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## Reasons to be cheerful



Trepidation over America's new environmental direction and uncertainty over Brexit have made this January feel particularly chilly. But this month's CIBSE Building Performance Awards should warm hearts and give us the opportunity to celebrate the individuals and organisations that contribute to improving our built environment and minimising use of natural resources.

The Hive library, in Worcester, was a worthy winner of a CIBSE Building Performance Award in 2013, and it is pleasing to see that it is continuing to make great strides in reducing energy use (page 28). It has comfortably surpassed performance

design targets; improving the controls for chillers, AHU fan inverters and pumps accounted for 12% of energy savings, but the biggest win came from reducing small-power use. None of these energy-saving opportunities would have been identified without the regular monitoring of operational energy and sensor data.

While services engineers continue to drive down the demand for energy in buildings, more analysis is being done on the supply side, too. On page 42, TÜV SÜD Wallace Whittle's David Davies and Alex Pepper look at the various options for supplying energy in the UK, and examine how hydrogen and electric vehicles will form an important part of the energy mix in the not-too-distant future.

Building services engineers are also working closely on the important issue of indoor air quality, which hit the headlines in the UK last month because of very high levels of air pollution recorded in London and the South East. Pete Carvell and Mohamad Tabatabaee, of Battle McCarthy, warn that not enough filtration is being installed in buildings to deal with polluted external air (page 20). They say the associated energy cost of filtering the air is inconsequential compared to the benefits of providing clean air for building occupants, and remind us that so-called 'fresh air' in cities is rarely that.

The value of building services engineers is evident in the above-inflation salary rises enjoyed by those working in the sector. The Hays Salary Survey, exclusive to *CIBSE Journal*, reveals that they received a 3.5% average pay increase in 2016 – and, thankfully, the survey also tells us that demand for engineers is holding up well in the face of Brexit uncertainty (page 55).

Finally, we would like to congratulate Aecom director Ant Wilson on being made an MBE in the New Year's Honours List. Wilson has been very supportive of the *Journal* over the years, and has been an inspiration to many young engineers (page 8).

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*CIBSE Journal* is written and produced by CPL (Cambridge Publishers Ltd) Tel: +44 (0)1223 378000. [www.cpl.co.uk](http://www.cpl.co.uk)  
1 Cambridge Technopark, Newmarket Road, Cambridge CB5 8PE.

**Editorial copy deadline:** First day of the month preceding the publication month

The opinions expressed in editorial material do not necessarily represent the views of the Chartered Institution of Building Services Engineers (CIBSE). Unless specifically stated, goods or services mentioned in editorial or advertisements are not formally endorsed by CIBSE, which does not guarantee or endorse or accept any liability for any goods and/or services featured in this publication.

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**Ant Wilson**, director, Aecom

**Terry Wyatt**, consultant to Hoare Lea

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### Hywel Davies

CIBSE's technical director looks at how Brexit will affect European standards



### Andrew Cooper

How Hammerson is measuring embodied energy on a retail extension in Didcot



### Liza Young

The *Journal's* deputy editor says services engineers are well placed to embrace the digital revolution



### Tim Dwyer

The technical editor's latest CPD looks at the application of brazed plate heat exchangers



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The official magazine of the Chartered Institution of Building Services Engineers

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©CIBSE Services Ltd. ISSN 1759-846X

## SUBSCRIPTION ENQUIRIES

If you are not a CIBSE member but would like to receive *CIBSE Journal*, subscribe now! Costs are £80 (UK) and £100 (international). For subscription enquiries, and any change of address information, please contact Nicola Hurley at [nhurley@cibse.org](mailto:nhurley@cibse.org) or telephone +44 (0) 20 8772 3697. Individual copies are also available at a cost of £7 per copy, plus postage.

The 2017 US annual subscription price is £100. Airfreight and mailing in the US by Air Business, C/O Worldnet Shipping NY Inc, C/O Air Business Ltd / 155-11 146th Street, Jamaica, New York, NY11434. Periodical postage pending at Jamaica NY 11431. US Postmaster: Send address changes to *CIBSE Journal*, C/O Air Business Ltd / 155-11 146th Street, Jamaica, New York, NY11434.

## CREDITS

Cover / Gravity road P6 Frederic Legrand - COMEO / Shutterstock P6 Maksim Kabakou / Shutterstock P8 Joseph Sohm / Shutterstock P12 Emily Taner / Shutterstock P12 Charles McQuillan / Getty Images P12 Thomas Pucher P13 Rawpixel.com / Shutterstock P13 Danila Shtantsov / Shutterstock P22 Luke Hayes P35 Volodymyr Krasnyuk / Shutterstock P39 Rustic / Shutterstock P40 Lena Skogsberg P42 Mascha Tace / Shutterstock P47 Carole Verbyst P60-61 Rustic / Shutterstock P60-61 Everything possible / Shutterstock

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ABC audited circulation:  
19,030 January to December 2015  
Printed by: Warners Midlands PLC

## IN BRIEF

### London councils get 'smart' investment

Several London councils have received funding for 'smart' innovations from the Green Investment Bank (GIB), including energy storage and LED lighting.

Camden, Islington and Waltham Forest councils are collaborating on a pilot project to determine whether solar energy storage can tackle fuel poverty. Panels and batteries are to be installed in 41 low-income households to test the technology and its impact on fuel use and costs.

