CIBSE JOURNAL

CIBSE

The official magazine of the Chartered Institution of Building Services Engineers

April 2013

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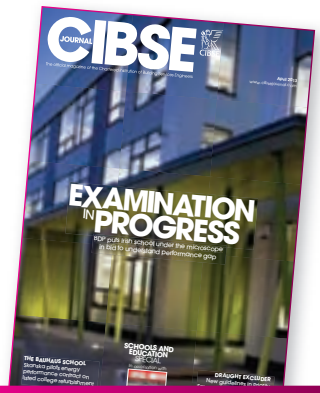


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**'We don't have a snowball's chance in hell of hitting the UK's carbon reduction target by 2050'**
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**Editorial**
**Editor:** Alex Smith
Tel: 01223 273520
Email: asmith@cibsejournal.com
**Deputy editor:** Carina Bailey
Tel: 01223 273521
Email: cbailey@cibsejournal.com
**Senior designer:** Dean Farrow
**Technical editor:** Tim Dwyer

**Advertisement sales**
**Sales manager:** Jim Folley
Tel: 020 7324 2786, jim.folley@redactive.co.uk
**Sales consultant:** Mark Palmer, Tel: 020 7324 2785, mark.palmer@redactive.co.uk
**Sales executive:** Darren Hale
Tel: 020 7880 6206, darren.hale@redactive.co.uk
**Senior sales executive:** Paul Wade
Tel: 020 7880 6212
paul.wade@redactive.co.uk
**Advertising production:** Jane Easterman
Tel: 020 7880 6248
jane.easterman@redactive.co.uk

**For CIBSE**
**Publishing co-ordinator:** Nicola Hurley
Tel: 020 8772 3697, nhurley@cibse.org



*CIBSE Journal* is written and produced by CPL (Cambridge Publishers Ltd) Tel: +44 (0) 1223 477411. www.cpl.co.uk 275 Newmarket Road, Cambridge CB5 8JE.

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CIBSE, 222 Balham High Road, London SW12 9BS
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# Cold comforts

Despite sustainable development barely meriting a mention in George Osborne's Budget speech in the House of Commons, there was some reassuring news buried at the bottom of the Chancellor's famous red briefcase. Tucked away in the detail was confirmation that the government was commited to the delivery of zero carbon homes by 2016. Budget documents also stated that in May there would be a detailed response to last year's consulation on Part L of the Building Regulations. The response will be in May, which still only leaves five months before the revised regulation comes into force.

Those concerned that Part L could be watered down in the face of the government drive for deregulation may have found little succor in the words of building regulations minister Don Foster at Ecobuild who talked of competing pressures between affordable housing and sustainable development and how 'decisions on energy efficiency aren't taken in a bubble'. It felt like he was preparing his audience of energy professionals for disappointment later in the spring.

Elsewhere in the Ecobuild hangers were insightful talks by those with an interest in making money from investing in energy efficiency. Gil Levy, partner at Sustainable Development Capital LLP (SDCL), quietly announced that his company had a pipeline of £450m in energy efficiency investments.

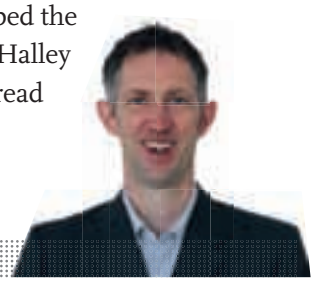
> There was some reassuring news on Part L and zero carbon homes tucked away at the bottom of the Chancellor's famous red briefcase

Levy said that there was an 'explosion in the energy efficient market', with many victins of the FiTs fallout looking to benefit from the drive to improve building efficiency and cut energy bills.

SDCL lends money to building owners to improve their buildings, and takes the risk if energy targets aren't met. SDCL shares the reductions in fuel bills with the client, and agrees contracts with the project team to ensure building performance is delivered as designed.

Hammerson's model for energy peformance contracts is similar and head of sustainability Paul Edwards reveals more details about how the retail developer is introducing soft landings – and higher consultant fees – in a bid to cut 25% off their shopping centre energy bills of up to £1m.

It's been a unseasonably cold March, but nothing compared to the Antarctic where Aecom has developed the building services for the extraordinary Halley VI research centre. Turn to page 26 to read all about it (but don't forget your coat).



**Alex Smith, Editor**
asmith@cibsejournal.com

# NEWS

*All the latest news from around the building industry*

**MAKING THE NEWS**

Atkins has produced a masterplan including landscape design, urban planning and tourism consultancy for the redevelopment of 11 km$^2$ of waterfront in Nanjing, China. The ancient Chinese city on the banks of the Yangtze River is preparing to host the 2014 Youth Olympic Games. Atkins won the Collaborative Working Award at the CIBSE Building Performance Awards for its work on the London 2012 Olympic and Paralympic Games

## In brief

**DATA CENTRE MOT**

The Data Centre Alliance (DCA) has launched the world's first independent multi-disciplinary data centre 'MOT'. DCA executive director Simon Campbell-Whyte said people buying data centre services had 'no sure-fire or simple way to judge the true quality and resilience of a data centre – unless they themselves were highly technical' before the scheme was launched.

**AWARD LIGHTS UP BRUNEL**

Brunel University has been awarded a runners-up prize in the Employability Initiative category at the Guardian University Awards 2013 for its collaboration with the Lighting Education Trust (LET) to develop a bachelor degree in lighting – less than a year after the course was launched. The Guardian University Awards recognise best practice, achievement and innovation across a range of categories.

# 39% 'now using BIM'

**Survey reveals growing level of BIM adoption**

Nearly three quarters of the industry believes that Building Information Modelling (BIM) is 'the future of project information', and 39% are now working with BIM, according to a major survey.

The NBS National BIM Survey, conducted between December 2012 and February 2013, received responses from 1,350 architecture, engineering and surveying professionals covering a range of company sizes.

However, almost two years after the publication of the UK Construction Strategy – in which BIM plays a central role – fewer than half of respondents were aware of the different levels of BIM, said NBS. Level 2 will be mandatory on all government projects by the end of 2016.

A lack of clarity around the subject was seen as an obstacle to more rapid adoption, with 74% agreeing that the industry is 'not clear enough on what BIM is yet'. Only around one third of those questioned claimed to be 'very' or 'quite' confident in their BIM knowledge and skills.

However, 73% said clients will increasingly insist on the use of BIM and over half of respondents said the government was 'on the right track with BIM'.

Of those who have adopted BIM, more than half believe it led to greater cost efficiencies, while three quarters reported increased coordination of construction documents. Improved productivity due to easy retrieval of information and better quality visualisations were other benefits, the survey indicated. Only 6% said they regretted adopting BIM.

'Digital construction is here to stay,' said Stephen Hamil, director of design and innovation at RIBA Enterprises. 'However, the true benefits of BIM will not be realised until the industry focuses on clear requirements around structured information.'

The Construction Industry Council (CIC) has also published its BIM Protocol that provides the legal framework to underpin wider adoption of BIM. It has also produced two other documents: *Best Practice Guide for Professional Indemnity Insurance when using BIM* and *Outline Scope of Services for the role of Information Management*.

All three documents are available to download free at **www.cic.org.uk**.

The full NBS National BIM Survey results are available at **www.thenbs.com**.

# Wrap turns to services

**● CIBSE partnership aims to cut building services waste**

The building services industry is missing out on major opportunities to cut costs and it could improve project delivery through more efficient handling of resources.

The Waste Resources Action Programme (Wrap), an independent, not-for-profit advisory body, has formed a partnership with CIBSE 'to increase awareness of the opportunities and business benefits of resource efficiency' and the engineering consultancy Aecom has been appointed to prepare CIBSE guidance on the topic.

Aecom estimates that building services represent between two and 12% of the total embodied carbon of a typical building and, because services are replaced frequently over a building's life, they 'represent considerable wastage of valuable resources'.

'Resource efficiency is, essentially, about doing more with less and covers the use of materials, recycled content, embodied carbon, water use, resource scarcity and security, life span and end of life potential (e.g. reuse, recyclability),' explained CIBSE technical director Hywel Davies.

Wilson: 'A simplified design solution can use fewer components and materials'

'Our industry has a huge role to play in ensuring increasingly valuable resources are not squandered,' he added.

WRAP and CIBSE will deliver a series of workshops covering ventilation, heating, cooling, lighting and lifts. They will also gather feedback on the practical implications of this initiative.

Aecom will identify opportunities to be resource efficient and to secure capital cost savings. These could include polyethylene pipework instead of copper and increasing the use of modular construction.

'There are already many good examples where resource efficiency principles are applied on projects,' said Davies. 'For example, air handling units can be re-conditioned and re-used on refurbishment projects.'

Improving resource efficiency is also a key part of streamlining project delivery, according to Aecom director Ant Wilson. 'A simplified design solution can use fewer components and materials. The capital cost should be lower, there is less to go wrong and less energy consumed in manufacture and operation.

'Resource efficiency can represent savings at every step and reduce the burden on the world's precious resources.'

Richard Buckingham, head of construction and refurbishment at WRAP, welcomed the partnership with CIBSE. 'We hope that the project will enable us to deliver beneficial guidance for the industry,' he added.

**Resourceefficiency@cibse.org**

# CIBSE launches new version of CHP guidance

CIBSE has launched a new version of its application manual *AM12 Combined Heat and Power for Buildings*, which was first published in 1999.

It features new chapters on district heating (DH) applications, information for assessing environmental benefits and more detail on tri-generation (cooling, heating and power (CHP)), as well as how to use thermal storage to extract maximum performance from a CHP system.

'CHP can offer a more energy efficient way of generating power and is cost-effective to implement in many applications,' a CIBSE statement said. 'CHP produces both electric or shaft power and thermal energy onsite or near site, converting as much as 85% of the input fuel into useful energy.'

Phil Jones, chairman of the CIBSE CHP and district heating group, said it was crucial that CHP was 'only put in the right places... and not in the wrong ones'. He added that the new guidance would also address some of the 'misleading statements about the carbon content of different energy sources'.

'Used appropriately, CHP increases resource energy efficiency and helps reduce $CO_2$ emissions. CHP systems can also improve power reliability by reducing or eliminating a building's dependence on the grid,' Jones added.

The launch took place at AECOM's offices in London where the guide's author, the company's technical director Paul Woods, said the role of CHP would change as the carbon content of grid-generated electricity was reduced.

However, he sees a long-term role for the technology, particularly as commercial users are expressing growing concerns about energy security.

'The three main challenges we face are $CO_2$ reduction, rising energy prices and security of supply – CHP can help with all three,' said Woods.

Hoare Lea's Huw Blackwell explained that CHP should not been seen as a 'silver bullet', adding that its misuse in some instances, simply to achieve planning permission, had done the technology no favours. He urged designers to get back into those projects to improve the operating performance of the systems.

Blackwell also pointed out that CHP and heat pumps were complementary technologies. 'They are not conflicting, because they suit different loads and applications,' he added.

*AM12* is available at **www.cibseknowledgeportal.co.uk**

# In brief

**NEW SCHOOLS COULD ALL ADOPT PASSIVHAUS MODEL**

All new UK schools could be built to the ultra-low energy Passivhaus standard, under designs being drawn up by a leading design practice.

Architype is working with contractor Thomas Vale to create a standardised school design that could be built for the £1,480 per square metre cost required by the government. The partners, who collaborated on three Passivhaus schools in Wolverhampton, said there was no reason 'why it wouldn't work anywhere in the country'.

The increased use of pre-fabrication is also helping achieve these low energy and efficiency standards in new school buildings. Pre-fabrication is also the key to applying Passivhaus standards in the residential sector, added Architype.

'We got fed up with developers not being interested in sustainability,' it said. 'We're working on an initiative to produce Passivhaus houses at the same cost as developers do, by full pre-fabrication in the UK.

**1,800 GREEN DEAL ASSESSMENTS IN FIRST MONTH**

The Department of Energy and Climate Change (DECC) has reported that more than 1,800 Green Deal assessments were carried out in the energy efficiency scheme's first month of operation between late January and late February.

The Green Deal Finance Company has also received £244m of government money to help set-up, finance and operate the scheme.

Triumphant Energy and Climate Change Secretary Ed Davey said: 'We're seeing clear signs of a promising new market gathering momentum.'

DECC added that £27m worth of contracts had been signed under the energy company obligation (ECO), where energy suppliers pay to retrofit homes for householders on lower incomes, or in older properties.

● There will be extra Green Deal funding for better performing systems, according to Steve Jones, Green Deal team leader at the Department of Energy and Climate Change. He said the government was aiming to bring changes in differentiating between products in April 2014.

# In brief

### FUNDING FOR POOR-PERFORMING HOMES STUDY

The government is to spend £380,000 on a study into the poor energy performance of many new build homes.

The study, announced at Ecobuild by Building Regulations Minister Don Foster, is to be carried out by the government, and manufacturing and construction industries. It will look into the reasons why many new homes fail to meet expectations, including the use of building materials and problems caused by construction practices.

The Minister said the alternative 'would be further regulation of industry, but I do not want to add red tape and financial burdens that would just be passed on to already-struggling homebuyers'. Foster said he would rather 'work with industry to improve standards and performance in practice'.

### TECHNICAL SYMPOSIUM OPENS THIS MONTH

This month CIBSE will be staging its third Technical Symposium, which will take place in Liverpool on 11-12 April. Focusing on 'Delivering buildings that are truly fit for purpose', the symposium will hear from a host of speakers presenting their papers, latest practice and research. Topics to be covered include benchmarking systems, monitoring and feedback methods, the integration of renewable energy systems and innovations. For information and to book your place, visit **www.cibse.org** and click on the 'Training and Events' tab.

# Heat pump industry calls for RHI certainty

**● RHI changes welcomed, but questions remain**

The Heat Pump Association (HPA) has cautiously welcomed the changes to the Renewable Heat Incentive (RHI) announced by the government following a public consultation

The government has set a target of 6.8 million heat pump installations in the UK by 2030, which would require the industry to step up activity from the current level of 20,000 units a year to 600,000. Support through the RHI is seen as a crucial market driver.

The HPA said it was concerned that implementation of Phase Two of the non-domestic scheme still seemed to be some way off, and urged the government to confirm that it would proceed, and that air source heat pumps (ASHPs) would be included, as indicated in the consultation.

The association also said there was a danger of creating a 'self-fulfilling prophecy' by announcing a very low 'trigger point' for a cut in the tariff for ground source heat pumps (GSHPs).

**'Investment in the RHI will be crucial in helping to develop the market'**

'The HPA is very concerned that it appears the view being taken is that deployment for GSHP is likely to remain low and, thus, a trigger point for its digression in tariff has been set at just 5% of total spend,' a statement said.

'GSHP deployment is low for a number of reasons, and a more realistic tariff, along with preliminary accreditation and, ideally, enhanced preliminary accreditation (EPA) would contribute positively to its wider deployment.'

All technologies have a 'trigger point' that, when reached, means the government will reduce its tariff, but most are set at 150% of anticipated uptake.

Heat pump manufacturer NIBE also welcomed the investment in the RHI, which it said would be crucial in helping to develop the market. UK managing director Phil Hurley said the government's vision was 'ambitious but achievable'. He said it would also require significant investment in the country's energy infrastructure to support the greater volume of heat pumps.

'There are also big issues with heat pumps not being installed properly,' he told a reception at Ecobuild. 'We need the installer network and the skills – if that is not in place, then it all falls down,' said Hurley.

# DECC ordered to pay £180,000 FiT legal bill

The government has been ordered to pay a total of £180,000 in legal costs to solar firms and campaign group Friends of the Earth as a result of claims, following its decision to slash Feed-in Tariffs (FiTs) in 2011.

FOE and two solar panel suppliers, HomeSun and Solarcentury, appealed against the cuts to the High Court. The judge ruled that the cut-off date for FiT claims was 'retrospective and illegal' and two subsequent government appeals have now been thrown out.

The Department of Energy and Climate Change (DECC) was originally ordered to pay the costs in December 2011. A spokesman for the solar firms said the government's decision to cut the tariffs retrospectively caused 'genuine damage' to the industry and undermined employment prospects for thousands of people.

'It would have been better if the government had not taken this action and dragged it out so long, not just because of the money spent but because of the confidence in the industry that was lost,' added Donna Hume, an energy campaigner at Friends of the Earth.

# Gaia architect Howard Liddell dies

**Award-winning architect remembered**

Architect Howard Liddell, principal of Gaia Architects Scotland and a passionate advocate of building on passive principles, has died aged 67.

Bill Bordass, of the Usable Buildings Trust, described Liddell as a polymath and a hands-on pioneer of green building who was always way ahead of the curve. 'When I first met him, he was deep into healthy, low-impact buildings and maximising the use of renewable non-toxic materials,' said Bordass.

'His particular interests included measures based on building physics – not just natural light, ventilation and solar, but dynamic insulation and vapour-permeable humidity stabilising structures.

'Where possible, he endeavoured

to design out not just the building services but the building services engineer – seeking to make even large non-domestic buildings as domestic as possible.'

Bordass recounted how Liddell, working with his wife Sandy Halliday and colleagues in an old monastery in Edinburgh, made major contributions to the Scottish Ecological Design Association (SEDA), which Liddell co-founded in 1991.

Liddell's OBE, awarded in January and presented at his funeral, cited SEDA and his other charitable work – including the 1992 Children's Eco-city project

Two recently completed, award-winning Gaia projects in the Tweed Valley included Plummerswood, a house with Passivhaus certification, and the Forestry Commission Scotland's Glentress Peel visitor centre. Both got top awards in 2012: Plummerswood for architectural excellence and Glentress for green tourism.

In his book *Eco-minimalism: the antidote to ecobling* Liddell wrote: '... the scattergun, "Christmas tree" approach should be ditched in favour of holistic, considered and appropriate deployment of building science in support of truly ecological, affordable sustainable architecture for everyone.'

# 80% carbon target 'technically possible'

It is possible for the construction industry to cut carbon emissions by 80% by 2050, but it will be 'very challenging', according to the Green Construction Board.

This joint government-industry group launched the latest in a long series of reports into improving the industry's sustainability at last month's Ecobuild show in London. The Low Carbon Routemap for the Built Environment, unveiled by former government Chief Construction Adviser Paul Morrell, sets out what will be needed to achieve the 80% reduction in greenhouse gas emissions from 1990 levels.

