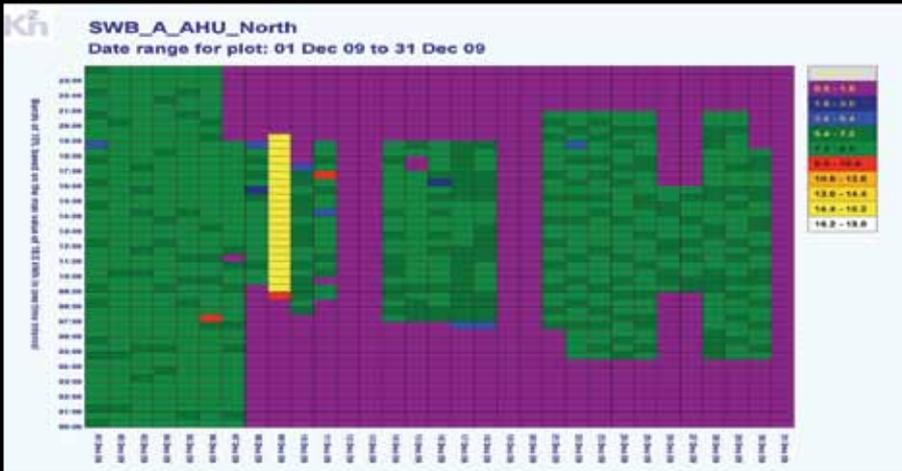
#### MCKENZIE HOUSE

Metering and monitoring enabled McKenzie House at Cardiff University to make substantial energy savings with little capital expenditure.

The data revealed that the HVAC systems were being run for far longer than necessary. The controls were changed so that they were only operating when areas were occupied.

Further energy savings were made when the comfort range was extended from 20-26°C to 21-23°C, and AHUs were turned off before people were due to leave the office.

In total the electricity savings achieved in this building from the HVAC system amount to around £55,000 per annum and are part of a total 33% (£74,000) annual electricity saving that has been achieved since 2005.



Sub-metering shows an AHU working outside office hours

6 Inspections only identified 37% of the measures that could have been taken to improve efficiency in those systems

and any sensors to be logged. iSERVcmb has developed a standalone Excel spreadsheet for this purpose. Participants use this spreadsheet to upload details of their HVAC systems onto the iSERVcmb database.

Once details are logged on the iSERVcmb database, the energy consumption of the HVAC components can be recorded and analysed by sending sub-hourly data from an automatic meter reading system to the iSERVcmb cloud-based servers. iSERVcmb prefers that participants record the consumption of as many components as possible but at a minimum they should at least record the chiller. The spreadsheets produced by the participating companies have already proven to be invaluable references, not only for understanding the HVAC system in a building, but also as business continuity documents, which allow information on where HVAC components, sensors and meters

are located to be quickly found – this is vital expensive-to-obtain information that is often lost when employees move on.

Time intervals between data collection should preferably be less than an hour (ideally 15 minutes says iSERVcmb), and should ideally be in the form of meter readings not just consumption over a time period – though pulse meter readings can be used. Data should be sent to iSERVcmb at least once a month via email. Direct data entry is possible via secure login facilities to the iSERVcmb database.

Reports are generated as soon as monitoring data has been uploaded. Participants will receive feedback on a number of indicators, including annual consumption against bespoke benchmarks for the mix of HVAC components and end use activities served.

Where possible and applicable, potential ECOs will also be identified, which could lead to energy savings of up to 60%, says iSERVcmb.

A case study is also generated on each system, which, along with the data, remains anonymous unless otherwise requested. Some have been happy to make their data public, says Knight. ‘One well-known firm said they didn’t care about anonymity. If their system’s not performing well they want to do something about it.’

The use of the iSERVcmb is free until funding ends in 2014, after which participating organisations can pay a monthly subscription if they want to continue to monitor and oversee their HVAC systems in this manner.

Data collected in iSERVcmb could potentially also be used in BIM. The fields used within iSERVcmb are intended to be compliant with Construction Operations Building Information Exchange (COBie) standards by the end of the project and therefore be integrated into BIM models.

Knight says there is an opportunity for organisations to make large savings with little capital cost. ‘The return on investment is often less than three months. It’s a no-brainer. To achieve the energy savings you usually just need a regular update of systems’ performance to prevent them drifting out of control.’

CIBSE’s technical director Hywel Davies says the project is vital. ‘Given the concerns about the mismatch between what the buildings are meant to use and really use, this is a really important and timely piece of research.’

‘It’s particularly timely when you consider the concerns about UK energy supply and the greater acknowledgement by government that reducing demand is a simple, cost-effective way of keeping the lights on.’ CJ

## Benefits to participants

The research runs until May 2014 and iSERVcmb is calling for owners or operators of HVAC systems to participate in the scheme. It has 300 systems in its database, but wants to reach 1,400 by the end of the project. It is also inviting HVAC system or component manufacturers, facility managers, and legislators or policymakers to join the scheme. Data collected remains secure and anonymous unless otherwise requested. Participation in iSERVcmb is free.

### iSERVcmb says there are numerous benefits for participating building managers and owners:

- Information on unexpected changes in energy consumption
- Bespoke energy consumption benchmarks for individual HVAC systems derived from the activities served
- ‘Real’ data from real systems makes the information easy to understand by all stakeholders, and provides confidence that the

performance benchmarks are achievable.

### Benefits of allowing this approach for EU member states:

- Improvement of the efficiency of the energy inspection process
- Reducing compliance burdens on well-run HVAC systems
- Achievement of lasting, cost-effective improvements in HVAC system energy efficiency
- Rapid identification of good and best practice in HVAC energy use without favouring any technology or approach.

### Benefits for participating equipment manufacturers:

- Independent verification of HVAC component energy performance in practice
- Marketing opportunities
- Opportunity to add value to HVAC products.