Project 24/7 Solar is part-funded by the charity National Energy Action and will test three types of storage batteries. It will look at user behaviour in a bid to establish whether solar panels can supplement evening energy use and reduce bills.

Barking and Dagenham Council has also received a £6.8m loan from the GIB to install LED street lighting throughout the borough.

### 3D material stronger than steel, but lighter

Researchers at Massachusetts Institute of Technology (MIT) have created a 3D material that it says is 10 times stronger than steel, but lighter.

Flakes of graphene were compressed into a paste, and the material was then 3D printed.

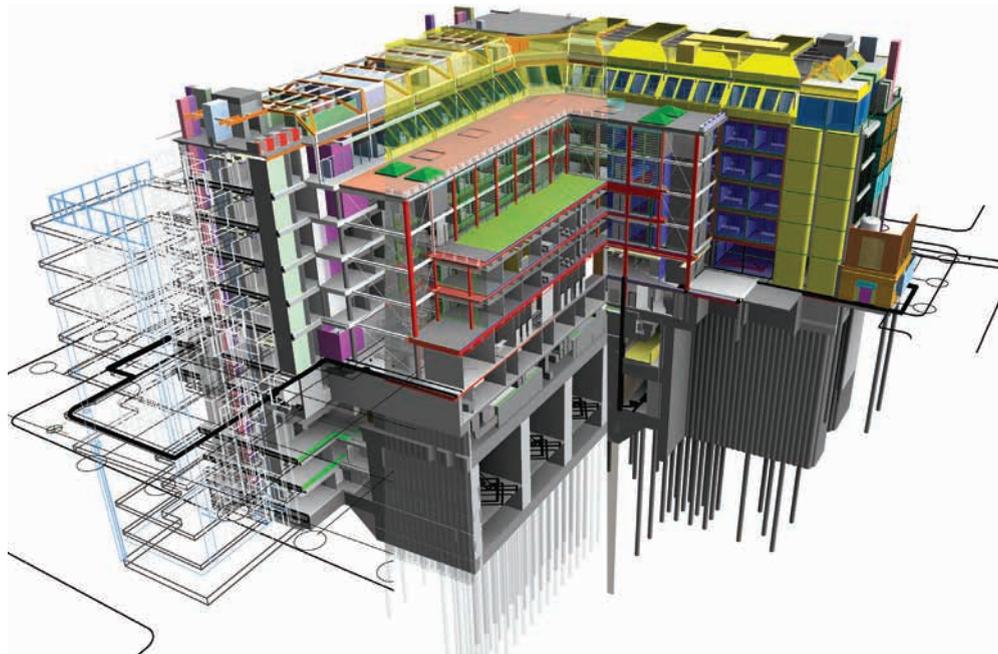
2D graphene is said to be the strongest of all known materials – 200 times stronger than steel – and the thinnest material on Earth, as well as transparent, impermeable, highly conductive and flexible. By producing a 3D version, the MIT team says it has created something potentially more useful in building design.

### TB+A scoops National Apprenticeship Award

Troup Bywaters + Anders has been named Medium Employer of the Year at the National Apprenticeship Awards, sponsored by British Gas.

The building services engineer was established in 1958 and 20% of its 210 employees, working across eight offices in the UK, are apprentices.

## WSP DESIGNS HI-TECH PROTON-BEAM THERAPY CENTRE



WSP is the M&E engineer for the UCL Hospitals Proton-Beam Therapy (PBT) Centre in London. The project – designed by STW Architects, with Bouygues UK as contractor, and Campbell Reith responsible for structures – includes five floors below ground, housing PBT equipment, and six floors above, which will be a facility treating blood disorders. The Level 2 BIM model includes 6D asset management and will be used in the operation and maintenance of the building.

## Industry salary rises still healthy but slowing, as employers get more savvy

Building services engineers enjoyed another year of inflation-busting salary rises last year, but wage growth is starting to slow after a sharp increase in the wake of the last recession.

These are the key conclusions of the latest Hays salary survey, compiled exclusively for *CIBSE Journal*. It found that salaries increased by 3.5% on average in 2016, well ahead of the 2.8% average increase for the construction and property sector overall. Intermediate and junior M&E design engineers saw healthy average rises of 4% and 4.7% respectively, while the average increase in M&E contractor directors' salaries was 5%. Associates and directors at consultants did not fare so well, recording wage growth of 3.10% and 2.70%.

Others that gained were quantity surveyors (5%), contractors' estimators (5%) and CAD technicians (4%). Ray Upjohn, chief executive at ChapmanBDSP, said that consultants were facing competition for digital engineers from contractors keen to gain BIM expertise.

However, Richard Gelder, director at Hays Building Services, said that wage growth had

slowed since 2015, when salary increases were running at 5%. 'Just 12 to 18 months ago, everyone was recruiting; there was real competition for skills and that fed into wage inflation,' he said. 'The cooling of the labour market reflects, in part, how employers have become more savvy about responding to hiring pressures.'

Upjohn agreed that salaries were levelling out after post-recession pay increases. 'The correction process is near the end,' he said.