It concludes that the target is 'technically possible, but very challenging', and that success

**'Success is dependent on improving the economic viability of technical solutions'**

is dependent on improving the economic viability of technical solutions and addressing market failures.

It also called for the industry to take responsibility for carbon reduction and recognise that it 'represents an economic opportunity, particularly in retrofitting domestic buildings'.

'This Routemap... shows that even closer collaboration is required in the future if we want to get closer to achieving our objective,' said Business Minister Michael Fallon. 'While the Routemap shows that the 80% target is a very challenging one, we must not lose sight of the overall objective, which is to minimise carbon emissions.'

### DIVERSITY PANEL LAUNCHES

A new CIBSE panel to promote diversity is to be launched on 18 April at an event in central London. The CIBSE Diversity for Improved Business Performance Panel reinforces CIBSE's commitment to diversity, aiming to provide a forum for sharing knowledge and best practice, as well as nurturing and retaining talent in the industry.

The event takes place from 6-8.30pm at the Building Centre, Store Street, London WC1E 7BT, with speakers including CIBSE past president Andy Ford; Labour MP Chi Onwurha; Loraine Martins MBE, director of diversity and inclusion at Network Rail; Dorte Rich Jørgensen, former Atkins' sustainability manager for London 2012; and CIBSE president-elect George Adams.

Attendance is free, but delegates must register in advance on the CIBSE Training & Events page at **www.cibse.org**

For more information, contact Neil Walsh on 020 8675 5211 or email **nwalsh@cibse.org**

### ACE IN PICKLES LEGAL ACTION

The Association for the Conservation of Energy (ACE) says it has started legal proceedings against Communities Secretary Eric Pickles for ditching 'consequential improvements' from the new Building Regulations.

ACE believes that by ignoring the results of his own public consultation on the issue, Pickles has acted unlawfully. Without the consequential improvement law, 2.2 million fewer households will now engage with the Green Deal, according to an impact assessment carried out by Pickles' own department.

## In brief

**WOMEN INSPIRE ENGINEERS**

The new women's engineering group, WiBSE, held its first official event at Ramboll's London office last month. Four women shared their experiences of rising to the top of their careers.

The women – Alex Lawrence, technical director at Ramboll, Debbie Beaven, finance director at Ramboll, Claire Devine, director at Capita Architecture and chairman of Women in Architecture – described their experiences of climbing the career ladder and the barriers they overcame.

Former UK diplomat and non-executive director at Mott McDonald, Clare Smith, spoke of her determination to secure a place at the Foreign Office before working around the world with her family in tow.

'I'm the woman in Islamabad who talked to the Taliban,' Smith joked to the audience when describing the role she played during an airline hijacking.

# CIBSE responds to 2013 Budget

The government will be responding to last year's consultation on changes to Part L of the Building Regulations by May, the Chancellor George Osborne announced in his Spring Budget Statement last month.

CIBSE has welcomed the news after raising concerns in December over delays to Part L. Nonetheless, the institution still believes uncertainty over the 2013 changes is holding back activity and causing additional costs in the sector, both in terms of energy saving opportunities and also to businesses committed to better building performance.

CIBSE technical director Hywel Davies said: 'It is good to have a firm date when we can expect an announcement, although it leaves consultants and clients with further uncertainty, which will not stimulate activity.' CIBSE has also welcomed announcements providing more certainty for zero carbon homes from 2016. It has stated that it will consult on the next steps for the zero carbon homes policy, including on the means of delivering 'allowable solutions' – part of the government's strategy for cost-effective delivery of mainstream zero carbon new homes – by the target date.

**'It is good to have a firm date when we can expect an announcement'**

A boost in infrastructure spending is also planned by government, with £3bn a year expected to come from departmental savings, to be spent from 2015-16. Chancellor George Osborne said this would enable government to spend an extra £15bn on capital spending over the next decade.

Osborne also revealed a 'Help to Buy' scheme to kickstart the housing market. A total of £3.5bn is to be spent on shared equity loans over the next three years, and a Mortgage Guarantee will allow lenders to provide loans to people with small deposits.

But the president of the Royal Institute of British Architects, Angela Brady, said Osborne's Budget would do little for the country's housing crisis. She said: 'The UK is in the grip of the worst housing crisis for decades, yet committing to build only a tiny proportion of the 300,000 new homes that are needed each year to meet demand.'

# Hammerson reveals plans for energy performance contracts

## Soft landings key to success says developer

Hammerson will draw up its first energy performance contracts (EPCs) with consultants by May, according to the property developer's head of sustainability Paul Edwards.

The energy performance contracts are set to take a carrot and stick approach, rewarding consultants that exceed energy targets and penalising those who fail to meet the targets predicted at design stage.

Edwards said EPCs would include soft landings and the involvement of facilities managers at early design stage.

A baseline design model establishing predicted energy use would be established using IES or TAS, according to Edwards.

He said: 'EPCs and DECs don't align, which is really annoying. We have to come up with a base model with the design team, and agree targets.'

Edwards said that Hammerson's FM team would be involved at design stage, when lighting loads and occupancy densities would be taken into consideration.

**'Soft landings give consultants opportunity to learn'**

Design changes or value engineering would be tested against the baseline model throughout the design process, explained Edwards.

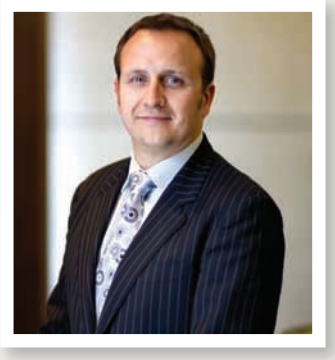
Consultants would continue to be involved in the project after completion. 'As part of the contract, consultants would check energy performance every month for 12 months to ensure commissioning is done correctly,' said Edwards.

He added: 'The 12-month soft landing gives engineers the opportunity to learn about the operation of the buildings. Being kicked off as soon as the building is completed is not good for them.'

Edwards said Hammerson was prepared to invest in soft landings and boost consultant fees. He said a proportion of the savings made from lower energy use would cover the larger fees.

'It's a sensible approach – it encourages people to deliver what they say they will,' said Edwards.

## 'You don't expect a clapped out old banger when you buy a Ferrari'



Paul Edwards couldn't be more straightforward about why he wants consultants to sign up to energy performance contracts for Hammerson's retail schemes. 'We develop £300m shopping centres and a year later find we discover they're using twice as much energy as we expected. We want buildings to behave as predicted by the consultants.'

'If a Ferrari did 0-60 in three seconds and I was getting 15 seconds, I wouldn't be very happy.'

Edwards, who is the current chair of the Better Buildings Partnership, is dismissive of energy performance certificates, which only offer a building's predicted energy rating. 'At the moment, we might be told the development has an energy performance certification rating of B, but it ends up being a G and we can't do anything about it,' he says.

Consultants signing up to Hammerson's energy performance contracts will be set targets based on a baseline energy model established by the design team. Hammerson's FM team will have input, helping to establish lighting loads and occupation rates.

'When we start more detailed design, we will test against the base model, and if value engineering takes place, we will also look at the impact of these changes,' says Edwards.

When CIBSE Journal reported that Hammerson was considering introducing energy performance contracts (Life after DECs, *CIBSE Journal*, February 2013), the CIBSE LinkedIn forum lit up with questions about how it would work. There was some cynicism about Hammerson's motives and whether consultants would be expected to work harder for less.

Edwards was surprised by the tone of some of the comments. 'It's a fantastic opportunity for engineering firms,' he says. 'We're simply asking the best engineers to step up to the mark.'

Consultants will be reassured that Hammerson is willing to pay consultants a higher fee to look at the performance of the building after completion – consultants will look at the building performance every month for a year to ensure systems have been commissioned properly.

'A little bit of investment in the design team by us will save us money, and if you have lower operating costs, it will add to the value of the building,' says Edwards.

# Workmanship 'key' to retrofit projects

The airtightness of existing homes must be improved if mechanical ventilation with heat recovery (MVHR) is to be fitted into existing homes, a major research study has found.

Project Calebre found that workmanship was critical to ensuring optimal performance. On the EON test house at Nottingham University, a contractor fitting an MVHR unit compromised the airtightness despite having experience of fitting 30 MVHR systems.

'A lot of work needs to be done in broadening out the training,' said Professor Dennis Loveday, principal investigator on Project Calebre, which stands for Consumer-Appealing Low Energy technologies for Building Retrofitting.

The report found that the refurbishment of existing housing could achieve airtightness levels of around 3 $m^3/(h.m^2)$@50Pa with good detailing and a high level of workmanship.

Project Calebre is a collaboration between six universities that aims to address the challenges of energy efficient refurbishment in the UK's 8.3m solid-wall properties. The project has been testing and developing technologies most likely to improve performance and be accepted by occupiers.

Loveday said: 'The project found that comfort and need for repairs were much bigger drivers than energy efficiency for householders.

Calebre has been looking closely at the integration of slender vacuum glazing for period windows and heat pumps that fit into the space of an existing boiler. The project is working with manufacturers to commercialise innovative products that had been refined in university laboratories.

Another important finding has been the impact of existing energy saving systems on retrofitting. Calebre says the order of measures can have a big impact on overall $CO_2$ emissions.

The findings of the ongoing project have been published to coincide with the launch of the Green Deal.

**www.calebre.org.uk/**

## Preview of presidential address planned

The Home Counties region will be holding its annual general meeting (AGM) on 23 April, with a tour of the Essex Record Office (ERO).

The ERO is a flagship building for Essex County Council, which houses historical and important regional records under specialised and controlled environmental conditions.

The AGM will follow the tour and then CIBSE president-elect George Adams will be previewing his presidential address.

The event is free, but a voluntary donation of £1 to the CIBSE Benevolent Fund is invited. For more information and to register, visit **www.cibse.org**

## Entries sought for young lighter competition

The Society of Light and Lighting (SLL) is pleased to announce that the Young Lighter of the Year (YLOTY) 2013 competition is now open for entries.

Finalists will get the chance to present at the LUX Live exhibition and the winner will receive the prestigious award at the Lux Awards in London on 21 November.

The competition, now in its 19th year, provides a unique platform for young lighters and is open to those under 30.

YLOTY gives the young lighters an opportunity to make a presentation on a lighting subject, hone their presentation skills in front of an invited panel of judges, and raise their profile within the industry.

For more information, visit **www.sll.org.uk/yloty**


# *Journal* and Knowledge Portal voted two of the top benefits

**CIBSE to improve communication to emphasise membership benefits**

Members have voted *CIBSE Journal*, the Knowledge Portal and the ability to get professionally registered as the top benefits of being a CIBSE member in the latest membership survey.

The annual survey, which was conducted in 2012, saw more than 2,200 members in more than 50 countries respond to tell the Institution what they valued most from their membership. More than 80% rated their membership as 'excellent', 'very good' or 'good'. However, there were a number of respondents who were not aware of some of CIBSE's membership benefits. The Institution now aims to improve the way it communicates these to both new and existing members.

Carilyn Clements, director of membership at CIBSE, said: 'It was great to see that more than 80% of members believed that CIBSE is considered important within the industry, and 70% agreed that being a CIBSE member had benefited their career. Also, 93% of respondents would recommend CIBSE to a colleague.

'More than 700 members who responded were keen to get involved in their regional activities or volunteer on a CIBSE committee, and we will be contacting those who expressed an interest over the coming months to let them know how they can get more involved.'

A large number of respondents were not aware of the social media channels that CIBSE has set up in the last year, namely LinkedIn and Twitter. Members that are registered on LinkedIn can join the CIBSE Group and contribute to the lively discussions.

Many members commented on the CIBSE website and on improvements that could be made. This feedback is well timed, as the Institution is currently starting to implement its new IT strategy and will be developing its website over 2013/14.

Clements added: 'We'd like to thank all the members who participated. You really do help to influence your membership offering.'

# Engineering Award entries invited

The CIBSE Young Engineering Awards 2013 are now open for entries. The awards bring together the CIBSE ASHRAE Graduate of the Year award and the Employer of the Year award in one high-profile event at the Institution of Mechanical Engineers (IMechE) this October.

The awards highlight the talent available to engineering employers, while demonstrating the importance of providing young engineers with opportunities to advance their careers. This year, the winner of the CIBSE ASHRAE Graduate of the Year award will win a trip to the ASHRAE Conference in New York.

To enter, you must have graduated in a building services-related discipline within the last two years. There is no age limit.

Those shortlisted will be invited to give a short presentation in front of the judging panel and audience on 9 October. The CIBSE Employer of the Year Awards recognise those employers – large and small – that have shown excellence and innovation in developing the engineers of the future, whether through a commitment to young people in employment or by supporting those employees through education.

The deadline for both entries is 31 July.

For more information and the application forms, visit **www.cibse.org/yea**

# Commission module goes live on web

CIBSE has just launched a new online learning module on Commissioning and Testing of Mechanical Services, bringing the number of modules in its portfolio to 11.

This new module provides an explanation of the main activities involved in the commissioning of air and water circulation systems.

'Commissioning' is a general term that can be applied to an entire system, or to the individual components within a system. For example, plant items such as boilers, chillers and pumps are likely to require commissioning in accordance with their manufacturer's instructions. Similarly, control systems will need to be commissioned

by a controls specialist. However, the pipework or ductwork systems that link all of these components together also require commissioning. It is these systems – for which no manufacturers' instructions exist and that are generally dealt with by commissioning specialists working under the instruction of system designers and installers – that are covered by this module.

The main concern of designers is to ensure that the distribution of flows around the system are correct. The module explains the design issues and the types of c valve, damper and/or flow measurement devices that need to be incorporated in systems to make them commissionable, operable and energy efficient.

The course is available for members at £150 plus VAT, and non-members for £200 plus VAT.

For further information visit **www.cibsetraining.co.uk/online-learning**

# Have bursary, will travel: Dale applications open

Applications for this year's Ken Dale Travel Bursary are now invited.

The bursary, which was established to commemorate Ken Dale's contribution to the Institution and the building services profession, makes awards available of between £1,500 and £4,000 to CIBSE members in the developmental stage of their career, to enable them to spend three to four weeks outside their own country researching aspects connected to their field of work.

The research should be of benefit to CIBSE, your employer and clients in the profession. CIBSE is particularly keen to encourage applications for research that articulates the Institution's concern for the environment.

The successful applicant will be required to complete a 5,000 to 10,000-word report, outlining the research undertaken, and report their research in a presentation to the CIBSE board. Last year's winner, Deivy Riquier, visited Sweden, Japan and the USA to investigate 'Advanced district cooling technologies: an international insight'.

For more information and an application form, visit **www.cibse.org/bursaries** Entries should be received by 12 April, with interviews being held on 7-9 May.

# Obituary

## *Richard E Tully CEng, FIMechE, FCIBSE, FASHRAE, FIOP*

Richard E Tully, a career-long CIBSE member, died peacefully after a long illness on 4 February, aged 88. He commenced his career in the early 1940s, joining a firm of public health engineers and then transferred to E Wingfield-Bowles & Partners. He joined Buckle & Partners at its foundation in 1946, became a partner in 1961, was senior partner from 1973 to 1988, and then a consultant to the practice from 1989 to 1990. He retained his directorship of Harringtons and continued his active interest in the industry during his semi-retirement.

He joined the Institution of Heating and Ventilating Engineers (IHVE) in 1946, and served on Council and various committees of the IHVE and CIBSE. He was CIBSE president in 1984/85 and was honorary treasurer from 1989 to 1994.

He served for five years as a CIBSE-nominated director on the board of the builder group responsible for CIBSE's magazine, then known as *Building Services*. He also served as a director of the National Engineering Specification (NES), then a CIBSE-owned company.

He then became the representative for the Association for Consultancy and Engineering (ACE), on the National Joint Consultative Committee for Building (NJCC) committees, and was the chairman of the NJCC in 1987.

He was the first Englishman to be awarded a Fellowship of the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) and achieved 50 years of membership in 2006.

Professionally, he was responsible for the overall design of comprehensive environmental engineering services for a variety of multi-purpose and specialist projects for public companies and government departments, including the original London Heathrow Airport central terminal area passenger buildings and the control tower.

In the course of his working career he travelled widely in Europe, North America, the West Indies, Africa and the Middle East. The portfolio of countries he visited expanded further during his semi-retirement years.

During his fulfilling retirement time, he was still interested in his professional institutions and continued to support them where he was able to do so. He believed in providing the tools to assist others in their careers and that CIBSE has an important continuing role to play in that.

To this end he established the Richard Tully Family Technical Publications Fund to support the development of guidance and technical information by the Institution. CIBSE would like to make special acknowledgement of this generous support.

Richard Tully will be missed by Pauline, his wife of 63 years, his family and many local friends whose company he enjoyed, and by many CIBSE members who knew him.

## Feb Technical Journal focuses on climate

The February edition of the *Building Services Engineering Research and Technology Journal* (*BSER&T*) is a special issue, focusing on 'Adaptation and resilience to a changing climate: supporting adaptation decision making.' The papers were presented at the CIBSE Technical Symposia at De Montfort University in 2011 and Imperial College in 2012.

This quarterly journal contains refereed papers on all aspects of building services engineering.

The current (February) edition includes articles entitled:

- Future-proofed energy design for dwellings: case studies from England and application to the Code for Sustainable Homes
- Assessing energy performance benchmarks for performing arts buildings using a new dataset
- Benchmarking small-power energy consumption in office buildings in the United Kingdom

Members may access this edition of *BSER&T* for free through the members' area at **www.cibse.org**

Society of Light and Lighting members also have access to the *Lighting, Research & Technology Journal (LR&T)*

### Diary date

**CIBSE AGM**

**The CIBSE annual general meeting will be held on 9 May 2013 at The Royal Society, 6-9 Carlton House Terrace, London SW1Y 4AG**

It will be followed by the incoming president George Adam's presidential address. Members will receive a calling notice later this month with details.