The survey found that 22% of building services employers feared a lack of talent would thwart their business objectives – and Gelder believes these shortages could be exacerbated with Brexit. 'There's a clear pool of non-UK people working in the sector, without whom we would really struggle,' he said.

The fall in the pound is also making the UK less attractive for overseas workers, according to Philippe Honnorat, UK head of building services at WSP Parsons Brinckerhoff. 'If the Spanish economy rises strongly, some of our people may decide to go back home.'



## ‘Active’ government will target Stem, says May

**Prime Minister announces £170m for new technology institutes and reveals interventionist strategy**

Prime Minister Theresa May has said the government will take an ‘active role’ in shaping the future direction of the UK business community after unveiling a green paper outlining her proposed industrial strategy.

As well as plans to upgrade infrastructure and spend £170m on new regional institutes of technology that will focus on science, technology, engineering and maths (Stem) skills, May proposed further investment in clean energy and promised to tackle ‘regulatory barriers’ once the UK leaves the European Union. The outline strategy includes a proposal to provide maintenance loans for school-leavers who want to follow a technical training route rather than go to university.

May also proposed an ‘industrial strategy challenge fund’ to distribute

millions of pounds for research and development in areas such as smart energy, robotics and artificial intelligence – as well as to extend and improve communication networks.

Business Secretary Greg Clark will lead a consultation process on the strategy and is inviting different technical sectors to make their case for targeted support, but he made it clear that technical skills and technology innovation will be priorities.

‘For many years, the UK has not been as good on technical education as our competitors,’ Clark told the BBC.

CIBSE technical director Hywel Davies said that publication of the industrial strategy would help to clarify government thinking in this area. ‘The explicit acknowledgement that energy efficiency is a strategic issue is very welcome, as is the commitment to underpin the UK skills base and invest in research and innovation,’ he said.

**Government will intervene in industry more under Theresa May**

## Builders report soaring material prices

The collapse of the value of the pound has led to rising material costs for 70% of UK builders, according to the Federation of Master Builders. Around 25% of all construction materials are imported, and rises of between 10% and 15% have been reported, with small and medium-sized firms (SMEs) particularly badly hit, the FMB said.

‘Anecdotally, construction SMEs are already reporting an increase of 22% in Spanish slate and a 20% increase in timber,’ said Sarah McMonagle, director of external affairs. ‘The combined pressure of higher material prices and the rising cost of skilled labour represent a serious challenge.’

This could lead to further house price rises and reduction in consumer choice, she added, as some homeowners may be forced to compromise because ‘certain materials have become too expensive’. It is also making pricing jobs ‘problematic’, with SMEs having to protect themselves from sudden price swings.

‘Some builders are attempting to mitigate this by introducing larger contingency funds when pricing a job, or by stipulating that the overall contract price will change in the case of material price hikes, which makes client budgeting more tricky too,’ McMonagle said.

## Property owners not prepared for cyber crime

Despite increased awareness of cyber-crime, many commercial property owners do not take necessary steps to protect themselves, according to the Electrical Contractors’ Association (ECA) and Scottish electrical trade body Select.

Their joint survey, which received 229 responses, found that 39% of building clients say they don’t take any steps to protect smart installations – but 49% said the risk of hacking was a potential barrier to installing connected technology.

‘These figures are very concerning, particularly when you consider the inherent risks in the modern day of not securing your business from hackers,’ said ECA head of specialist groups Steve Martin. ‘Clearly this is an area that clients urgently need to address, given the anticipated growth in smart installations over the coming years.’



## Construction orders rebound in December – but costs are rising

Construction buyers enjoyed their fastest rate of order growth for nearly a year in December. The surge in activity at the end of 2016 was captured in the latest Markit/ CPS UK PMI Index, which rose to 54.2 in December, from 52.8 the previous month. It was the fourth month of consecutive growth, according to analysts.

‘New business volumes expanded at the strongest rate for 11 months in December, marking a sustained recovery from the soft patch seen in mid-2016,’ the survey said. ‘Respondents cited rising client demand and a resilient economic backdrop.’

However, the survey also recorded rising cost pressures, with input prices reaching their highest point for more than five years. ‘December’s survey data confirmed a solid rebound in UK construction output during the final quarter of 2016,’ said report author Tim Moore, senior economist at IHS Markit. ‘All three main areas of construction activity have started to recover from last summer’s soft patch, but growth remains much weaker than the cyclical peaks seen in 2014.’

## IN BRIEF



## US architects urge Trump climate U-turn

More than 250 American architectural practices sent an open letter to US President Donald Trump on his inauguration day, urging him to change his mind about climate change and recognise it as 'an unrivalled economic opportunity'.

The letter was coordinated by the coalition Architects Advocate, which was formed during the election campaign. It calls for the new president to support investment in renewable energy, level subsidies that support fossil fuels and nuclear energy, and keep the United States in the Paris Climate Agreement.

'Because buildings alone account for almost 40% of total US energy use and 72% of electricity use, America's architects are on the front line, addressing climate change in a meaningful way,' the letter said.

'By taking decisive action now, we all can be remembered as historic and courageous actors who helped secure humanity's future. We can turn our climate challenge into an unrivalled economic opportunity that creates desirable and healthy jobs in rural and urban communities alike.'

## Local grid switched on in Yorkshire

A virtual power station is being created across 40 council homes in Yorkshire, as part of a £250,000 pilot scheme to reduce energy use and fuel bills. Batteries will store electricity, generated by PV panels, that is normally sent back to the grid. They will be fitted to 30 homes with PVs and to 10 without. Software will calculate generation and demand for power, and take account of each home's use of power to maximise storage capabilities. The pilot, funded by Northern Powergrid, is taking place in Oxspring, near Barnsley.



The proposed tidal lagoon in Swansea bay

# 'Mr Building Services' made an MBE in New Year Honours

## Ant Wilson rewarded for more than 30 years' service to the industry

The man memorably described as 'the most famous person in building services' [by former CIBSE President George Adams] has been made an MBE in the New Year's Honours List.

Ant Wilson, director of sustainability and advanced design at Aecom, has been rewarded for services to building and engineering.

A CIBSE Fellow and Silver Medallist, Wilson has been a key figure in the sector for more than three decades. He has contributed extensively to the institution's work in building modelling, façade engineering, lighting, carbon reduction and energy certification. He was an adviser to the government on Building Regulations for many years, and was awarded Fellowship of the Royal Academy of Engineering in 2015.

Wilson was a member of CIBSE Council from 2003-2009 and served on the CIBSE Carbon Task Force. He was also a founding member of the Society of Façade Engineering, is a Fellow of the Society of Light and Lighting, and currently serves on the CIBSE Certification Advisory Group and on the CIBSE Knowledge Programme sub-committee.

A former winner of the ACE Engineering Ambassadors award and the Institute of Mechanical Engineers award for promotion of construction and building services, Wilson has

also served his local church in Dunstable for more than 30 years.

'CIBSE offers its warmest congratulations to Ant Wilson, who has made outstanding contributions to the engineering industry, and has been an exemplary voluntary contributor to CIBSE and wider society for more than 30 years,' said CIBSE President John Field.

'This latest honour is a richly deserved recognition of the impact he has had on a vital industry for the UK economy and society as a whole, and the difference he has made through tirelessly giving his time and energy to ensure that it continuously improves.'



Ant Wilson

## Tidal plans get support – 90 years on

A tidal power project first proposed in 1924 has finally received official backing.

The £1.3bn tidal lagoon, consisting of 16 turbines built along a breakwater in Swansea Bay, could make a 'strong contribution' to the UK's energy supply, according to a government-backed review. It would also bring 'significant economic opportunity' to Wales and the country as a whole.

The wait goes on, though, because the government has not granted permission for work to begin and a marine licence would also need to be secured.

However, former Energy Minister Charles Hendry, who led the review, said the lagoon would be a 'no regrets' project and could kick-start plans to develop a network of similar lagoons around the UK coast. He said the potential impact on consumer bills of large-scale tidal lagoons 'appears attractive, particularly when compared to nuclear projects'.

'If you look at the cost spread over the entire lifetime [estimated at 120 years], it comes out at about 30p per annum, per household, for the next 30 years. That's less than a pint of milk,' said Hendry. 'That's where we can start a new industry and do it at an affordable cost to consumers.'

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# 2016: a record-breaking year for renewables in Britain

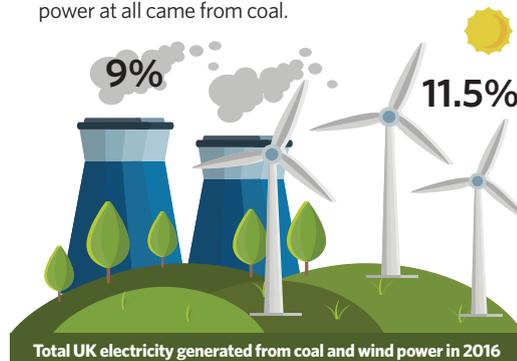
## On Christmas Day, 40% of UK's electricity came from renewables

Several renewable-energy records were broken last year, including wind turbines generating more energy than coal-fired power stations for the first time.

Only 9% of UK electricity came from coal generation in 2016 – down from 22.6% in 2015, according to analysts Carbon Brief. Wind power accounted for 11.5%. On Christmas Day, more than 40% of the country's electricity came from renewables, according to power-station operator Drax – a 63% increase on the same day in 2015. Biomass generation, meanwhile, had quadrupled compared with the same day in 2015. Three-quarters of the renewable energy

used on Christmas Day was from wind turbines – 31% of the UK's needs.

From April to September, electricity generated by solar panels outstripped Britain's coal-power stations for the first time, including one day in May when no power at all came from coal.



## Overheating in UK buildings will lead to more deaths, says report

Modern UK building standards are creating overheated buildings that will contribute to increasing mortality rates as global temperatures rise, according to a new study.

A lack of air conditioning and the continued focus on heat retention is creating a particular problem in new housing, researchers at Loughborough University's School of Civil and Building Engineering have revealed. They say the UK industry refuses to promote the use of air conditioning in mainstream housing developments, while advocating its use in upmarket apartment blocks.

The research – produced by Kevin J Lomas and Stephen M Porritt, and published in *Building Research & Information* – claims the resultant overheating affects the health and wellbeing of occupants, and can increase mortality rates among the elderly and infirm.