## New members, fellows and associates

### FELLOWS

**McClean, Christopher Anthony**
Marina del Rey, USA

**Sadio, Frank Kenneth**
Birmingham, UK

### MEMBERS

**Adeduntan, Adebowale Richard**
Dublin, Republic of Ireland

**Cheung, Chun Chung**
Kowloon, Hong Kong

**Chow, Chun Kit**
Hong Kong, Hong Kong

**Foo, Siang Juan**
Manchester, UK

**Garcia, Ace Glen**
Jeddah, Saudi Arabia

**Kumari, Kavita**
London, UK

**Lai, Chi Kong**
Hong Kong, Hong Kong

**Lam, Ka Ho**
Kowloon, Hong Kong

**Lam, Kwok Wing**
Chai Wan, Hong Kong

**Lau, Wing Keung**
Etobicoke, Canada

**Leung, Shing Chi**
Kowloon, Hong Kong

**Maruthayanar, Gita**
Perth, Australia

**Morgan, Chris**
Penarth, UK

**Mou, Yun Nin**
Ma On Shan, Hong Kong

**Ng, Pak Kui, Patrick**
Tuen Mun, NT Hong Kong

**Ng, Wai Yan**
NT Hong Kong

**Quinn, Jack**
Dublin, Republic of Ireland

**Richards, Jay Glen**
Oud Metha, Dubai, United Arab Emirates

**Savidis, Alex**
Whitley Bay, UK

**So, Pok Man**
NT Hong Kong

**Tam, Yiu Fai**
Tuen Mun, Hong Kong

**Torres Coto, Jorge**
Chula Vista, USA

**Wong, Ming Fai, Angus**
Hong Kong, Hong Kong

**Woo, Tsz Fung**
Kowloon, Hong Kong

**Wu, Siu Lok Daniel**
Kwai Chung, Hong Kong

**Yousuf, Sharib**
Leeds, UK

### ASSOCIATE

**Parker, Richard Andrew**
Stalybridge, UK

### LICENTIATES

**Hubbard, Stephen**
Ingatestone, UK

**Makinde, Akin**
Oxford, UK

**Norris, Richard John Roy**
Oxford, UK

### FELLOWS

**Christopher McClean BEng (Hons) MSc CEng FCIBSE**

Chris McClean is MEP group director for Buro Happold's Los Angeles office and has played a significant role in expanding and strengthening the company's capabilities in California. He has extensive global multidisciplinary experience and has delivered many projects with a strong focus on sustainable design, such as the recently completed Perot Museum of Nature and Science in Dallas, designed by Pritzker Prize Laureate Thom Mayne.

**Frank Sadio BEng (Hons) CEng FCIBSE**

Frank Sadio has more than 30 years' experience in delivering creative building services solutions, together with project management, for a diverse range of clients. He is currently an associate with Heston Associates multidisciplinary consultancy, which offers consultancy, design and management services. Sadio has enjoyed a varied career and has gained experience in a number of key sectors, including education, telecommunications, data centres, healthcare, custodial and retail. He is currently working in the commercial sector while developing the business regionally to provide added diversity to the current company profile.

DAIKIN

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# Scale up your expectations

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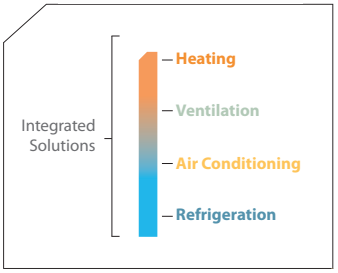
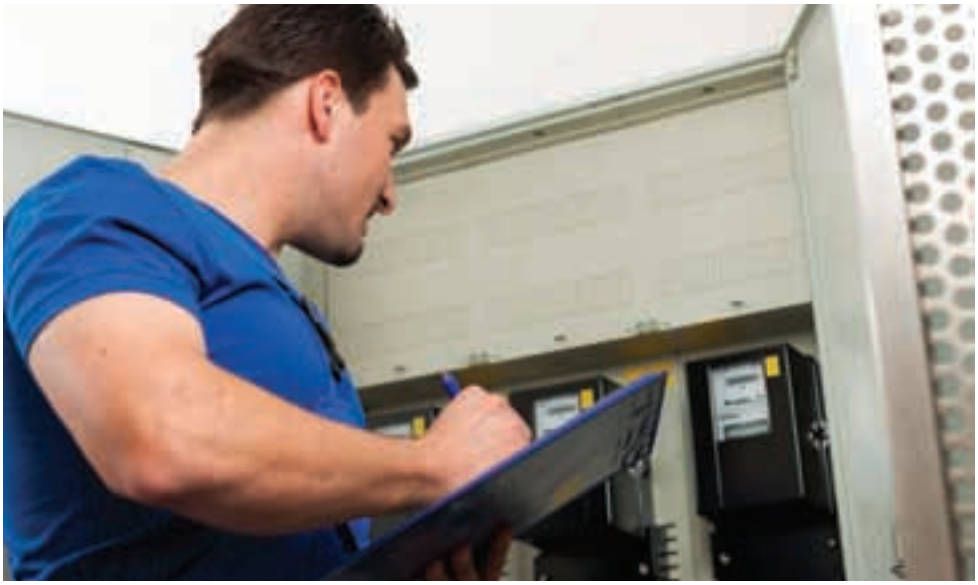
What's more, VRV typically takes up to 30% less plant space than a chiller and the running costs of an energy saving VRV heat recovery solution are around 40% less than a 4-pipe fan coil system. All in all, VRV may exceed your expectations in every way.




For more information visit **www.daikin.co.uk/futureofVRV**

# Your letters



KZENON / SHUTTERSTOCK

**This month:** Calculated vs actual CHP district heating performance, and the 'benefits' of energy monitoring

## Calculated performance

There have been many discussions about the benefits of combined heat and power and district heating. The energy benefits are stated on the basis of calculated performance. As we know from building performance, this is often very wrong compared to the measured data.

To avoid this mismatch between the calculated and the actual, I suggest that the heat providers publish and label the energy content of the delivered heat. For each kWh of heat sold to a customer, it should be clear how much fuel was actually used, be it electricity, gas, oil, coal, wood or refuse; and, if the system was used to make electricity, how many kWhs were exported.

This information is certainly known by the providers of the heat, so they should be able to publish results from previous years. This data will create a much needed evidence base for the discussions on the provision of heat in the UK.

*Bill Watts FCIBSE*
*Partner of Max Fordham llp*

## Overstating the case?

In the *CIBSE Journal*'s January 2013 article headlined: 'Early warning system', it overstates the benefits and understates the costs of metering and monitoring to reduce energy consumption in buildings. No specific examples are provided with data.

One can readily determine the potential for energy savings for almost any building by looking at the total building's metered energy data. If the consumption, or cost per unit area, is higher than the norm for that building type, there is great potential for reductions. If the consumption or cost per unit area is lower than the norm, there is little potential for reductions. This simple determination is quick and easy and, for most buildings, does not cost anything.


EARLY WARNING SYSTEM

If the consumption is higher than the norm, then a trained and experienced engineer can often determine most – or all – of the measures that should be undertaken, without the time and expense of metering and monitoring.

> It is essential to recognise the human and capital expenses involved in monitoring

The CBECS database in the US has end-use energy data for most building types, and serves as the benchmark for programs like Energy Star. However, with my experience installing and monitoring thousands of submeters of all types over many years, it is essential to recognise the human and capital expenses involved, both initial and ongoing.

Depending on the meter type, and whether it's in a new or existing building, the initial cost usually exceeds £1,000 per meter, but can often be thousands of pounds per meter. The quality and reliability of meters used is often not known. I have some cases where the monthly energy cost per meter is only a few pounds, so the capital cost can never be recovered.

Having an experienced engineer to examine 1) the data; 2) the energy using systems; and 3) the use and occupancy of the spaces served is vital, and not something a spreadsheet template alone can accomplish. The capital cost of making any changes, along with the potential savings, may not justify implementation.

Plus there is the ongoing cost of operating and maintaining 1) the measure itself; 2) the metering systems; and 3) monitoring the data.

*Eur Ing Int PE Larry Spielvogel PE CEng FASHRAE FCIBSE FSLL*
*Consulting Engineer*

*CIBSE Journal* welcomes article proposals from any reader, wherever you are – whether it be letters, longer opinion pieces, news stories, people or events listings, humorous items, or any ideas for possible articles.

**Please send all letters and any other items for possible publication in the *CIBSE Journal* to: editor@cibsejournal.com**, or write to Alex Smith, editor, *CIBSE Journal*, CPL, 275 Newmarket Road, Cambridge, CB5 8JE, UK. We reserve the right to edit all letters. Please indicate how you wish your letter to be attributed, and whether you wish to have your contact details included.

# CE: CHECK EVERYTHING!

Standards are voluntary and there is no obligation for compliance in the UK, says **Hywel Davies**, but the impending Construction Products Regulation will make CE marking mandatory

In the UK, standards are generally voluntary agreements for a product or a service to meet an agreed specification. This 'standard specification' is then available for anyone to use on a voluntary basis. There is usually no compulsion to use the standard – so that any product meeting what is deemed to be an 'equivalent' standard may be used.

However, when regulators use a specific standard to specify something, the standard becomes mandatory.

But the voluntary nature of construction standards in the UK is set to change. From 1 July 2013, the Construction Products Regulation (CPR) replaces the Construction Products Directive (CPD). The European Commission has confirmed that harmonised European standards (ENs) based on the CPD or, in future, the CPR, have to be considered as mandatory because, when a construction product is covered by the 'harmonised' element of an EN, the only way to assess and to declare its performance is by using the assessment methods and criteria included in the EN.

## Harmonised standards

A 'European standard' is one adopted by a European standards body[1]. However, a European standard is not 'harmonised' unless it is the subject of a 'mandate' and a reference is published in the *Official Journal of the EU* (*OJEU*).

A mandate is a specific instruction from the European Commission to a European standardisation body, such as CEN or CENELEC, to prepare a standard that at least addresses a list of prescribed properties or characteristics, although CEN/CENELEC may choose to add others.

A standard prepared under such a 'mandate' contains an 'Annex ZA'. This provides details of the clauses that address the 'mandate' – these are the harmonised provisions of the standard – and only these clauses. The standard may also contain additional clauses included by the standards committee, but these clauses are not harmonised, and do not affect the CE marking of a product against Annex ZA.

## Making CE marking mandatory

This has significant implications for all those in the European Economic Area who develop, use and specify by reference to construction product standards. Under the CPR, CE marking is mandatory from 1 July 2013, and the only means of CE marking is compliance with the harmonised standard. So, under the CPR, a standard becomes mandatory in Europe, and is the sole and exclusive route to CE marking once it is: harmonised (referenced in the *OJEU*); adopted in at least one member state (but under CEN rules all CEN members must adopt it anyway); and any period of co-existence with national standards has ended.

Article 17(5) of the CPR states that: 'From the date of the end of the co-existence period, the harmonised standard shall be the only means used for drawing up a declaration of performance for a construction product covered by it'. And Article 4(1) of the CPR requires that, when a construction product is covered by a harmonised standard, the manufacturer has to draw up a 'declaration of performance' when placing the product on the market. This is all mandatory, and starts on 1 July 2013.

This makes harmonised standards mandatory, and has implications for public procurement. It is currently commonplace to specify that a product shall meet a given standard, with the allowance of products that do not meet that standard but are deemed to be 'equivalent'. Under Article 4(1) this will no longer be possible for a product covered by the CPR, which simply must meet the standard.

> This is an entirely new departure for standards in the UK

It also has implications for installers. No longer will it be possible to replace a product with another that the installer is more familiar with, or is cheaper, or even one that is considered more appropriate. If that product does not carry a CE mark, based on a 'declaration of performance' against the appropriate harmonised European standard, then it cannot be used.

## Maintenance and repair implications

It may have implications for maintenance and repair activity, too. If a component of a system has failed and that component is covered by a harmonised standard, then the component may only be replaced with a CE marked replacement.

This means manufacturers must comply with European standards where the product is harmonised and they want to sell in Europe, which includes the UK.

This is an entirely new departure for standards in the UK, and it remains to be seen how it will work out. In the meantime, it would be prudent to remember that CE stands for Communitee European, but also for Check Everything, or Caveat Emptor.

CIBSE has established a small working group to look at the detailed implications of the CPR for the sector.

## References

1. The two principle European Standards bodies for construction products are the European Committee for Standardisation (CEN) or the European Committee for Electrotechnical Standardisation CENELEC, the electrical standards body.

● **HYWEL DAVIES** is technical director of CIBSE **www.cibse.org**

# DESIGNING REALITY

Evidence is showing that passive build solutions are at risk from unpredictable user behaviour and technical fallibility, says **Chris Butters**

Should all future building follow the Passivhaus model – in which balanced ventilation with heat recovery is an essential component? Both research and field surveys suggest that dogmas surrounding heat recovery are starting to look shaky.

We should be testing many ideas for the future rather than legislating all our eggs into the passive basket.

There are two issues with Passivhaus type buildings. One is *technical*, the other – much less debated – is *human*. In theory, heat recovery makes sense – but many factors can reduce the theoretical benefits, such as uncontrolled air leakage, bad workmanship and the failure of mechanical ventilation systems.

Subtract the negatives from the positives and the picture for Passivhaus may look very different with regard to payback, energy savings and reduced climate emissions. In some cases heat recovery will be excellent but, in others – particularly small buildings and retrofits – it may be pointless.

## Forgiving buildings

In a new publication looking 'beyond passive'[1], we explore a more realistic construction approach that accepts fallibility in people and technology, and considers more resilient or 'forgiving' buildings.

Researchers are constantly frustrated at people's ability to misuse buildings. Actual energy use can be *three times* what was calculated. Buildings should be able to tolerate change, different uses and an element of neglect or forgetfulness. Ultimately, no amount of theoretically efficient technology can replace user behaviour.

Most people *can* follow user manuals. However, *reality* tells us that many don't – and it's not just elderly people, problem families or the careless. Failure to operate *passive* buildings correctly puts both buildings and people's health at risk. We need robust solutions that can tolerate minor mistakes, forgetfulness and misuse. Such people-based solutions also account for failing technology and bad workmanship.

> In some cases heat recovery will be excellent but in others – particularly small buildings and retrofits – it may be pointless

Some experts have said it is 'impossible' to achieve passive energy levels without mechanical ventilation and heat recovery. Yet Acharacle school in Scotland, designed by our colleagues in the GAIA network, achieves[2] just that. (See page 9 for an obituary on Howard Liddell, principle of Gaia Architects in Scotland).

In schools with natural ventilation, including Acharacle and several designed by GAIA in Norway, the users themselves are the ventilation 'system'. Ventilation is mainly achieved by opening windows for short periods between lessons, and easy-to-read sensors for temperature, humidity, light and carbon dioxide *teach* pupils to understand and control their environment. There are automatic vents, just in case everyone forgets.

This is a very different design philosophy from Passivhaus – nature's own forces, plus the users are the primary solution; the technology is only a supplement.

Sometimes we have to use mechanical ventilation where there are high ventilation needs – such as high humidity, polluted outdoor air or the presence of synthetic materials – but, with the right materials, the requirement for extra ventilation is minimal[3,4]. In buildings with hygroscopic, low emission materials, the need for more ventilation is low in winter; in summer, natural ventilation is normally enough, given moderate windows, shading, cross ventilation and other truly 'passive' solutions.

Today's Passivhaus trend is narrowing our thinking and constricting future building options. These buildings are excellent in some circumstances, but if health, resilience and forgivingness are important, then other design approaches can be preferable and more genuinely 'green'. We need a far more holistic science[5,6], as well as more common sense, if we are to achieve what has been our motto in Gaia Architects for 30 years: buildings that are healthy both for people and for the planet.

On the technical side, the overall energy and climate effect of heat recovery needs debate. But it is important that ventilation solutions be simple, resilient and chosen in the light of everyday human reality.

Acharacle school: passive but not Passivhaus

## Problems with heat recovery

There are issues that can affect the efficiency of heat recovery systems:

- Uncontrolled air leakage reduces potential heat recovery. Even in quite airtight buildings, air leakage provides a significant part of our ventilation needs. If a building is moderately leaky, there is no point in a heat recovery unit. Designers also have to bear in mind that buildings become less tight over time.
- Mechanical ventilation systems use electricity and typically become 1% less efficient every year, delivering less energy efficiency than expected. A survey of thousands of units in Sweden[7] provide a real shock: average heat recovery is less than 30%. And in a warming climate with lower heating needs, potential heat recovery decreases.
- Precision on site is required for passive builds – we are often not realistic about what the construction industry can deliver on site.
- The embodied energy of the ventilation equipment and the technical ventilation spaces should be accounted for when considering $CO_2$.[8]
- Airtightness is near impossible in many old buildings, hence heat recovery efficiency in retrofitted properties will be compromised.
- There are non-technical risks such as noise, dry air, electromagnetic radiation, and change of building use.
- Serious damage to the building can occur if the unit fails while occupants are away.


Monitoring in Acharacle classrooms

> Research suggest that dogmas surrounding heat recovery are starting to look shaky

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**CHRIS BUTTERS**, Chris Butters architect and consultant, Gaia Architects

# OPPORTUNITY COSTS

BIM provides an opportunity for building service engineers to reduce construction time and cut costs, but their earlier involvement in design must be reflected in higher fees, argues **Phil King**

The building information modelling (BIM) revolution is well under way. The UK government has set a target to reach BIM Level 2 on public-sector work by 2016 and private-sector clients are increasingly requesting BIM on their projects.

BIM leads to better collaboration, coordination and exchange of information within industry. For the client, it helps to mitigate risk, reduce costs, minimise waste, shorten programme time and smooth handover and facilities management.

For mechanical, electrical and plumbing engineers, it means early involvement and more detailed work at the front end, giving us a big opportunity to reduce overall construction time and cost through services design. It also means a higher volume of pre-fabrication and modularisation, with benefits in quality, reduced snagging time, speed of installation and economies of scale.

## BIM in practice

BIM is a shared digital representation of physical and functional characteristics of a built object, on which critical project decisions can be based. When we reach Level 3 BIM, we'll be using a fully integrated and collaborative process enabled by web services and using 4D construction sequencing, 5D cost information and 6D project lifecycle management information.

This means inputting more detail in the design phases and marks a major shift in the way we look at the costs associated with building projects.

**Traditionally, these look like this:**

*Design* 1 unit of cost
*Construction* 10 units of cost
*In occupation* 100 units of cost

**Using BIM, they look more like this:**

*Design* 1.5 units of cost
*Construction* 8 units of cost
*In occupation* 90 units of cost

This supports Paul Morrell's change programme, achieving both greater integration and a 20% reduction in building costs – not to mention the savings in operation.

Hilson Moran's BIM model of 20 Fenchurch Street

> Building contracts will need to encourage an open culture and cover the use of BIM

More time and effort at the design stage and less in construction should be reflected in the fees awarded. However, in reality, to achieve this we'll need to be able to quantify money saved as a result of early involvement.

Changes to contracts will inevitably follow. Appointments and building contracts will need to encourage an open culture and cover the use of BIM, as well as outputs (2D drawings, specification, 3D model, or all three); responsibilities, including transfer of the model; and liability.

There should be a single owner of the 3D model during the design and construction stages, to which all parties contribute. Additional responsibility and liability impacts would need to be reflected in the owner's contract. On handover to the client, agreement is needed on how the model will be updated after practical completion.

Lastly, there'll be a change in how we work together – engineer to engineer. There will be greater coordination between mechanical engineers, electrical engineers, public health engineers and BIM operatives. We'll need to think in 3D, work in areas not systems, and eliminate paper mark-ups, using the software instead.

### BIM: what we need

- A standardised library of parts
- BIM education
- Measurable and coordinated outputs
- BIM standards and codes
- Best practice examples
- A standard to enable CFD, DTM, EPC and Part L calculations in the model
- Calculations for pump/fan sizing
- An agreed split between the consultant and contractor
- A standard to create the bill of quantities and asset register, covering how all objects in the model are quantified
- A process for tracking changes
- Standardised schedules/templates linked to specification stage by stage
- Standard colours for each service
- A method for feeding plant quotes into BIM, taking into account variations in tenders
- A process for measuring benefits of BIM: cost, risk and programme

We'll also use BIM to do much more, including the creation of 3D geometric models for the following:

- Dynamic thermal modelling
- Computational fluid dynamics
- Comfort studies
- Pedestrian wind comfort analysis
- Natural ventilation studies
- Fire and smoke modelling
- Acoustics modelling
- Part L assessments
- Energy performance certificate assessments

BIM is an opportunity, not just for engineers, but for the government, too, in meeting its cost-reduction targets. Its success won't happen seamlessly and, as with any new technology, we'll all need to evolve.

**PHIL KING** is a director at engineering consultancy, Hilson Moran

# GOING FOR BROKE

Industry leaders and MPs turned out in force for Ecobuild, the largest eco show on earth, to thrash out how the UK can meet its carbon reduction targets. **Alex Smith** and **Carina Bailey** report

'We don't have a snowball's chance in hell' of hitting the UK's carbon reduction target by 2050, David Strong told a packed Ecobuild session last month.

The chairman of the Energy Efficiency Partnership for Buildings questioned the coalition's self-styled 'greenest government ever' label, following a number of policy U-turns. This included the Feed-in-Tariffs 'fiasco', which he described as 'fundamentally flawed' because consequential improvements were not introduced alongside them.

He also cited the government's refusal to introduce industry's recommendations on display energy certificates (DECs) and the failure to publish the revised Building Regulations for Part L as evidence, in his view, that the government is not interested in being green. He added: 'The Treasury is philosophically absolutely opposed to this and seems to be entirely immune to any evidence that a green economy creates jobs and growth.'

This accusation of a lack of enthusiasm and support for a green economy, levelled at the Chancellor George Osborne, was frequently repeated by speakers throughout the three-day event, staged at the Excel Centre in London.

But Lord Deben (formerly John Gummer), chairman of the Committee on Climate Change (CCC), told delegates that the Climate Change Act was 'entrenched' in the British Constitution by law and the only way to avoid the 2050 target was to repeal the Act itself.

He added: 'In order to reach our 2050 targets we may have to tighten what we're doing – or loosen it. But we won't know for several months to come.'

Explaining why people doubt the objective, he said: 'Everyone is in favour of everything in general, and not keen on it in particular.'

Paul King, chief executive of the UK Green Building Council (UK-GBC), said the UK would achieve its 2050 target, but it would take a 'revolutionary change on the back of a technological breakthrough' to get there.

But, according to David Reiner, senior lecturer at the University of Cambridge, the biggest hurdle will be persuading British voters on why such disproportionate steps to cut the UK's carbon have to be taken when, ultimately, China will be the world's dominant emitter.

## The route of all knowledge

During the conference, the Low Carbon Routemap for the Built Environment was launched by Paul Morrell, chairman of the Route Map Working Group at the Green Construction Board.

The route map, developed by Arup, has three routes to zero carbon and assumes that the electricity grid will be green – a dangerous assumption, according to Morrell: 'If it isn't green, we have probably set off the biggest time bomb in history.'

He added: 'I don't think it's the end of the road for zero carbon, I think it's the beginning of a new road,' but he warned it would be a hugely complex journey.

The route map sets out what is required from the construction industry to achieve an 80% reduction in greenhouse gas emissions from 1990 levels by 2050. Morrell said: 'We


Bordass (right) tells Foster to 'focus on in-use performance, not virtual carbon'

can't leave it to unfortunate future generations to solve, we have to get half way there in 17 years' time. Most of what we need to know we know now, it's how we drive take up.'

To hit the 2050 target, domestic properties need to reach zero carbon, and industry needs methodologies for buildings that aren't worth treating, added Morrell.

Speaking of the delayed government announcement on Part L of the Building Regulations 2013, Neil Jefferson, chief executive of the Zero Carbon Hub, said: 'If we are going to see change [in the domestic sector] in 2013 we need to know about it soon if we are going to implement it in October.'

Mark Clare, chief executive of Barratt, told delegates that, in the end, the customer will have far greater influence on what industry builds than regulation ever will.

But Dr Brenda Boardman, Emeritus Fellow, Environmental Change Institute, University of Oxford, said the real key to lowering emissions was through demand reduction. Morrell even suggested a need to live/work in cooler indoor temperatures and lower levels of light. But, he stressed, 'there's no point in saving money on our heating bills if we go off on holiday with the savings. Something has to happen.'

## The future is green

Panellists agreed that a green economy promotes growth during a 'Green for growth – reality check' seminar, with Michael Fallon MP stating they are 'two sides of the same coin'.

Rhian Kelly, director for business environment at the CBI, agreed, but said waiting on government policy was damaging confidence – particularly in a year when the key vision and strategies showing how the sector can grow to 2025 are awaited.

She added it was now clear the Green Deal was not going to be a 'big boon' for the sector.

Chris Gorse, Professor of construction management and director of the Centre for Knowledge Exchange, Leeds Metropolitan University, identified £200bn worth of retrofit opportunities, but stressed industry has a lot to do in terms of performance.

His research team has found that buildings perform up to twice as badly as expected and that their thermal performance is missing their target by up to 200 times. In other cases performance is 'somewhere close'.

He said: 'We're never going to achieve what we expect when we have no tolerance. Anything that's 20% worse than expected at the moment is probably a very good building.'

During a packed Ecobuild debate on the role of legislation in bridging the performance gap Bill Bordass, said that

### THE GREEN INVESTMENT KNIGHTS

The appearance of investment firm Sustainable Development Capital LLP (SDCL) stirred up plenty of interest. Partner Gil Levy revealed that SDCL had a £450m pot for energy efficient projects in the UK. SDCL would carry the investment risk of buildings failing to meet energy targets, said Levy, and would benefit from the subsequent reduction in energy bills, along with the client.

SDCL would set up a special vehicle company to manage the project and draw up energy performance contracts with contractors to ensure predicted energy savings were achieved.

'This is by far the greatest opportunity to make savings, and hedge against energy price increases in the UK,' said Levy.

> We can't look at the regulations in isolation – we need tough love to help them deliver this stuff
> *Pete Halsall*

> Hardly anybody will hit this target by 2020. Politicians have taken their eye off the issue, blaming lack of affordability – this is not acceptable
> *Ian Taylor*

government departments were pulling in different directions on regulation, creating complicated legislation: 'We need to focus on in-use performance not virtual carbon.'

Those fearing that the Building Regulations may be watered down would have been alarmed by Building Regulations Minister Don Foster's reference to the competing pressures of affordable housing and sustainable development.

As well as expressing a wish to streamline regulation, Foster said he wanted to see more research to help close the performance gap, and announced £380,000 of funding for the Zero Carbon Hub.

The chairman of the Good Homes Alliance, Pete Halsall, described the performance gap as a chasm. He suggested government could incentivise the construction industry by lowering stamp duty for better performing buildings. 'We can't look at regulations in isolation – we need tough love to help them deliver this stuff,' he added.

## Industry concerns over domestic RHI raised

Fears that the renewable heat industry could fall into hiatus within weeks grew after Greg Barker MP was unable to confirm that the promised domestic Renewable Heat Incentive (RHI) would be out by the summer.

A member of the audience asked the Minister of State for the Department of Energy and Climate Change to restate that the scheme would be available within weeks – or face the very real prospect of an industry in hiatus. An interim measure, the Renewable Heat Premium Payment, was due to close at the end of March.

Barker said he wasn't in a position to announce anything, but that something would be announced 'soon'. He explained: 'Bringing forward a domestic RHI proved much more difficult than we anticipated. Really it was like starting from a blank piece of paper.

'Part of the problem with a universal RHI is the extraordinary span of technologies that have very, very different features. I think the mistake we started with was the approach – a one-size-fits-all approach, which had at its heart a desire for simplicity.

'Trying to force those very different technologies into one universal type of incentive I don't think works.'

He added: 'I fully take on board your point – we need to avoid a hiatus, I'm just not in a position to make an announcement.'

### Missing the target

In a seminar on the Energy Performance of Buildings Directive, Ian Taylor, partner at Feilden Clegg Bradley Studios, reminded the audience that all public buildings had to be nearly zero by 2019 (private buildings by 2021) and that to meet the EU's long-term target on $CO_2$, buildings had to produce less than $3kg/CO_2/m^2/yr$.

Taylor said: 'Hardly anybody will hit this target by 2020. Politicians have taken their eye off the issue, blaming lack of affordability – this is not acceptable.'

Using data from Carbonbuzz, which records actual building performance, he found offices exceeded targets by 50% on average, schools by 100% and universities by 300%.

CIBSE's technical director Hywel Davies said that by managing buildings properly, energy demand could be cut by 20% within five years and 35% in 10-12 years.

Rob Pannell, director at the Zero Carbon Hub, said industry should not forget that global temperatures were predicted to rise by 2050. He said: 'We may need a green deal for shuttering in 2050 when it gets so warm.'

Bennetts Associates director Julian Lipscombe said that councils' rigid enforcement of the Merton renewables rule had made it difficult to minimise buildings' energy use before considering renewables.

### Baffling landscape

The merits of various ratings schemes was the subject of a debate led by Cundall partner David Clark. His own research revealed no correlation between energy performance certificates (EPCs) and actual energy consumption. 'Unfortunately, EPCs are used in most rating tools to measure performance of buildings,' he said. 'We need real information.' Clark added that government reneging on its promise to roll-out display energy certificates (DECs) to the private sector 'was a huge missed opportunity'.

Deloitte partner Miles Keeping said the number of rating systems created a 'baffling landscape'. He said that chief financial officers would only occupy a green building if there was a link between high ratings and productivity.

Speaking of BREEAM, Aecom's regional director of sustainability Dave Cheshire said too much paperwork was required to demonstrate compliance. He added: 'Less than 5% of buildings are assessed by BREEAM. They should all be assessed, but maybe we need to lose some of the rigour.' **CJ**

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# NEW FRONTIER

With temperatures of -50°C in winter and 55 days of complete darkness each year, the Antarctic is the most inhospitable place on Earth. But Aecom and Hugh Broughton Architects are learning to conquer it, as **Andy Pearson** reports

> Technology is critical to the occupants' survival in this unforgiving environment

Halley VI must be one of the coolest places on earth to live, literally. The research station is located 15km from the sea on the floating Brunt Ice Shelf that forms part of the Antarctic ice cap. Temperatures this close to the South Pole drop to -50°C in winter and even at the height of summer they struggle to rise above freezing. In addition to the extreme cold there is also the wind: Halley VI's proximity to the open sea means the site is regularly buffeted by gusts in excess of 100kph.

Designed by engineering consultancy Aecom and Hugh Broughton Architects, Halley VI has been created to sustain the lives of the scientists that permanently occupy one of the most hostile and remote places on earth. It also has to comply with the strict requirements of the Antarctic Treaty Environmental Protocol, so its environmental impact has to be minimal. As a result, Halley VI generates its own heat and power, has minimal water consumption and even processes its own waste. And when it finally does reach the end of its life, the building's design means it can be removed without leaving a trace.

## Eight-legged freak

Halley VI became fully operational earlier this year after a three-year construction period. The research station is the most southerly of all the British Antarctic Survey's facilities. Halley VI is the sixth incarnation of a research station in this hostile location since 1956. Its first four predecessors were designed to be buried by snow, over a metre of which falls on the continent each year. Under this relentless inundation, each base survived about a decade before becoming entombed in ice.

By the time of Halley's fifth incarnation in 1992, its design had evolved to avoid being buried. This station was built on extendable legs to raise it above the snow. Despite the success of the elevating

## RAISING THE MODULES

To prevent the station being buried under the metre of snow that falls on the ice shelf each year, it has been designed to rise up with the accumulating snow. Each leg can be raised individually, enabling the snow to be packed under the foot of the raised leg using a bulldozer.

Once this has been done under each of a module's four legs, the entire module is raised. Flexible connections on the services running between modules ensure the services remain undamaged by the procedure. It is expected to take a week to raise the entire station.

concept, however, the station's permanent location on a floating ice shelf – flowing out to sea at the rate of 400m a year – meant that it had travelled so far from solid land that the ice shelf was in danger of 'calving' and the research station being cast adrift on an iceberg.

For its sixth iteration, Aecom and Hugh Broughton Architects' £26m station is based on eight linked, highly insulated modules, each mounted on four sturdy, hydraulically-extendable legs to enable the modules to climb out of the snow. To allow the station to be relocated, each of the 4.5m-high legs are mounted on skis to enable modules to be disconnected, towed inland and reconnected – a key difference from its predecessor.

### The giant frozen centipede

Halley VI comprises seven blue modules and a larger red pod strung out in a line across the ice like a giant frozen centipede. The red module is the heart of the station. This two storey, 470m² pod is clad with vertical and inclined glazing and translucent silica-based insulation panels, providing a comfortable, communal space for cooking, group dining, recreation and socialising. Attached to the red pod's northern side are three blue, 150m² accommodation modules. On the southern side are the two life support modules, containing all the station's M&E plant, along with the two science modules housing its laboratories. These eight hermetically sealed pods are arrayed side-on to the prevailing wind to slow down the formation of drifts. In this arrangement, the wind-driven snow accumulates in long tails on the aerodynamically designed module's leeward side, keeping the windward side clear for access. The perpendicular alignment also ensures the skis are scoured free of snow by the wind channelled beneath the modules.

Up to 70 scientists will occupy the base in the summer. In winter, the number will decrease to a skeleton staff of 16, who will remain confined to the station for up to 10 months a year. Technology is critical to the occupants' survival in this unforgiving environment. The two life support modules house the bulk of the station's plant, including six combined heat and power (CHP) units, water and sewage treatment plant, a sprinkler (misting) tank for fire suppression and space for fuel storage. Each module has been designed with sufficient capacity to service the station, so that if one is damaged by fire, for example, the remaining unit is capable of keeping the station running.

### The power of CHP

The CHP units burn aviation fuel (AVTUR), which remains liquid at temperatures down to -47°C and provides


90% of the energy of conventional diesel. The generators provide all the station's electrical power and most of its heat. Heat from the generator's cooling system is used to warm the accommodation's fresh air supply, providing space heating through a radiator-based wet system and to heat the central domestic hot tank. The station also has AVTUR fuelled back-up boilers to provide additional heat in the extremes of winter or when the electrical demand is low.

The decision to use a series of smaller CHP units allows the electrical supply to be matched to demand. All units use common replacement parts, while the choice of smaller engines make it easier to manhandle the units should they ever need replacing. 'Repetition and adaptability is the key to the design's success in this remote location,' says Alan Fox, director of building engineering at Aecom and lead mechanical engineer on the project.

Piped and cabled services from the life support modules pass from one pod to the next through a warm service zone, located beneath the floors of the pods. Each pod has a small plant room containing a standardised heat recovery ventilation unit, in addition to connections to heat and electricity from the CHP plant and hot and cold water.

The ventilation units have been designed to cope with an average outside air temperature of -20°C. The units have three-stages of heating: first, a frost heater pre-warms the air before it passes through a plate heat exchanger; after that a second heater battery is used to regulate the supply air temperature. When the outside air temperature drops below -30°C, the units switch to full recirculation, supplemented with occasional, minimal bursts of fresh air to keep conditions habitable.

'Below -30°C we effectively don't take in fresh air to the pods because the loads are too high,' explains Fox. The warmed air to the sleeping modules is also humidified using an electric humidifier to prevent it from becoming too dry.

When demand for heat falls, heat from the CHP is diverted to melt snow to produce water for the station. A purpose-designed melt-tank is located beneath the walkway, connected to the two life support modules; the tank will be filled with snow by hand or by bulldozer, depending on the weather. Melt water from the tank is stored in tanks in the life support modules; there is sufficient water for four days' use in summer and 14 days in winter.

## The station's energy footprint

This adds significantly to the station's energy footprint. Accordingly, Halley VI features aerating taps and reduced-flow showers, a water-efficient laundry and a

> The £26m station is based on eight linked, highly insulated modules, each mounted on four sturdy, hydraulically-extendable legs to enable the modules to climb out of the snow

vacuum toilet system, similar to those installed in aircraft, which uses 10% of the water of a conventional drainage system.

For sewage treatment, a Microbac bioreactor sewage treatment plant is used. This has been designed to create a good growth environment for bacteria to help reduce the amount of sludge produced. The Antarctic Treaty Environmental Protocol prohibits the dumping of waste on land or in the sea. As a result, both waste food and human waste is dried in special centrifuges, before being burned in a Surefire incinerator or shipped out. In addition, recyclable waste is separated, compacted, bagged and shipped off the continent annually by the station's supply ship.

The base's lighting system, too, has been developed as a low energy scheme. The site's southern location means the sun will fail to appear above the horizon for 105 days each year, and the station will be in complete darkness for 55 days. Externally, LEDs are used for floodlights, while the modules incorporate LEDs in their underside to assist 'way-finding' in bad weather. In the low Antarctic temperatures, the LED lamps operate up to 30% more brightly than usual.