UK Building Regulations have reduced heat-loss levels by 23% since 1970, according to the researchers, but do not contain provisions for controlling overheating. If weather trends continue on their current path, heat-related deaths could treble by the 2050s.

## Heating standard for HIUs published

The Building Engineering Services Association (BESA) has published a test standard for heat interface units (HIUs). It was adopted from a test regime developed by energy consultancy FairHeat and overseen by a steering group of experts from BEIS, E.ON and SSE.

The initial test regime was developed by FairHeat in partnership with Martin Crane, of Carbon Alternatives. It was adapted from a Swedish methodology to suit UK operating conditions as part of a project funded by the Department of Energy and Climate Change.

The BESA technical standard will be used to compare manufacturers' products and equipment types, to help network designers evaluate the performance of individual HIUs against their design parameters. It will also be used to create a database and improve the industry's knowledge of HIU performance.

For more on the testing regime see 'Heat networks: Change by degree', *CIBSE Journal*, January 2017.

## Price of solar and wind is a match for fossil fuels

Solar and wind is now either the same price or cheaper than new fossil-fuel capacity in more than 30 countries, according to the World Economic Forum. This means renewables have reached an economic 'tipping point', says the forum. However, it added, investors and energy firms are still not investing sufficiently in green energy projects.

Renewable energy is now 'the best chance to reverse global warming', says Michael Drexler, head of development at the forum. 'It is not only a commercially viable option, but a compelling investment opportunity.' In just 10 years, he adds, the cost of producing electricity from solar has fallen from \$600 (£478) per MWh to \$100 (£80), and wind-generated electricity now costs just \$50 (£40) per MWh.

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# RHI recipients could be named in NI political crisis

**Oversubscribed scheme will cost taxpayers almost £500m**

Businesses that receive subsidies from Northern Ireland's Renewable Heat Incentive (RHI) - which brought down the power-sharing government, prompting fears that the peace process could collapse - may be named publicly.

Economy Minister Simon Hamilton has promised 'complete openness and transparency' about the scheme, which prompted a political crisis after the resignation of Sinn Féin Deputy First Minister Martin McGuinness last month.

The RHI was launched by First Minister Arlene Foster, of the Democratic Unionist Party, in 2012, and is now set to cost taxpayers almost half a billion pounds. McGuinness said the



**Deputy First Minister Martin McGuinness resigned in protest**

scheme was flawed and open to abuse.

Northern Ireland's version of the UK-wide RHI became heavily oversubscribed and several observers claimed the scheme's conditions were not stringent enough.

Hamilton has written to those in the non-domestic RHI scheme, indicating his desire to publish their details.

## CITB plans training levy cut ahead of key vote

The Construction Industry Training Board (CITB) is to reduce the training levy it charges firms by a third next year, ahead of a vote on its future.

It has offered to cut its bill from 0.5% to 0.35% of an employer's payroll, but the creation of the separate Apprenticeship Levy - which starts in April - means some firms are now being asked to pay twice.

To renew its Levy Order from the government, the CITB must demonstrate there is industry consensus for it to continue, and employers will vote on the issue between August and September. The government is expected to make a decision on the organisation's future by February 2018.

The CITB's chief executive, Sarah Beale, said she was 'confident that this Levy offer is the best option'. However, some industry sources questioned its relevance in the face of the new apprentice scheme.

'The big question is whether there should be a CITB levy at all,' said Tony Howard, director of training at the Building Engineering Services Association. 'It has not been able to spend all the money it raises through the levy for years and can't get funding to more than 9% of SMEs.'

## MAKING MUSIC ON THE BANKS OF THE VISTULA



BuroHappold is providing the building services and structural engineering for this striking concert hall in Warsaw, Poland. The auditorium will be home to the Sinfonia Varsovia Orchestra and is part of the Sinfonia Varsovia Centrum, which includes five historic buildings, plus the concert hall. The project is part of the regeneration of the Praga district on the eastern bank of the Vistula river.

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Responsibility for energy and environment

# Bonfield: CIBSE engineers can raise housing standards

**Guidance and expertise will underpin standards in new Quality Mark for housing retrofits**

BRE chief executive Peter Bonfield has called on CIBSE members to use their expertise to help underpin the new Quality Mark for green retrofits proposed in the *Each Home Counts* review, which he chaired.

Bonfield said that new technologies being installed in homes – such as MVHR, heat networks and PVs – required CIBSE expertise to ensure they are properly designed and integrated.

'It's an exciting time,' he said. 'There is a need for CIBSE expertise, standards and competency frameworks to ensure that people are trained and competent.'

Under the Quality Mark, the review proposes that installers, designers and assessors are properly certified and work to a new code of conduct. A code of practice will be established to ensure good-quality installations. Existing certification schemes will carry on, but will sit under the Quality Mark.

Bonfield said best practice from other schemes will inform the Quality Mark and that, with a standardised approach, installers will be able to embrace more technologies. Guidance and expertise will be collated in information hubs for installers and designers to access. Bonfield said: 'We will capture knowledge and reflect it back in practical CPD qualifications. There will be better



**Peter Bonfield said people are hungry to improve standards**

technical understanding.'

Bonfield's highly anticipated review was published before Christmas and, he said, has elicited a positive response.