Inside the modules, lighting is predominantly long-life fluorescent lamps mixed with LEDs for emergency lighting and some accent lighting. Fluorescents were chosen for their energy efficiency and because they produce a better quality of light – an important consideration when you consider the station will be in complete darkness for a significant part of the year. Internal work areas are illuminated to high levels using cool, artificial light. The living areas and bedrooms use far warmer-toned lighting than the laboratories.

### Psychological wellbeing

To help maintain the scientist's psychological wellbeing, each bunk is provided with a wall-mounted seasonal affective disorder (SAD) bed-head lamp with local control, which allows occupants to receive up to 10,000 lux of ultra-blue 17,000 K daylight-coloured light as part of their morning wake-up alarm. The panels operate on a dawn setting to reach full brightness slowly, to assist in the suppression of melatonin and to help stimulate the body's production of mood-enhancing serotonin.

Halley VI's low energy lighting solution helps minimise the station's impact on the environment. In fact, the design treads so lightly on the planet that the only waste left on the frozen continent is treated waste water, but even this has been purified to European bathing standards before being discharged. Aecom has even made provision in the design for the future installation of photovoltaics and solar thermal panels. Tests are under way to establish the applicability of the units in the Antarctic. If successful, the panels will be used in the summer months when the station is fully occupied and bathed in continual daylight, reducing its environmental impact still further. **CJ**

## Building the world's most remote research station

Construction and commissioning of the base took place in a 10-week period over four austral summers, from the beginning of December 2008 to February 2012. The short build-period and difficult conditions meant that it was critical to prefabricate and modularise as much of the station as possible before the modules were shipped to the ice shelf.

All components were delivered by sea and had to be towed to the site on sledges across thin ice. The weight of individual components and modules was limited to six tonnes if they were hauled on a sledge, and nine tonnes if the components had their own skis.

The finished blue modules weigh up to 100 tonnes each, while the red communal module weighs close to 200 tonnes, which meant each had to be supplied as a kit of parts and assembled 12km away at Halley V, where the ice was thicker. The finished modules were then towed to the station's final location using caterpillar tractors over a prepared surface. During the first summer – when temperatures can reach a balmy 4°C and it is light 24 hours a day – all of the standard modules were assembled by a 60-strong construction crew from contractor Morrision, working in shifts around the clock.

First the lower space-frame of the superstructure and the modules legs were assembled. Then floor cassettes, containing the bulk of the piped services and electrics, were lifted into position by crane and the underfloor cladding installed. The accommodation pods and large prefabricated mechanical and electrical plant were than craned onto the newly created platforms before the portal frame superstructure steelwork was lifted into position.

In the second summer, lightweight glass-reinforced plastic cladding panels were bolted to the steelwork. The panels consist of closed-cell polyisocyanurate foam insulation encapsulated in GRP. The system provides a U-value of 0.113 W/m2K. The triple glazed windows have a U-value of 0.7 W/m$^2$K. Fit-out of the fixtures, fittings and services in the modules took place over the final two summers.

# BIM, BIOMASS &

So what is Ecobuild? A trade show? A consumer show? Is it really 'eco'? **Ewen Rose** reports from the exhibition halls of Excel

The sandal-wearing, bearded eco-warriors and self-builders of early Ecobuilds are just a distant memory. Their straw bales and mud huts were nowhere to be seen in 2013. Solar panels dominated two years ago and are still a major presence, but the growth of LED lighting and biomass took centre stage this year.

Anecdotal evidence suggested few contractors or consultants were attracted, but the end user sector was quite well represented. So, not a trade show, then? Or a different type of trade show?

There was much talk about the potential for the Renewable Heat Incentive (RHI) to drive the biomass market, particularly for prefabricated plant systems and in school applications, according to Jeff House, head of marketing at Baxi Commercial Division.

'We did take the opportunity to try and steer people towards only using biomass where it is appropriate,' he said. 'We had quite a few public sector specifiers and end-user clients on the stand, but a large proportion of visitors were people we had invited ourselves.'

Some were worried that the government would continue flip flopping about renewables. 'We have been waiting for the RHI for more than two years,' said Phil Hurley of Swedish heat pump manufacturer NIBE. 'We saw with the Feed-in Tariffs (FiTs) that you can get rapid market growth from incentive schemes, but we can't have the same stop-start approach. We must have long-term commitment so we can develop an industry'.

## DIY Green Deal

NIBE held a major product launch as the show was opening, unveiling its new 2040 range of heat pumps covering 8-16kW capacities. Hurley said the government's target of having 6.8 million heat pumps installed by 2030 was 'achievable' so long as funding support remained consistent and the industry overcame installation problems and its skills shortage. NIBE also launched a biomass boiler and a whole-house heat recovery system – several trends in one exhibitor.

Of the two incentive schemes, RHI seemed to have more credibility with visitors than the Green Deal. Several suggested it might be better for the industry to develop 'DIY Green Deals' where the installer puts up the funding and reclaims the loan from their customer depending on the level of energy savings.

Moving from Earl's Court changed the nature of the event two years ago. The high profile conference, this year boasting speakers as diverse as Joanna Lumley, Greg Barker and media grandees like Jonathan Dimbleby, is now hidden away from the main show floor. So, perhaps it is now a major conference with some exhibition stands nearby.

You certainly can't criticise the variety. It was possible to talk to a charity supporting solar projects in Africa (Solaraid – headed up by the hugely energetic former CIBSE marketing manager Pippa Palmer); a mainstream commercial boiler manufacturer; LED lamp makers; water management firms; wood building system suppliers and a lady selling flowers for biodiversity projects, within a few metres of each other.

However, the show's own credentials were questioned. 'It's not really a

# JOANNA LUMLEY

sustainable show,' said Madeleine Cox of renewables wholesaler NRG8. 'It does send out very mixed messages – look at the carpets and the lighting that never goes off. What's going on?'

How to store renewable energy proved a popular topic for visitors and Ireland's Mastervolt reported brisk business on its stand as specifiers looked to plug this gap in the retrofit market with flexible battery arrays.

The solar panel market has also evolved since it dominated the Ecobuild of two years ago. The cutting of FiTs decimated that field, but there is still life in the market and there was much excitement about the emergence of 'hybrid' PVT (photovoltaic thermal) panels that combine both electricity and hot water generation in a single panel.

Italy's Fototherm was busy with enquiries as specifiers clearly spotted the potential of being able to increase output from the same footprint. That was a success story, as was the explosion in LED lighting products supported by the Lighting Experience. This walk-through adventure traced the development of lighting technology and concluded with the intricacies of the LILG Guide that explained the metrics behind LED systems.

## Inventive

BSRIA chief executive Andrew Eastwell welcomed the diversity of the show because it demonstrated the 'incredibly inventive' nature of the sector. He added that if we adopted all the technologies on show we would be able to avoid the looming power cuts predicted on the eve of the show by Ofgem chief executive Alistair Buchanan.

However, Eastwell pointed out that we have not solved the problem of how to integrate technologies, and that government incentive schemes are not helping.

'The government tends to be very widget-based, so incentivises individual products rather than looking to support complete systems – that is the jump we need to make. How about a grant scheme that incentivises the builders based on the performance of the complete building?' said Eastwell.

Visitors were also excited by the possibilities promised by phase change materials. Shaun Fitzgerald, managing director of Breathing Buildings, said changes to the Building Regulations this year would drive the industry down this route. Of course, there is building information modelling (BIM) to knit all these things together and the big winners should be facilities managers (FMs), who were at Ecobuild in some numbers.

However, Kate Fletcher of Arup said there would need to be more evolution 'in the FM chain' so they can persuade clients that there is a benefit in updating their BIM models. Contractors, too, need to do more to help the BIM process gain traction among their clients.

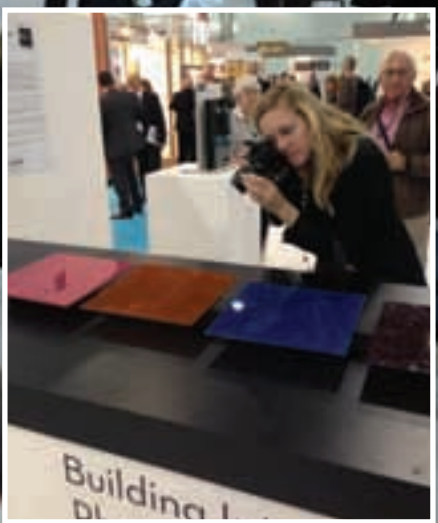
It was easier to move speedily around these myriad technical offerings because the aisles were noticeably quieter than previous years. Exhibitors blamed the economy, but also felt there was confusion about the intended audience.

'The UK seems to have lost its way when it comes to exhibitions,' said David Pepper, managing director of heating equipment manufacturer Lochinvar. 'Visitors to US shows seem to go with a much more gung ho business attitude. Engineers will happily visit a manufacturer's stand to ask questions and do business – they are not scared about being sold to.'

Heat Recovery Ventilation (HRV) is also a market segment on the move, with Total Home Environment saying that sales of their Genvex products had increased by 23% year-on-year. Managing director Michael Hunt said much of this growth could be explained by pressure from Part F and Part L of the Building Regulations coupled with continued rises in fuel costs.

And the flowers? Caroline Mann from Habitat Aid said there was enthusiasm among housing associations and architects for sustainable landscaping to improve the biodiversity of their projects – particularly around solar PV arrays. **CJ**

> There was much talk about the potential for the Renewable Heat Incentive to drive the biomass market



# DATA INPUT

According to research, human error is the root cause of most data centre outages. Investment in team development is essential to ensure facilities' efficient operation, say **Sophia Flucker**, **Robert Tozer** and **David Cameron**

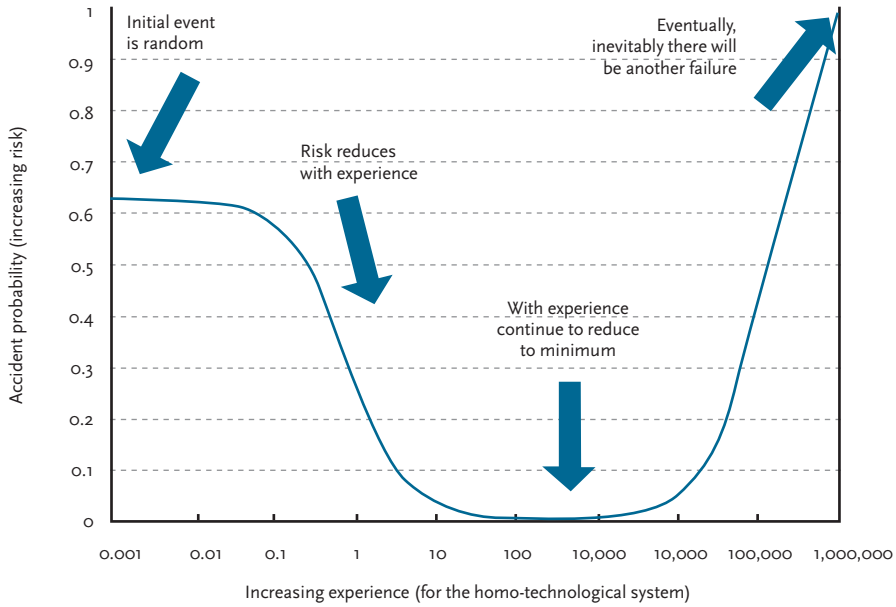
> By engaging the operational team, the facility and energy performance can both be improved, saving the business money

The successful operation of a data centre is dependent on the performance of its staff. Operator and management errors are the root cause of most data centre failures, and the operational team also has the power to deliver significant improvements in facility energy performance.

Recognising the important role that people have in the industry, it is vital to invest in team development to enhance organisational and individual learning and experience, as well as to optimise the data centre's total cost of ownership.

Analysis of industrial failures has found that most failures are due to human error and that failure rate reduces with experience. As operatives learn more about the job, the failure rate decreases to a minimum level, but, eventually, complacency leads to other failures, as very experienced operators still make mistakes.

Google's Douglas County data centre in Georgia




**Probability of failure vs time**

## Probability of failure

Statistics for the data centre industry also suggest that human error is the root cause of most outages. Data centres are typically designed with resilient topology to improve availability, however it is impossible to entirely design out human operators. In some cases, redundant infrastructure design can make the systems and interactions highly complicated, making them more difficult to operate and potentially increasing the likelihood of misoperation, rather than improving reliability.

While operational team performance improves with experience and training, 100% uptime remains an aspiration and failure can never be completely eliminated.

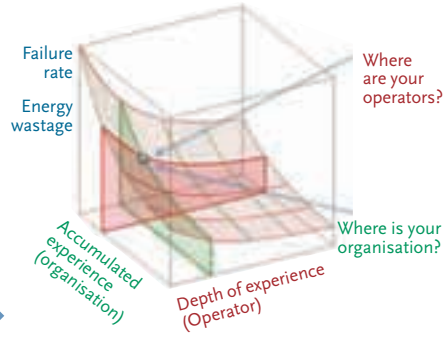
## Response to failure

In recent years, the data centre industry has focused on energy-efficiency facing policy, corporate social responsibility and financial pressures. Similarly, energy performance can be improved as experience and understanding grows. Data centre operators are often reluctant to consider making improvements to their energy efficiency due to fears about what this could do to their reliability. This is understandable given the 'mission critical' nature of most facilities; having confidence that facility risks are well managed takes priority.

However, there are plenty of improvements that can be implemented to safely reduce energy consumption, some of which also improve reliability. For example, in the case of data hall air management, removing hot spots reduces the likelihood of hardware failure and allows operating temperatures to

> Data centre operators are often reluctant to consider making improvements to their energy efficiency due to fears about what this could do to their reliability

**Impact of organisational and individual depth of experience on failure rate and energy wastage**



> Removing hot spots reduces the likelihood of hardware failure and allows operating temperatures to increase, resulting in energy savings

increase, resulting in energy savings.

Experience is relevant to both organisations and individuals. At an organisational level, this can be described by the number of data centre operating years and reflected in how effectively the processes in place deal with change management, resources and so on.

Within a team, the depth of experience of individuals is important and may be described by the number of years of relevant experience, their knowledge and attitude. Training has an important role in helping enhance team knowledge, but an individual's attitude towards learning is also important.

This is reflected in their openness towards learning new things, sharing with others and their ability to work as part of a team. In some cases you may find a human Single Point Of Failure (SPOF) where all the site knowledge rests with one person – the availability of that person presents a risk to the operational continuity of the facility.

The learning process can be modelled as a continuous cycle with a number of elements reinforcing each other: reflection, theory, practice and experience.

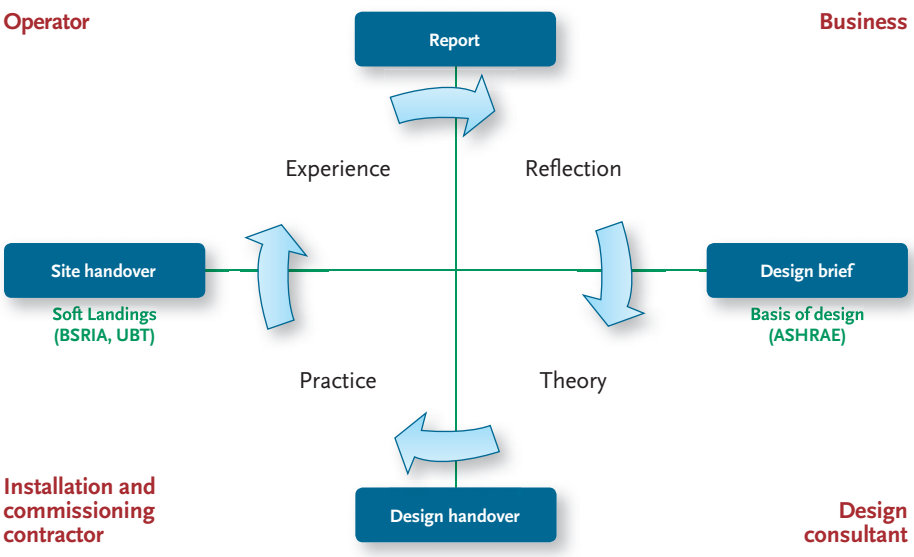
## Learning curve

We reflect on a problem, analyse it theoretically, put the theory into practice, experience the outcome and then reflect on how well this addressed the issue.

It is possible to apply this model to the data centre industry, where generally the different parts of the cycle apply to different roles – the business' managers reflects on its needs, the design consultant applies engineering theory to create a facility to fit those needs, the building contractor has to put this into practice and the operational team experience the results.

There are various points of handover where information is transferred – the client creates a design brief for the designer, who, in turn, writes a specification for the contractor. They hand over the finished site to the operational team, who reports back to the client.

A common problem is where these handovers do not go smoothly and there are contractual or organisational barriers between the different stakeholders, so knowledge is not effectively transferred.




The learning cycle

When trying to tackle risk or energy performance within an organisation, the barriers need to be removed; it is important to look at how to involve the right people and get them to interact in a collaborative way, allowing the organisation to benefit from their combined knowledge.

A data centre's total cost of ownership comprises capital cost, operating cost (labour and utilities) and reliability cost (failures have a financial impact). The investment focus is often on the infrastructure rather than the staff, even though the operational team is central to the facility's successful operation.

By engaging the operational team, the facility reliability and energy performance can both be improved, saving the business money. Where the operational team have ownership of improvements this also has a positive impact of staff motivation. As it matures, the industry is starting to recognise the importance of the human capital that supports it. It is a fast-moving, high-tech and often high-pressure environment – investing in developing team performance allows the full facility potential to be realised. **CJ**

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1 Duffey & Saull 2008 "Managing Risk: The human element"
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**SOPHIA FLUCKER**, **ROBERT TOZER** and **DAVID CAMERON** are from Operational Intelligence, which works with data centre operational teams to help them reduce their total cost of ownership.

# LITTLE AND OFTEN

Behavioural studies show that tankless water heaters may be less energy efficient than they first appeared. Researchers **Paul Glanville**, **Douglas Kosar** and **Jason Stair** crank up the heat

> 50% of hot water draws last one minute or less and 75% of all draws occur within less than 15 minutes of one another

Over the past decade, tankless water heaters (TWH) have garnered an increasing share of the North American gas-fired, residential water-heating sector in an otherwise stagnant market. Despite residential, gas-fired storage water heaters (SWH) still being more prevalent than TWHs in North America by almost a factor of 10, roughly 20% fewer were shipped in 2012 than 10 years ago, while TWHs enjoyed a threefold growth during the same period[1].