'I am surprised by how hungry people are to improve the sector. They were fed up with a race to the bottom in terms of quality and cost.'

CIBSE technical editor Hywel Davies said the review had identified 'a number of aspects of home energy efficiency improvement that would benefit from greater quality control and assurance to bolster consumer confidence'.

'If industry can come together to deliver the recommendations, it could lead to a real improvement in standards,' he said.

■ See Phil Jones' letter on page 16.

## First speakers for Technical Symposium

More than 50 papers will be presented at the seventh CIBSE ASHRAE Technical Symposium at Loughborough University from 5-6 April.

Delivering Resilient High-performance Buildings is the theme for 2017, and has been inspired by the ASHRAE and CIBSE presidential themes of 'Adapt today to shape tomorrow' and 'Improving performance' respectively. The aim is to provide evidence of the successful adoption of resilience in the design and operation of buildings.

Speakers from all over the globe will attend, including Tom Lawrence, of the University of Georgia, Atlanta. He will consider how smart grids open the potential for buildings to participate in load-management and demand-response programmes with grid operators.

Other confirmed speakers include Sophia Flucker, of Operational Intelligence, who will examine the environmental impact on data centres of embodied energy in materials and the grid power source. Meanwhile, Kevin Kelly, of Dublin Institute of Technology, will uncover a new interior lighting design methodology.

To book a place, visit:

[www.cibse.org/symposium](http://www.cibse.org/symposium)

## Green Deal resurrected

The government's axed Green Deal scheme is set to be brought back to life by private sector investors in the City.

Greenstone Finance and Aurium Capital Markets bought the Green Deal Finance Company (GDFC) and its loan book for £40m. Kilian Pender, founder of Greenstone Finance and the new CEO of GDFC, told *Building* magazine they were looking to get former Green Deal installers back on the scheme. 'Over time we want to be one of the trusted brands in the energy space in the UK.'

The Green Deal offered consumers free or low-cost green home improvements, which were paid off through energy bills.

# Planners must connect buildings with environments

A holistic view of planning should be taken when designing cities, according to experts at last month's CIBSE Resilient Cities Group seminar.

Cities could be planned to improve people's health, said Audrey de Nazelle, of Imperial College London, at the event hosted with the Adaptation and Resilience in the Context of Change (ARCC) network.

De Nazelle said dense cities promote sustainable and active forms of transport, but there was risk of exposure to air pollution.

She said studies have indicated that the benefits of physical activity outweigh adverse effects associated with air pollution and/or traffic injuries.

Other aspects, including daylight and vegetation, also have to be considered. Changing the amount of vegetation cover in cities can have a significant effect on heat and pollution levels, said Sue Grimmond, from the University of Reading. 'Modelling of the environmental impact should be submitted and quantified to planners,' she said.



**City planning needs holistic thinking**

Lee Chapman, of the University of Birmingham, said big data should be used to measure the resilience of cities, and the Internet of Things could help protect major infrastructure – for example, by using crowdsourcing to collect weather data.

All speakers underlined the importance of bridging the gap between academic and professional knowledge. 'We do not want just the analysis – we want the solutions too,' said Jo Harris, sustainable construction group manager at BSRIA.

## IN BRIEF

### Making the case for EngTech registration

CIBSE is encouraging graduate members, or those with an engineering HNC/HND, to apply for the first grade of professional membership and registration, Licentiate EngTech. Applicants with a Level 3 qualification or above in building services will not need to attend an interview, and one to two years' experience can usually satisfy the competence criteria.

A new set of member case studies showcases some of the successful LCIBSE EngTech applicants, who come from a range of professional and academic backgrounds. You can view these at [www.cibse.org/membercasestudies](http://www.cibse.org/membercasestudies) and find information on applying at [www.cibse.org/licentiate](http://www.cibse.org/licentiate)



Licentiate member  
Chelsea Lawrence

### Yorkshire Region Awards clarification

CIBSE would like to clarify some details printed on page 13 of the January 2017 issue of the *Journal*, relating to the CIBSE Yorkshire Region Awards.

The article did not mention that Peter Hansford, former UK government chief construction adviser, spoke at the event. He congratulated all the winners and said he hoped members would take up the call to help inspire the next generation into construction.

References to BuildParabongo, the school in the Ugandan region of Parabongo, should have stated that the school was designed by the King Ecgbert students, rather than Helen Vardy.

# College talk seeks to inspire engineers of the future



Mildenhall College Academy pupils listen to the presentation

### Presentation to promote industry to students

Around 180 students from the Mildenhall College Academy sixth form, in Suffolk, were treated, in January, to a presentation by CIBSE member Mike Malina, from Energy Solutions Associates.

The presentation – organised by CIBSE member Eddy Warren, the sixth form's head

of English, Dr Kathy Warren, and pastoral lead, Carol Cooper – aimed to give the youngsters an insight into building services engineering.

Malina started with a general overview of all aspects of engineering, before looking more specifically at M&E in building services engineering, where his experience lies.

After the first presentation to the college in 2015, this year's event was attended by some of the senior teaching staff.

These visits aim to shine a light on the opportunities available to students in the industry, and to raise awareness of building services engineering as a career.

A number of questions were posed and the presenters trust that the involvement of the teaching staff will help prompt further questions across the year.