For end users, the value is clear: water is heated as it is demanded and, with little to no onboard storage, the standby thermal energy loss is negligible, leading to a significantly higher efficiency. Additionally, TWHs are sized with thermal inputs of up to five times that of SWHs, and may be controlled right down to 5% of maximum design output, making it possible for them to meet sustained hot water demands over a wide range of flow requirement. For these reasons – and others – end users appear to have gladly paid the higher installed cost for TWHs – relative to SWHs – which often led to the venting being upgraded and gas piping upsized.

Tankless water heating is certainly not a new technology, with European and Japanese manufacturers introducing products to the US marketplace in the 1970s[2]. But there are a number of factors driving this current growth, including:

- Advances in water-heating technology and controls establishing TWHs as high-efficiency alternatives to gas-fired SWHs, especially those with a condensing efficiency greater than 90%
- New and prominent market drivers, particularly the enactment of Energy Star for residential water heaters in 2009, followed by utility and government incentive programmes

> Tankless water heating is certainly not a new technology, with European and Japanese manufacturers introducing products to the US marketplace in the 1970s

- The successful marketing of non-efficient TWH benefits, specifically promising 'endless' hot water[3]

## Tankless water heater performance testing

This surge in TWH popularity has brought a better understanding of the technology's performance limitations, with discrepancies in 'delivered' (actual use by end users) versus 'rated' (expected) efficiency. This has been characterised by several recent studies of TWHs, conducted because of the minimum hot water 'draw rate' requirements and the start-up sequence delays found in the technology.

These deficiencies prompted some energy efficiency codes to be changed.

The State of California had downgraded the efficiency of tankless water heaters in its residential efficiency codes

One prominent case for non-prescriptive compliance saw the State of California's Residential Building Energy Efficiency Standards reduce its TWHs efficiency requirement by a 0.92 'de-rating' factor[4] – a reduction to 92% of the manufacturer's stated efficiency.

By design, TWHs are ideally best suited for – and most efficient during – 'steady state' operation, that is when there is a continuous steady draw off of hot water. This means that the efficiency of the system is reduced when hot water is drawn from the system in small amounts, for short periods of time or intermittently. Unfortunately, recent field studies have shown that, in comparison with the hot water 'draw' pattern* US products are rated with[5], actual hot water use consists largely of this type of use.

A recent survey and analysis of residential hot water use in North America[6] – representing 159 homes across the US and Canada – found that: 90% of hot water draws are less than 10.4 litres (2.75 US gallons); 50% of hot water draws last one minute or less; 90% of water withdrawals from a system are taken at less than 11.4 litres (three US gallons) per minute; and 75% of all draws occur within less than 15 minutes of one another.

These studies have, however, primarily focused on daily energy efficiency. This led the Gas Technology Institute (GTI) in Chicago, Illinois, to evaluate the performance of several products in greater detail under controlled conditions in its Residential Appliance Laboratory, focusing on these short-term usage effects.

A battery of tests was devised to investigate short-term and daily simulated use which, in addition to energy efficiency, focused on: water-side pressure drop; delays to fire and deliver hot water**; and outlet water temperature stability during variable loads. Four TWHs were evaluated: one minimum efficiency TWH (non-condensing) and three high efficiency TWHs (condensing), one of which had a small buffer tank onboard. Their specifications are shown in the table (see page 44). Key highlights of the research are presented in this article.[7]

## The results

TWHs perform best (most efficiently and stably) during 'steady state' operation; however, as real hot water use is highly transient, installed performance – compared to 'rated' performance – may




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suffer. To capture these impacts, short-term tests were grouped into three categories:

- **Defining modelling parameters** – One goal was to provide better parameters for the development of TWH simulation tools. Representative heat transfer parameters of the TWH were defined to go beyond a simplified 'on/off' model, capturing transient effects. For example, focused testing defined the ability of the heat exhanger to retain heat between firing (thermal capacitance, kJ/K). For the low and high-efficiency TWH, this capacitance was as much as 24.5 and 11.2 kJ/K (12.9 and 5.9 Btu/°F) respectively. Also, when defining the combined heat transfer coefficient, UA, it was found that the maximum quantity of heat that could be stored by the low-efficiency heat exchanger was 264 kJ (250 Btus). Depending on frequency of hot water draws, this heat may be recoverable.
- **Short term on/off tests** – With the exception of bathing (including showers), most hot water draws are intermittent, causing TWHs to come on and off in a rapid fashion. A hot water draw pattern was designed to capture this effect, with six one-minute long draws spaced apart by progressively longer durations from a 30 to a 360 second delay. By varying the draw rate and temperature rise ($T_{out} - T_{in}$) and using a mass flow meter to observe changes in firing rate, the TWH response was monitored over all tests. In general, TWHs will monitor a draw for three seconds before opening the gas valve,

**Table 1: Characteristics of TWHs Tested**

| Description | Firing Rate (kW) | | | Certified Performance | |
|---|---|---|---|---|---|
| | Min | Max | EF | Max Litres per second | at ΔT (K) |
| Non-condensing | 3.224 | 58.584 | 0.82 | 0.271 | 43 |
| Condensing 1 | 2.784 | 58.584 | 0.93 | 0.277 | 43 |
| Condensing 2 | 5.832 | 51.287 | 0.92 | 0.265 | 43 |
| Condensing with small Buffer Tank (BT) | 4.982 | 58.584 | 0.95 | 0.322 | 43 |

and it takes five seconds for the unit to begin heating water. This may not seem long, but for 30-second draws the end user may not receive hot water at the desired temperature. To limit this impact, one product bypassed certain control sequences for draws within five minutes of one another to reduce these delays by half.

- **Temperature stability during variable loads** – Using a hot water draw pattern with step changes in flow rate from steady state, low flow to high flow – for example, 5.7-11.4 litres per minute (1.5 to 3 gpm), and vice versa – the outlet temperature stability was observed. As the draw rate abruptly decreases, a small outlet temperature overshoot may be observed (< 2.8K) as the TWH adjusts and residual heat from the heat exchanger is withdrawn. As the draw rate increases abruptly, significant temperature undershoot can be observed, up to 6K, as some TWH products will interrupt firing to adjust controls and ultimately avoid scalding outlet temperatures.

## Daily simulated-use testing

Using the standardised daily hot water draw pattern of 242 litres per day (64 gallons/day) and two 'realistic' patterns generated from field data, a mid pattern of 246 litres per day (65 gallons/day) and a low pattern of 114 litres per day (30 gallons/day), the delivered efficiency, gas and electricity consumption, and operating economics of the TWHs were estimated. Using the Energy Factor (EF) as a metric of delivered efficiency, with the ratio of energy output and energy input accounting for transient effects[8], the results are summarised in figure 2, with some observations:

- Water heater efficiency is a strong function of daily hot water consumption; however, draw intermittency and number play a role. For the 'standard' and 'mid' draw patterns with similar daily volumes drawn, a loss of efficiency and average delivered temperature are seen with the more intermittent 'mid' pattern.
- Onboard buffer storage tanks are a double-edged sword. The TWH with a buffer tank has an option to schedule its tank thermostat. GTI performed the

> The delays to delivering hot water are as much a function of the water heater itself as the piping layout

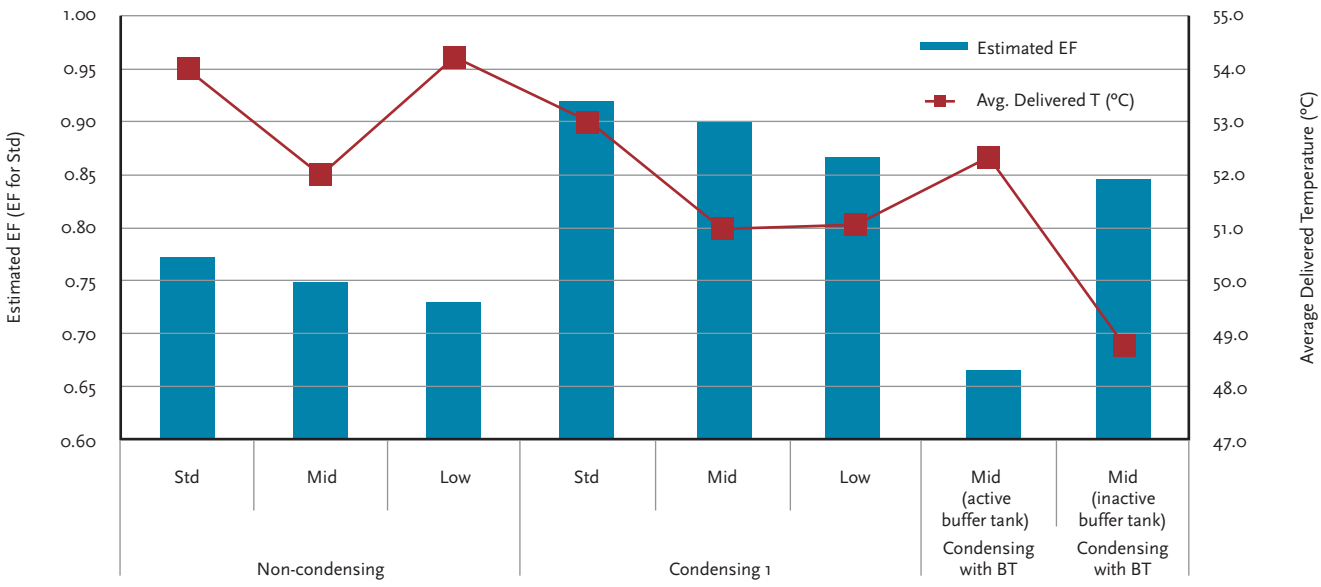


**Figure 2: Estimated Energy Factor (EF) and Average Delivered Temperature**

'mid' pattern testing both extremes, with the thermostat disabled and with it active all day. When active, the average delivered temperature is good, though at a significant energy cost. When inactive, which effectively doubles the internal pipe volume, the average delivered temperature suffers.

## Conclusion

The benefits of gas TWHs are known and documented – more efficient hot water generation than gas SWHs and the ability to sustain a given hot water demand.

However, they are not without drawbacks, concerning the degradation of delivered efficiency with rated versus more realistic usage. It has been shown that using more realistic draw patterns versus the US standard has an impact on the performance of all water heater technologies. From this, TWHs may suffer a disproportionate impact, as they are best suited for steady state operation. To better inform stakeholders, and in support of developing enhanced simulation tools, this laboratory study built on prior research by characterising TWH performance through standard versus realistic daily use patterns and a battery of short term tests, consisting of unusual, if not extreme, usage patterns.

Ultimately, how this impacts the end user is still a subject of investigation. For example, the delays to delivering hot water are as much a function of the water heater itself as the piping layout. Additionally, while emphasis in this study was placed on delivered efficiency, the difference in annual operating cost between the non-condensing and condensing TWH in California is less than $10 (using the 'mid' pattern)[9]. Thus the added cost of a higher efficiency TWH – 0.92 EF versus 0.82 EF – may be hard to justify while natural gas is so inexpensive in the US. **CJ**

**the amount of hot water being drawn from the system throughout the day/week/year*
***the time (delays) between the time at which there is a controller asking for hot water to be produced, to the time that the gas ignites (fires) and the time that the hot water flows*

**Tankless water heater**

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5 The hot water draw pattern used by the U.S. Dept. of Energy is six 10.7 US gallon draws, drawn at 3.0 US gallons per minute, each spaced an hour apart.

6 Lutz, J. and Melody, M. 'Typical Hot Water Draw Patterns Based On Field Data', Lawrence Berkeley National Laboratory - Environmental Energy Technologies Division, November 2012.

7 The full set of test results and analysis can be found in a technical paper published through the Proceedings of the 2013 ASHRAE Winter Meeting, held in Dallas, Texas

8 The standard EF is specific to the standard draw pattern, which its calculation includes adjustments for departures from specified outlet temperature, ambient conditions, and other variations.

9 Assuming $0.15/kWh and $0.97/therm


**PAUL GLANVILLE**, senior engineer, **DOUGLAS KOSAR**, institute engineer and **JASON STAIR**, engineer, work at the Gas Technology Institute in Chicago, IL, USA.

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# Air source VRF systems for flexible room heating and cooling, heat recovery and hydronic heating

This module considers the development of VRF systems and newer implementations for producing higher temperature hot water for hydronic heating systems

Variable refrigerant flow (VRF) systems are a refined and more flexible development of the mature technology that has been applied in 'split' direct expansion (DX) and heat pump systems. As well as providing distributed, temperature-controlled room units, by applying reversible heat pump technology VRF can simultaneously shift heating and cooling around the building, so reducing overall energy use. This CPD will consider the development of the VRF system and explore the newer implementations capable of efficiently producing directly useable hot water.

### Reduced area

Compared with a ducted air system, heat being transferred around a building through refrigerant pipework requires a fraction of the area, in terms of 'conduit' size, to provide similar heating or cooling to a space. For example a load of 5kW would require a circular air duct of around 350mm compared with a pair of refrigerant pipes of less than 15mm diameter (plus insulation for both the duct and the pipes). Normally, there would also be a need for ventilation air where the volume flow of ducted air would be related to the fresh air requirement. This is likely to be far less than the air flow that would be required to meet the whole heating or cooling load in the space and, if required, is often supplied using a dedicated outdoor air system (DOAS) that may also enable closer humidification control.

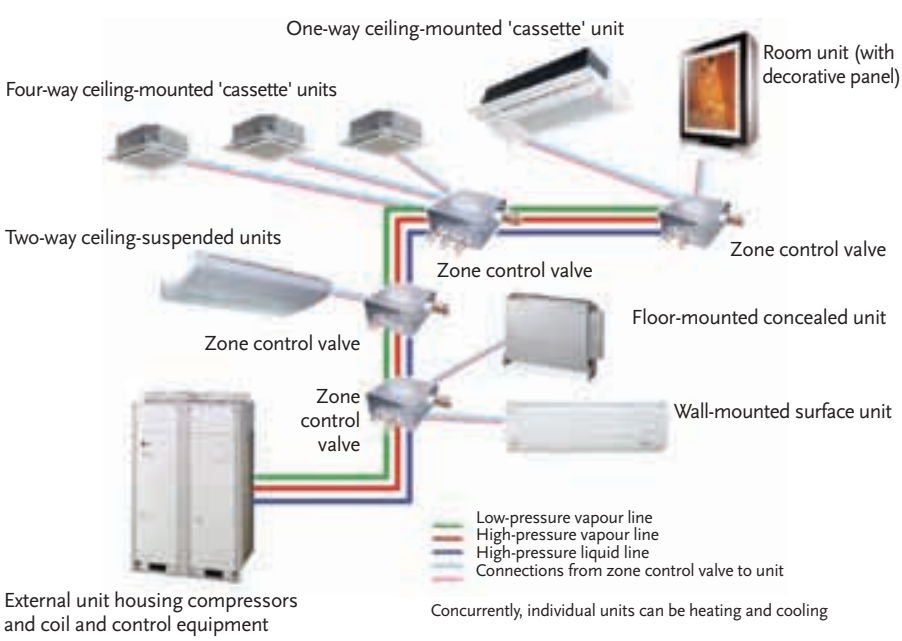


**Figure 1: An example three-pipe VRF system**

The use of 'split' DX systems is common across the globe due to both the reduced space required for the installation of ductwork and the relative simplicity of installation. (Note: direct expansion, or DX, refers to the direct expansion of refrigerant for cooling.) Often, DX systems comprise a single room unit attached to a single external 'condensing' unit (either simply 'through-the-wall' or with a short length of pipework connecting the two units). Recent 'multi-split' DX systems – where several internal units are individually connected to a single external 'condensing' unit – are almost all powered through a variable flow compressor that will

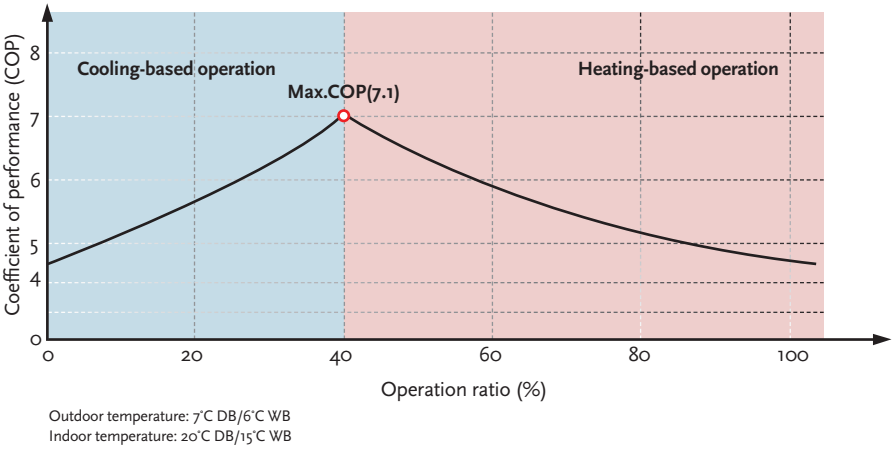


**Figure 2: Potential operating COP at ideal conditions can reach more than 7** (Source: LG)

accommodate changes in the sum of the demands from the multiple connected room units. These are limited to providing either cooling, or – in the case of a reversible 'heat pump' system – heating across all the units at any one time. The reach of a traditional multi-split system would typically be limited to less than 100 metres of total pipe run (so, for example, if there were four internal units they could each be 12.5m metres away from the external unit).

## Evolution

Over the last 15 years, variable flow systems have evolved from simple multi-splits so that, through more sophisticated control mechanisms, they can extend to supply dozens of indoor units connected with several hundred metres of pipework to one or more outdoor units using variable flow (controlled by the demands at the room unit). They can also supply terminal units spread over 100m vertically from the outdoor unit. Rather than use separate gas and liquid pipe runs to each and every unit, these systems use a single pair (or trio) of refrigeration pipes that can serve many units (and sub groups), and are known as VRF systems.