By raising awareness of the industry and the job opportunities it offers, Malina and Warren hope some of the college's students may go on to choose engineering as their future career.

To find out more about the presentation, contact Eddy Warren on [eddy.warren@supaflex.com](mailto:eddy.warren@supaflex.com)

## Regional focus

### South West

CIBSE South West was established in 1978 and covers a broad area – from Penzance, in Cornwall, to Swindon, in Wiltshire – with a meeting point in Bristol.

Representatives from the Young Engineers Network (YEN), the Society of Light & Lighting (SLL) and the Society of Public Health Engineers (SoPHE) sit on its committee, and CIBSE SW's 1,097 members include: facilities managers at naval ports; site engineers at nuclear power stations; sustainability consultants delivering zero carbon homes; and heating, ventilation and air conditioning engineers, supporting businesses and industry.

The committee, which includes members who are – or are working towards – CEng and IEng, is looking forward to welcoming members of EngTech.

CIBSE SW and its YEN have close ties with the University of West of England (UWE) in Bristol, which offers two CIBSE-accredited courses. Each year, students undertake research on behalf of the Glastonbury Festival in relation to its energy management. They investigate subjects such as battery-hybrid systems, smart meters, stage power management and the energy concerns of mobile traders, as well as

CIBSE SW chair  
Josh Eckett



alternative ways of reducing and supplying power. To find out more about CIBSE at UWE, contact [Patrick.O'Flynn@uwe.ac.uk](mailto:Patrick.O'Flynn@uwe.ac.uk)

CIBSE SW's current programme of technical and social events includes: 'Lighting: More psychology and art than science?'; 'BIM in healthcare'; and a number of charitable events. Chair Josh Eckett and the committee are aiming to improve communication with members across the region by extending activities into areas such as Bath and Swindon. They plan to try debate-style events and hosting with other groups, institutions and organisations. For more details contact [Josh.Eckett@burohappold.com](mailto:Josh.Eckett@burohappold.com) or visit [bit.ly/2jvRnza](http://bit.ly/2jvRnza)

## CIBSE membership briefing webinars

The CIBSE membership team is hosting a number of webinars and briefing sessions to help support people as they move up the membership grades.

The briefing sessions will focus mainly on applications for the Associate and Member grades and registration with the Engineering Council at the Incorporated Engineer and Chartered Engineer levels.

During the sessions, information will be given on a wide range of subjects related to membership applications. The dates are:

- North East Region, 14 March 6-7.30pm, Newcastle
- Home Counties, 8 May, 6-7.30pm, London
- Home Counties North West, 10 May, 6-7.30pm, St Albans
- CIBSE HQ, 8 June, 6-7.30pm, London
- Home Counties, 26 September, 6-7.30pm, London

For details and to book, visit [www.cibse.org/briefings](http://www.cibse.org/briefings)

A range of webinars that also offer support for applications, include:

### Qualification requirements webinar

28 February, 1-2pm  
29 March, 5-6pm

### How to start your engineering practice report

9 March, 5-6pm

### LCIBSE EngTech membership and registration

27 March, 1-2pm  
6 June, 1-2pm  
1 August, 1-2pm

Find out more and book at [www.cibse.org/webinars](http://www.cibse.org/webinars)



From left: Amelia Paszkowski; Edward Clarke, chair of the SoPHE education committee; Brittany Harris; and Ross Boulton

# Flood barrier wins SoPHE young engineer prize

## Winning system could help combat problem faced by two million UK homes every year

A cheap and efficient flood barrier has won the Society of Public Health Engineers (SoPHE) Young Engineers Awards.

The project – designed by Amelia Paszkowski, Brittany Harris and Ross Boulton, from BuroHappold Engineering – consists of a simple plastic and rubber barrier that can be put up by one person in 45 minutes to protect a 10x6m property from 0.5m of flood water.

The design costs four times less than current systems, weighs 40 times less, and can be stored, erected and taken down by the homeowner, without having to rely on the input and resources of local authorities.

SoPHE challenged award entrants to design a system to protect a bungalow from flooding – a problem that is faced by two million UK homes every year and costs the economy more than £1.4bn.

The system had to cost less than £500 and be small enough for the average homeowner to store, as well as be simple for elderly homeowners to set up.

In addition to meeting the design specifications, the winning team members were commended for their commitment to sustainability, both in terms of materials and the community impact.

All the components of their system are re-usable, recycled and biodegradable, while the ease with which it can be set up and managed encourages communities to be self-reliant and cooperative in deploying flood defences.

Edward Clarke, of the SoPHE education committee, said: 'This competition gives young engineers a hands-on chance to create

a project that directly impacts the health of our society, and tackles some of the most pressing issues that affect people in the communities around them.

'Engineering makes the modern world work, and demonstrating that is key to attracting the next generation of young minds.'

Rachael Porter, from Hoare Lea, received a high commendation at the awards ceremony, which was held during the 13th SoPHE anniversary dinner in November. The judges thought her design demonstrated an excellent appreciation of the brief and created an innovative solution.

All the finalists received an afternoon for two on a Sunseeker motor yacht.

John Griggs, of JPJN Partners, was awarded an Honorary Fellowship of the Society at the event, in recognition of his contribution to the industry. SoPHE was also able to donate £1,500, raised during the evening, to the charity Engineers Without Borders UK.