Each outdoor unit would typically provide up to about 200kW cooling capacity and the distributed indoor units up to 35kW each unit. The outdoor unit will commonly have multiple compressors, and at least one of these would be a variable capacity device. The compressors would normally be rotary or scroll compressors that inherently have little vibration and are controllable through modulating speed or digitally altering the geometry.

The appearance of the indoor units is similar to that of a traditional (water based) fan coil unit and they are similarly flexible with their positioning in the space. As with any coil that can operate below the dew point temperature of the room air, they should always be fitted with appropriate condensation drains. The room units will contain a fan, a refrigerant coil and controls providing both autonomous and integrated control operation. The room unit's temperature will be set by the condition of the refrigerant running through the coil in the unit, in response to room – or zone – temperature sensors.

The specific controls will be determined by the manufacturer's particular arrangements, but they would typically enable temperature control, fan speed control and, if included, dampers to allow fresh air supply. However, the headline operational benefit of VRF is through its integrated operation with both the other terminal units and the outdoor compressor unit. All will be connected through a common control system, which may itself be linked in to a central building management system and protocols such as BACNet and LONworks.

There are number of configurations offered that include single-mode systems (offering either heating or cooling concurrently to all the indoor units, which may be simply referred to as 'heat pump' VRF systems) and dual-mode systems employing two or three refrigerant pipes sequentially, serving units that individually can concurrently provide heating or cooling (these are frequently known as 'heat recovery' VRF systems).

Operationally, single-mode VRF systems will be similar to traditional multi-splits (aside from their ability to service more extensive systems). They can take advantage of the diversity of the timing of loads (for example, the temporal variation in peak cooling required for east- and west-facing office zones) to reduce the main system size (just as VAV does in ducted air systems). While operating in heating mode, all the internal coils will be acting as condensers, and the heating will be controlled by the electronic 'expansion' valve (sometimes referred to as a 'linear expansion valve') metering the flow. This will maintain an appropriate level of sub cooling (and so coil temperature) in the refrigerant as it leaves the room coil to return via the common return pipe to the external condensing unit. The electronic expansion valve in the external unit will, in turn, act to maintain an appropriate degree of superheat at the compressor intake, while the flow of refrigerant is modulated to meet the flow demands of all the distributed units.

Conversely, when operating as cooling devices the internal units would function as evaporators, and the degree of cooling provided will be controlled through the local expansion valve maintaining appropriate superheat (and so coil temperature) at the exit of the local coil.

Where there are concurrent loads for heating and cooling in different zones, dual-mode (heat recovery) systems allow heat to be moved around the building between areas that require heat and those that require cooling. Heat would effectively be moved from areas that require cooling to those that require heating without the need for the refrigerant to pass through the condenser/evaporator coil in the external unit. The external compressor will still operate (to provide the compression for the cycle), and will adjust capacity to satisfy the total cooling being delivered by the sum of the individual units.

The room units contain the same coils and fans as for single-mode systems. However, by applying appropriate controls and some sophisticated piping arrangements, they allow concurrent heating and cooling within separate room units.

Each of the indoor units is individually controlled, maintaining a required refrigerant flow to meet the load requirements by the use of electronic expansion valves (EEV), and the sum of all the flows is matched by modulation of the compressor output. The EEV also allows each individual unit to be isolated when an area is unoccupied or no conditioning is required.

In two-pipe heat recovery systems, a control unit local to a number of internal units provides a redirection of refrigerant between internal units so that some can act as evaporators providing cooling while, concurrently, others may act as condensers providing heating. The external unit will provide the compression to power the refrigeration cycle and, in some circumstances, if the cooling load of individual units matches the heating load of other units (plus the heat of compression from the external unit), the external coil will be bypassed and so the internal unit coils will be providing the complete evaporation and condensation

elements in the refrigeration process.

In a three-pipe system, as shown in Figure 1, one pipe would be the liquid line (as connected to the outlet of a condenser); one a high-pressure vapour line (effectively at the pressure of the compressor discharge); and one a low-pressure vapour line (effectively operating at the pressure at the inlet to the compressor).

When cooling is required, a control unit would open the unit's coil to the liquid line (through the expansion valve) and provide the outlet into the low-pressure vapour line, so acting as an evaporator. For heating, the coil would be opened to the high-pressure vapour line and the outlet to the liquid line, so acting as a condenser. In both cases, the amount of cooling or heating would be controlled by the EEV to produce the required degree of superheat, or sub-cooling, respectively.

Where there is an appropriate balance of heating and cooling loads across a building (the 'sweet spot' typically being where the cooling amounts to 40%[1] of the total building load), manufacturers show that there is potential to operate with an effective coefficient of performance (COP) in excess of seven (as shown in Figure 2). This COP would not prevail throughout the whole season's operation, being dependent on both the external conditions and the load balance.

In a heat recovery VRF system, there are opportunities to capture heat not required for space heating that may otherwise be rejected, and use it productively, for example, in a thermal store or to generate domestic hot water. Similarly, there is potential to use the heat pump facility of the VRF to supply heat for hot water generation.

The thermodynamics of the vapour compression refrigeration cycle will mean that when using a refrigerant, such as the commonly used R410A, the maximum temperature that can be efficiently generated is about 50°C. This is usable for underfloor heating applications and potentially some 'low temperature' heat emitters, as well as preheating for domestic water.

But as the difference between source (for example, the outdoor or room air) and the required target temperature (for example, the hot water store) increases, so does the compressor pressure ratio, and this will reduce the capacity of the system, alongside a falling system COP.

## Hot water generation

A number of methods have been identified to lift the upper temperatures of the cycle specifically for building services applications. A method being offered by several VRF manufacturers is to provide a cascade arrangement, where a second refrigeration cycle (using R134a refrigerant) uses the heat from a condenser in the VRF system to provide heat for the R134a evaporator. This cascaded system (Figure 3) can provide a useful solution where the demand for heat (for example in hot water storage) can absorb the variations in the space heating demands from the building, so more fully utilising the heat generated to produce the cooling required by the remainder of the installation.

## System considerations

As with any air source heat pump, the outside coils are likely to accumulate frost when the system is in heating mode (since the outside coil is acting as an evaporator at low temperature). This may be cleared via a number of automatic mechanisms, depending on the number and layout of external coils – though any defrost cycle will affect the system performance (and 'derate' the installed capacity). However, the effect of the cycle is unlikely to be noticeable in the room units. When there are multiple external units, such defrost cycles can be effectively sequenced while still maintaining heating to the internal units.

One of the developments that enable VRF is the control mechanism to maintain the lubricating oils in the compressor. Recovery of oil entrained in the refrigerant is principally achieved by capturing the oil before it enters the main distribution pipework. However, there will always be some carryover of lubrication oil into refrigerant flow, and this is recovered through a automatic dedicated cycle (lasting a few minutes), where the electronic expansion valves in individual units are automatically manipulated (they are all linked via the system's control network) and the compressor operates to pump the oil from the system back to the outside unit.

There is likely to be a significant network of insulated copper refrigerant piping to serve a VRF-based system, including many brazed joints and some flared connections. The design for the refrigerant network must comply with the requirements of safety standards (such as BS EN 378 Refrigerating systems and heat pumps – Safety and environmental requirements and ASHRAE Standard 15 – Safety Standard for Refrigeration Systems). Similarly, the installation must be installed and operated to comply with the current standards, most notably the 'F-Gas' regulations.[2]

The cost of installing a VRF system is similar to that of a three- or four-pipe water-based fan-coil system.[3] Particularly where there are opportunities for heat recovery, which may include using excess space heat for low and higher temperature hot water production, this electrically-powered system can be both straightforward and flexible to install and operate, and provide competitive seasonal efficiencies and operating costs.



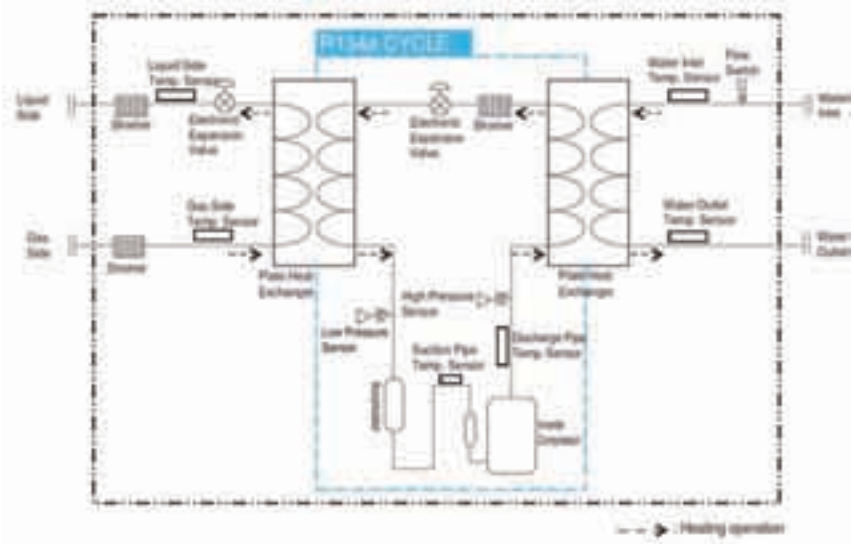


**Figure 3: Cascaded refrigeration process to provide hot water heating** (Source: LG)

## Further reading:

ASHRAE Handbook – HVAC Systems and Equipment (2012), chapter 18 has one of the most comprehensive introductions to VRF, together with examples of application (and provided some source material for this article).

## References


1 LG UK – *Heating with Air Conditioners to reduce carbon emissions*, Powerpoint presentation, 2013.

2 (In Britain) *The Fluorinated Greenhouse Gases Regulations 2009, The Ozone-Depleting Substances (Qualifications) Regulations 2009.*

3 ASHRAE Handbook 2012 – *HVAV Systems and Equipment*, page 18.3

# Module 51

April 2013

1. **In the example given, what is the approximate ductwork size required to meet a 5 kW room thermal load that is comparable to two sub-15mm refrigerant pipes?**

a. 15mm
b. 150mm
c. 250mm
d. 350mm
e. 450mm

2. **According to this article, what vertical reach can be accommodated with current VRF systems?**

a. 4m
b. 12.5m
c. 15m
d. 100m
e. In excess of 100m

3. **In a VRF system, which of these is least likely to be incorporated into a room unit?**

a. Compressor
b. Condenser
c. Evaporator
d. Expansion device
e. Fan

4. **Which of these is the attribute that most clearly picks out systems that are termed 'VRF' from 'multi-split'?**

a. There can be multiple internal units
b. The compressor will be a variable flow device
c. The system can be operated to serve individual units across several hundred metres of distribution
d. The internal unit will control the temperature in the individual space
e. The F-Gas regulations will apply to the system

5. **In the example cascade refrigeration system, what is the refrigerant used in the higher-temperature section?**

a. R134a
b. R407c
c. R410a
d. R717
e. R744

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**Telephone:** 020 7880 7614 **Email:** Patrick.Lynn@redactive.co.uk

## Revved up lighting at new Honda showroom

Honda motorcycles are renowned for their high quality engineering and classy, understated design and these principles are reflected in the design of the new Honda motorcycle dealership in Chichester.

With a large glass frontage, allowing a high level of daylight into the showroom, and gloss white ceiling tiles, a minimalist and clean luminaire was needed to complete the designer's vision for the space. JCC's Skytile, with it's evenly lit optic and high quality LEDs, was selected to provide this clean and unobtrusive solution.

● **Visit www.jcc.co.uk, email sales@jcc.co.uk or call 01243 838 999**

## SE Controls provides creative environment

Students at Loughborough University's £14.7m East Park Design School building are being helped in their studies by an integrated natural ventilation system from SE Controls, which ensures that carbon dioxide ($CO_2$) is kept in check and indoor air quality levels are maintained. The natural ventilation control and actuation system was designed and installed by SE Controls to manage the $CO_2$ levels and ensure the temperature within the building is maintained within comfortable limits by using precise incremental control.

● **Visit www.secontrols.com or call 01543 443060.**

## ISO award for HygroMatik

HygroMatik has been awarded ISO14001 certification demonstrating its compliance with the international Environmental Management Standard DIN EN ISO 14001:2004. The company has also once again received certification in accordance with the DIN EN ISO 9001:2008 Standard that confirms the effectiveness of its successful quality management system. The environmental and quality management at HygroMatik has been brought together as a single Integrated Management System (IMS), which encompasses the company's guidelines and instruments relating to occupational health and safety.

● **Visit www.hygromatik.com or call 02380 443127**

## Rehau wins WRAS approval

Ahead of the forthcoming European Drinking Water Guideline, which will set maximum limits for certain metals including organic and cementitious materials in contact with UK drinking water, REHAU has switched to a common material already approved and included in the draft.

The process of implementing the new Drinking Water Guideline is already in place in the Netherlands, with Germany changing over by the end of 2013. Having signed a Declaration of Intent, the UK and France will soon follow suit.

● **Visit www.rehau.co.uk**

## Step into the theatre

Providing cooling and ventilation in theatres and auditoriums presents a unique set of challenges in air distribution design. Usually these buildings are built on a grand scale and enclose large volumes of unoccupied space. Comfortable conditions at seating level with no draughts and low noise levels are vital. Gilberts' new ST Series provides a range of diffusers perfectly suited for this type of application, fitting in to the steps or risers, under and around theatre seating areas and provides two specific diffuser designs.

● **Visit www.gilbertsblackpool.com or call 01253 766911**

## Danlers launches 'intelligent' batten-mount PIR occupancy switch range

Anlers has launched a new range of Batten-mount PIR occupancy switches capable of significant energy savings at low cost. They are ideal for switching lights off when not required and with energy savings of up to 50%, the payback period is kept to a minimum. The one touch 'Intelligent' calibration process can distinguish the difference between artificial and natural light delivered to the photocell, resulting in optimised switching levels and enhanced energy savings.

● **Visit www.danlers.co.uk or call 01249 443377**

## Riegens launches at LuxLive

Riegens Lighting chose LuxLive 2012 for the launch of its new Frame slim-line, suspended luminaire. Combining the latest generation of LEDs with prismatic light technology, Frame's aesthetic design makes it ideal for high-end office lighting installations. Frame provides direct light with the use of anti-glare micro prism optics, while providing a soft indirect upward light using an opal diffuser. Frame is available with 33W or 43W LEDs and, if required, sensors for energy savings and light control. Frame comes complete with electronic driver, on/off or DALI/Switch&Dim and a sensor option is also available on request.

● **Visit www.riegens.co.uk, call 01376 333400 or email riegens-lighting@riegens-lighting.com**

**Telephone:** 020 7880 7614 **Email:** Patrick.Lynn@redactive.co.uk

## First UK installation of Rehau chilled ceiling system in the Crystal

The Crystal, a Sustainable Cities Initiative by Siemens, located in London's Royal Victoria Dock, is the first building in the UK to use REHAU's chilled ceiling system. Two 30m² conference rooms in London's newest landmark – which also houses the world's largest exhibition on the future of sustainable cities – have been fitted with REHAU's new high performance chilled ceiling panels to provide efficient and effective localised cooling.

● **Visit www.rehau.co.uk**

## Pegler Yorkshire leads the way in design of hospital tap

Plumbing systems manufacturer Pegler Yorkshire is the company behind the UK's first Antimicrobial Copper tap, in line with the recommendations set out by the Health Protection Agency (HPA). An investigation by the HPA found that as water is not sterile within a plumbing system, waterborne micro-organisms are capable of forming a biofilm, which is known to be more resistant to disinfectants than floating waterborne micro-organisms. To reduce the possibility of these biofilms harbouring opportunistic pathogens, which can be responsible for hospital infections, a key recommendation has been made by the HPA to remove the rosette or flow straightener from within the tap outlet.

● **Visit www.pegleryorkshire.co.uk, email brochures@pegleryorkshire.co.uk or call 0844 243 4400**

## Drumbeat publishes white paper on infrared thermography

The dynamic new energy management business support service Drumbeat Energy Management has published a white paper on infrared thermography. The white paper is entitled *Understanding Infrared Thermography: The role of Thermography in Detecting Energy Inefficiency*. The paper explores the pros and cons of thermography in detecting energy inefficiency in buildings and how the technology is revolutionising energy efficiency assessments in the three areas that matter most – speed, accuracy and cost.

● **Visit www.drumbeatenergy.com, email info@drumbeatenergy.com or call 020 7078 4103**


## Two decades of CableCalc Level P marked with a free version of new twin and earth calculations

To mark 20 years of CableCalc, Castline Systems has released a new, free version of its popular CableCalc program, which will calculate single-phase radial and ring circuits wired in twin and earth cable. It includes free technical support by email. CableCalc Level P is a fully working, unlimited-use version and provides far more than just simple volt drop calculations. CableCalc Level P can be downloaded from **www.castlinesystems.com** free of charge.

● **Call 01293 871751 or visit www.castlinesystems.com**

## JCC patents RadiaLED technology

JCC's new RadiaLED bulkhead range solves the problem of LED hotspots and traditional visibility of unsightly 2D lamps. The unique radial configuration of the LEDs allows light to project horizontally across a highly reflective surface. Light is then transmitted outwards through the diffuser to create even illumination.

Both the opal and prismatic diffusers have been engineered using high specification polycarbonate to enhance the light distribution and ensure maximum light output with no shadows or visible LED chips.

● **Visit www.jcc.co.uk, email sales@jcc.co.uk or call 01243 838 999**

## Stokvis Econoplate H debuts at Sustainability live

Stokvis Energy Systems will be showcasing the most recent developments to its product portfolio at the Sustainability Live exhibition at the NEC, Birmingham from 16-18 April. The Stokvis stand (G1) can be found within the NEMEX section of the exhibition and will feature a selection of the company's high performance products and systems that are suitable for a diverse range of applications, including commercial, education, healthcare, hotels and leisure projects. Stokvis will be taking the opportunity to officially launch its new Econoplate 'H'Series interface unit.

● **email info@stokvisboilers.com or visit www.stokvisboilers.com**

## Wieland Supports Fast Installation at Riverbank House

Wieland Electric has supplied its Metalynx armoured structured wiring system to enable fast connection of lighting, small power and fan coil units at Riverbank House in the City of London. Located at Upper Thames Street, the 10-storey Riverbank House is the new headquarters for Man Group plc, providing 29,000 m² of high quality office space in the capital's busy financial district. Use of Wieland's Metalynx structured wiring facilitated fast installation, as many of the connections could be made off-site and simply plugged in on site.

● **Email ian.holdom@wieland-electric.com**

**Telephone:** 020 7880 7614 **Email:** Patrick.Lynn@redactive.co.uk

## Hamworthy hits the road with hot water range

Hamworthy Heating is touring the length and breadth of the country this year to showcase its diverse range of hot water products. During events at various locations around the country, customers will be given the opportunity to speak to Hamworthy sales engineers and hot water specialists about the array of hot water products available, from direct fired water heaters, to calorifiers and storage tanks, plus the recently launched solar thermal solutions.

● **Visit www.hamworthy-heating.com or call 0845 450 2865**

## MHS Boilers are a wise investment for Plymouth school

MHS Boilers, part of Elco Heating Solutions, has supplied Mount Wise Community Primary School, Plymouth, with two 100 kW Thision L wall-mounted boilers, and a 500-litre Thision WH hot water generator, alongside a Pisces pressurisation unit and 300 litre Gemini calorifier. The installation was part of the complete refurbishment of a 60-year-old heating and hot water system, the new equipment from MHS replacing ageing oil-fired units. The boilers provide space heating to the school's buildings, while the Thision WH supplies the kitchen and washrooms with instantaneous hot water.

● **Visit www.mhsboilers.com**

## Dual supply marshalling box simplifies circuits at Winchester hospital

Hager's Klik.system dual supply marshalling box has saved Winchester hospital both time and money during the installation of essential and non-essential lighting circuits for its new 2,000m² outpatients' clinic. The outpatients' department will have a large, open plan area, plus a number of consulting and treatment rooms. Using the Klik. system dual linking marshalling box, both essential and non-essential lighting circuits can be fed from the same marshalling box and be controlled by a single digital sensor and wall switch.

● **Visit www.hager.co.uk , email info@hager.co.uk or call 01952 675612**

## PM's support for Prysmian

Prime Minister David Cameron visited the Prysmian factory in Eastleigh this week, to demonstrate the government's support for private sector manufacturing in the UK and in response to calls for regulating the import of substandard cable. Cameron opened the new high voltage testing laboratory, a £2m facility that typically tests extra high voltage power transmission cable at one million volts. The laboratory will be a central resource for Prysmian's worldwide manufacturing operation, but represents only a fraction of the £15m the company is investing in its UK plants this year.

● **Visit www.fpcables.co.uk**

## Mitsubishi Electric offers free CPD Guide to ErP Labelling


A free, CPD-approved guide to the new energy labelling of air conditioning systems has been produced by Mitsubishi Electric following the introduction of the Ecodesign Directive for Energy Related Products (ErP). The legislation affects anyone installing, specifying or using air conditioning units under 12kW and, for the first time, incorporates seasonal energy efficiency, rather than simply recording efficiency in heating or cooling mode at a single heating or cooling load. The new system introduces performance data at four different measuring points, as well as allowing for the different climatic conditions across Europe.

● **Email air.conditioning@meuk.mee.com or call 01707 282880**

## MAGNA1 of a kind

Today there are circulators available that can save significant energy – for example the Grundfos MAGNA3 – first introduced in 2012. This range of medium and large circulator pumps comes complete with electronically controlled motors based on permanent magnet (PM) and compact stator technology. This suite is designed for circulating liquids in a wide range of commercial applications, including heating systems, domestic water systems, air conditioning and cooling systems, as well as in renewable applications such as ground-source heat pump systems and solar heating systems.

● **Visit www.grundfos.co.uk, email uk-sales@grundfos.com or call 01525 850000**


## Pipe gives deep waves

Deeper Waves for Tighter Curves – that sums up a major product improvement for the CALPEX range of flexible preinsulated pipes. Launched at the Frankfurt ISH Exhibition on 12 March by BRUGG Pipesystems, new CALPEX is up to 24% more flexible, thanks to an ingenious new geometry with more pronounced corrugation. John Knight, PIPE2000 sales director, explains: 'CALPEX from BRUGG Pipesystems is a highly reliable and well-engineered PE-Xa preinsulated pipe system for underground use. It's a bonded system using PUR insulation which gives very low heat loss.'

● **Visit www.pipe2000.co.uk or email pipe@pipe2000.co.uk**


## Titan Products launches TPZ-Net Zigbee wireless range

The TPZ-Net is a new range of wireless environmental products from Titan Products. Incorporating Zigbee wireless technology, the range creates extremely stable, self-healing mesh networking capabilities. The TPZ-Net range is designed to monitor temperature, $CO_2$, humidity, light and occupancy levels wirelessly and transfer this information back to the Titan Products coordinator, where the information can be transferred onto a BACnet network or to other Titan product controllers, or I/O (input/output) devices.

● **Visit www.titanproducts.com or call 0161 406 6480**

## Myson's iVECTOR proves an invaluable resource

The Myson iVECTOR has proved invaluable in the commercial sector. With its compact size and energy efficient heating technology, the iVECTOR has become the natural choice for heating commercial buildings such as schools, universities, care homes and showrooms across the country. Andrew Lowery, product manager, said: 'The value of wall and floor space can be overlooked, but in commercial environments, such as corporate offices and retail environments, space is definitely money.'

● **Visit www.myson.co.uk**

## COOL DX Top brings new advantages, but keeps same simple interface

Swegon, a major producer and supplier of energy efficient ventilation and climate systems, has launched COOL DX Top. COOL DX Top is a new addition to the product series COOL DX, which are chillers for GOLD RX Top, Swegon's top connected air-handling units with rotary heat exchanger. It is as simple as always, but with several new advantages. For Swegon's series GOLD RX air-handling units there is an existing customised chiller series, COOL DX, comprising a combination of products, with simplicity a key factor. Swegon is the largest wholly owned company in Investment AB Latour.

● **Visit www.swegon.co.uk or call 01992 450400**

## Universal dimmer meets LED challenge

Theben's KNX-compatible Universal Dimming Actuator leaves designers free to choose lighting from any manufacturer, mixing and matching to build the best solution for each application, which is the core principle and purpose of the KNX open protocol. The Universal Dimming Actuator DMG 2 T KNX is part of Theben's successful MIX range, a series of devices, consisting of a base unit and up to two extension modules, making it easier and more cost-effective to control multiple channels.

● **Visit www.theben.de/en**

## Marco data guide offers Cat 6 solution

Marco, a leading uPVC Cable Management Company, and the UK's largest manufacturer of Steel Wire Cable Tray, has launched an innovative new accessory that allows users to meet Cat 6 compliancy on the Marco Apollo Trunking Range.

The new Data Guides are pre-fabricated into the base of the flat angles and tees, and are plastic-welded into place prior to despatch. For the external and internal angles, the Guide is clipped into the base of the trunking and the cover is then placed into position after the cables have been laid.

● **Visit www.marcocm.com**

## RNSS pitch-perfect at Allianz Park

The new Allianz Park stadium in North London, home to Saracens Rugby Club, has raised the bar for audio systems in the world of rugby. The upgrade to a concert-standard sound system for the 10,000-seater stadium, designed and installed by RNSS, has been designed to give fans the best possible audio experience. Hi-fidelity sound is now available throughout the stadium. In addition to the new East grandstand, it also encompasses the three other stands and all internal spaces. This includes the 105 metre-long interior space under the East stand, which doubles as a match day bar, indoor athletics track and training area.

● **Email Simon Bennett, simonb@rnss.net or call 07710 400446**

## Hitachi Air Conditioning Europe announces new Hi Efficiency VRF

Hitachi Air Conditioning Europe SAS is proud to announce the launch of its latest product innovation for medium- to large-sized applications. Thanks to a number of unique Hitachi technologies, the new models present a convincing solution for all European climates, with one of the highest energy-efficiency ratios on the market. The FSXNH range is currently the highest performing (Annual Performance Factor – (APF)) VRF system in Japan, recently receiving the Japanese Energy Efficiency and Conservation Award 2013. FSXNH offers 2-pipe heat pump and 3-pipe heat recovery options.

● **Visit hitachiaircon.com, email aircon.enquiries@hitachi-eu.com or call 01628 585394**

# PRODUCTS & SERVICES

**Telephone:** 020 7880 7614 **Email:** Patrick.Lynn@redactive.co.uk

### CP's Vitesse installed at AJW's HQ

Lighting control company CP Electronics has supplied its Vitesse Plus and Vitesse Modular lighting control systems to A J Walter Aviation for the newly constructed global HQ and logistics centre close to Gatwick Airport. The new-build facility has been constructed using best practise in sustainable building design to ensure the highest BREEAM rating has been achieved. The site will provide 175,000 square feet of purpose-built office and storage facilities for AJW's extensive range of Airbus and Boeing components, engines and consumables.

● **Visit www.cpelectronics.co.uk, email enquiry@cpelectronics.co.uk or call 0333 9000671**

### Get close to information with Havells roadshow

Havells, a global specialist in electrical and power distribution equipment, has invested in a mobile roadshow to demonstrate some of its latest innovative and unique solutions to the electrical contractors, consultants and facilities managers. The roadshow will showcase the company's growing range of electrical distribution solutions, focusing on peripheral application requirements, such as metering and surge protection. These areas of electrical distribution often create the greatest challenges for electrical installers and specifiers alike, because of the need for compliance with the myriad of UK regulations and standards that are applicable.

● **Visit www.havells.co.uk or email customerserviceuk@havells.com**

### Synergy between elegance, comfort and cost-saving

Climaveneta, a leader in energy efficient air conditioning solutions for big projects, presents a new unit for commercial and residential architecture. The i-LIFE Slim is a solution that meets modern requirements where design and aesthetics must go hand in hand. Designed to blend into any kind of setting and home, it features a refined layout and elegance: linear and modern design of the casing, minimal lines and gentle curves, plus use of high quality plastic materials. Climaveneta has focused on aesthetics and paid attention to the detail, offering the perfect solution for any type of ambience.

● **Visit www.climaveneta.com**

# DIRECTORY

**Your guide to building services suppliers**

**Telephone:** 020 7880 7614 **Email:** patrick.lynn@redactive.co.uk

## Air Conditioning



## Air Handling



## CAD Services



## Controls/BMS/Controllability



## LST Radiators



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## Pump Packages

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The successful candidate will have proven experience in scheduling and conducting technical maintenance activities, switching plans, contract management and full experience in HVAC, generation, HV, water and fire alarm systems. Full knowledge of current electrical / mechanical regulations is also required.

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**Contact: darren.warmington@bsvrecruitment.co.uk**

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# Events & training

## NATIONAL EVENTS AND CONFERENCES

**CIBSE Technical Symposium**
11-12 April, Liverpool
Two-day symposium with a focus on practices that ensure buildings realise their energy and environmental promise.
groups@cibse.org

**International Lighting Conference**
12 April, Dublin
A panel of world-renowned lighting experts and researchers will present on the day. CIBSE Ireland and SLL event.
www.cibseireland.org/cibse-annual-conference

**Lighting Masterclass**
25 April, Sheffield
The Society of Light and Lighting Masterclass season continues its tour.
www.sll.org.uk

**Greenbuild Expo**
8-9 May, Manchester
A free exhibition with a programme of seminars, including speakers from the UK Green Building Council, and DECC.
www.greenbuildexpo.co.uk

**CIBSE AGM**
9 May, London
CIBSE annual general meeting, with inauguration of new CIBSE president George Adams and his presidential address.
www.cibse.org

**ThinkFM 2013**
10 June, London
Facilities management event. This year's focus is 'the leadership challenge'.
www.thinkfm.com

## CIBSE GROUPS AND SOCIETIES

For more information visit **www.cibse.org/events**

**The Lighting Tightrope**
8 April, Coryton
A presentation on achieving an appropriate balance between lighting quality and energy efficiency.
www.cibse.org/events

**The CPVC thermoplastic fire sprinkler piping system**
9 April, London
A Society of Public Health Engineering event, with a presentation by IPS Flow Systems.
steve.vaughan@aecom.com

**CIBSE South West region AGM**
11 April, Bristol
Annual general meeting.
millham.orchard@tiscali.co.uk

**Society of Facade Engineering AGM and lecture**
16 April, London
Joint meeting of the Society of Facade Engineering and the Institution of Structural Engineers, with a lecture on The Walbrook Building.
www.cibse.org/events

**West Midlands region AGM, and the five areas of performance failure that most commonly result in M&E consulting engineers being sued!**
17 April, Birmingham
With a speaker from Hoare Lea.
Nigel.Marriott@gmtreble.co.uk

**Home Counties region AGM**
23 April, Chelmsford
AGM followed by preview of CIBSE president-elect George Adams' presidential address.
www.cibse.org/events

**Home Counties North West region AGM**
25 April, High Wycombe
AGM with Bentley Systems MEP BIM presentation.
www.cibse.org/events

**Waste to energy pyrolosis**
2 May, Bristol
A South West region event.
millham.orchard@tiscali.co.uk

## CPD TRAINING

For more information visit **www.cibsetraining.co.uk** or call the events team on 020 8772 3660

**DEC training (two days)**
10 April, Birmingham

**Building Regulations Part G (2010) explained**
16 April, London

**EPC training – two days**
16 April, London

**Writing a comprehensive and compliant air conditioning report**
16 April, Birmingham

**Fire safety engineering design: module one (two days): principals of FSE, means of escape and smoke control**
17 April, London

**Low and zero carbon energy technologies: undertaking feasibility studies and understanding design considerations**
18 April, Bristol

**Introduction to BS7671:2008 – requirements for electrical Installations' incorporating amendment 1 – July 2011**
23 April, London

**Smoke control: matching the method to the building**
24 April, London

**Introduction to combined heat and power**
24 April, London

**Energy surveys**
25 April, Newcastle

**Successful diesel generator**
30 April, Manchester

**Fire detection and alarm systems for buildings – BS5839 Part 1 2002**
30 April, London

**Standby diesel generator**
30 April, Manchester

**Introduction to 11 kV distribution and protection**
1 May, London

**Part B (fire safety) of the Building Regulations**
1 May, London

**Air Con 1: comfort climate and heat gains**
2 May, London

**Low and zero carbon energy technologies: undertaking feasibility studies and understanding design considerations**
2 May, London

**Electrical services explained – three days**
2 May, London

**EPC conventions**
7 May, Birmingham

**Cooling and refrigeration**
8 May, London

**Unvented and other types of efficient hot water system**
9 May, London

**Part L Building Regulations**
9 May, London

**Air conditioning inspection for buildings**
13 May, London

**Air Con 2: the air conditioning process**
14 May, London

**Energy surveys**
15 May, London

**Rainwater harvesting and greywater recycling in the sustainable environment**
15 May, London


This year the Green Deal will be a focus for debate

## Greenbuild EXPO 2013

### 8-9 May, Manchester Central

The UK Green Building Council (UK-GBC) joins Greenbuild Expo 2013 at Manchester Central for its fifth year on 8-9 May.

A free programme of thought leadership, debate, training and seminars will look at ways to improve the environmental impact of our existing building stock.

There will be more than 150 exhibitors showcasing the latest green products and solutions for both refurbishment and new build domestic and commercial properties.

The Green Deal/ECO Arena will host key organisations and government departments – including the UK-GBC and the Department of Energy and Climate Change – on what this policy means for the built environment.

For the first time, the 2013 expo will also be home to the CO2t Transport Conference, and see the return of Ignition 13, the UK's only wood fuel event, which will be debating how biomass will work as part of the Green Deal and the introduction of the domestic Renewable Heat Incentive.

Seminars will include sustainability in architecture, with sessions on materials, methods of construction and creating smart buildings. There will be a focus on new build, with 'Building Forensics' from John Rich of Stubbs Rich Architecture, examining why buildings fail, despite being drawn and built to high environmental standards.

**www.greenbuildexpo.co.uk**

SUTCLIFFE CONSULTING ENGINEERS

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01482 226 444

## Associate Director Electrical Engineer
### Kingston upon Hull

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Although based in Hull we work nationally and the candidate must be prepared to travel. If you are interested in joining our committed professional team and have the relevant experience and qualifications, please email your application with a full CV to reception@sutcliffeconsulting.co.uk

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### Electrical Building Services Engineer | Sittingbourne
£35,000 Plus Benefits

A well renowned medium sized M&E Consultancy who are experiencing successive project wins are currently looking for a well-rounded intermediate electrical design engineer. Successful candidates will have experience of initial and detailed design from conception stage to completion, including experience of working closely with clients, attending design/client meetings and leading aspects of projects. Our client actively supports the development of its engineers and ensures that all their staff are provided with development opportunities such as CPD courses and training in order to generate the best out of their team.

### Mechanical Design Engineer | Oxford
£38,000 Plus Benefits

We are currently working on behalf of an expanding building services consultancy in the Oxford area. They are currently looking for a Mechanical Design Engineer to work on various projects within the team at their Oxford office. This is a fun and exciting place to work with an enviable portfolio of clients within the UK and internationally. The ideal candidate for this position will have a minimum of 4 years' experience within a building services consultancy. They not only want someone who is technically capable, but also has the potential to be promoted through the business to a very senior level.

### Principal Electrical Engineer | London
£50,000 Plus Benefits Plus Bonus

A multi-disciplinary practice in London with a host of specialist teams, this M&E consultancy is able to respond to every aspect of the building environmental brief. My client currently has a fantastic career opportunity for a creative and driven Principal Electrical Engineer to meet a sustained workload and further strengthen the successful London office team. The ideal Principal Electrical Engineer will be technically well rounded and able to offer the benefit of their experience to more junior electrical engineers within the team. You will be responsible for supporting and delivering designs for a range of project types and sizes. Whether you are leading the team, meeting with clients, developing and producing reports, specifications and guidance, or overseeing testing and commissioning activities. You should be able to work closely as a team to ensure the best results.

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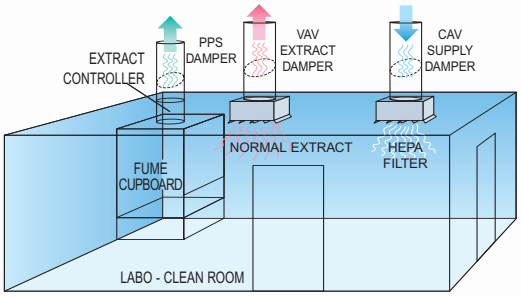


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Website: http://www.cmr.co.uk

Tel: +44 (0)1268 287222
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