## Thank you

SoPHE would like to thank all the supporters of the event: ACO Building Drainage, Aliaxis UK, Alumasc Water Management Solutions, Andrews Water Heaters, AO Smith, Aquality Trading & Consulting, Blucher UK, Emmeti UK, European Vacuum Drainage Systems, Geberit Sales, Girpi, Goodwater, Grundfos Pumps, Hamworthy Heating, Heatrae Sadia Heating, Honeywell Control Systems, Horne Engineering, Hydrotec (UK), Kylemore Services, Lochinvaier, Pegler Yorkshire Group, Pipex, Polypipe, ProEconomy, Reliance Worldwide Corporation (UK), Rinnai UK, Roth UK, Saint Gobain Pam UK, Sentinel Performance Solutions and Teekay Couplings.



Heat networks feature in the Battersea power station redevelopment

## Phil Jones urges peers to develop codes of practice; heat-meter regulations are queried; and the future of heat is debated

### A call to arms

I note with enthusiasm that one of the recommendations in the Bonfield report is for defined codes of practice on energy-saving technologies. Although the report addresses the domestic sector, the arguments hold strong in non-domestic buildings. Some of us are well ahead of this curve.

Having conceived and chaired *CP1 Heat networks and CP2 Surface water source heat pumps*, it is clear to me that our direction of travel needs to be towards more codes of practice. Guides are useful – I’ve written a few – but codes set minimum standards on the basis of ‘shall’ rather than ‘might’ or ‘could’. CP1 is already changing the district heating sector, both technically and through procurement specification. Indeed, it is underpinning the £300m Heat Network Investment Programme.

This is a ‘call to arms’ to CIBSE members and anyone working in the built environment to help develop more codes of practice to set minimum standards and improve the way we design, build, commission and operate effective/efficient buildings. Join the cause – help develop a code.

*Phil Jones FCIBSE*

*CIBSE CHP and District Heating Group chair*

### Taking the heat

I recently received an amusing email with the heading: Why regulations are driving the market. A more interesting topic might be: Why are regulations driving us nuts?

The heat-meter regulations are a great example of this. They are written for domestic energy supplies of heating water to blocks of flats, but also apply to commercial buildings for chilled and heating water. Anyone who has been responsible for billing in office blocks knows occupiers couldn’t care less about their bills – they don’t even try to save on their electricity charges, let alone chilled water.

We are supposed to do a study to show if capital cost of an energy-metering scheme is viable against a reduction of 10% in energy use – but 10% is an arbitrary and unrealistic proportion. Because the real saving is much lower, the landlord is induced to do work that is a waste of money.

Having installed these very expensive meters, the landlord is only obliged to use them to invoice tenants if the annual cost of doing so is less than £70 per year per tenant. Can you imagine a managing agent of a large office building being able to invoice his tenants for less than that? This new regulation will soon be consigned to the same dustbin as the Code for Sustainable Homes and the Green Deal.

*Terence A Rook FCIBSE*

*Stinton Jones Consulting Engineers*

## CIBSE CHP & District Heating LinkedIn Group considers the future of UK heat

### Ian Allan

It is crucial that we act now to decarbonise heating and hot water use if the country is to meet its commitments under the Climate Change Act. One of the best ways to do this is to switch homes and workplaces to district heating schemes.

### Marc Asker

Anaerobic digestion and energy from waste are reasonable considerations. But I remain of the opinion that our heating – and growing cooling – needs should be met by electricity, which can be produced entirely by renewable sources.

As regards the Climate Change Act, if we miss targets the goalposts will be moved or the ‘other’ party will be blamed. To make any scheme/technology the primary choice, it has to stack up economically, not just environmentally.

### Ian Allan

I agree that any scheme needs to stack up economically – this will be a challenge while carbon is not taxed in the UK. I am not sure there will be any one solution, be it district heating or electrification of heat, or hydrogen in the mains. District heating is particularly suited to built-up areas and in making use of heat where it is a by-product of industry or other process.

### Marko Cosic

I don’t think you need carbon taxes – the avoided cost of servicing and replacing individual gas boilers is enough to make many schemes economic, provided the capital equipment isn’t over-specified and retail overheads can be kept down. Excess capacity in the electricity-generation market and distribution networks is a tougher one. Direct electric is tough to beat in many applications.

## “Office-block occupiers don’t try to save on their electricity charges, let alone chilled water”

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Kingsbury House

# Breaking up is hard – and there’s no standard formula

It now seems the UK government will seek to leave the European Single Market and the Customs Union when it negotiates Brexit. Hywel Davies explores the implications for European Standards and the Eurocodes

Among the questions most frequently asked by CIBSE members about the implications of Britain leaving the EU are ones on the standards they use in their daily work. At two recent CIBSE regional events, there were specific queries about the future status of the Eurocodes.

While there are many uncertainties about the UK’s negotiations for exiting the EU, there are some things we know for certain when it comes to standards. The first is that UK participation in CEN<sup>1</sup>, the European Committee for Standardization, is not related to EU membership – nor is it up to the UK government. CEN, along with CENELEC for electrical standards and ETSI for telecommunications, is recognised by the EU and the European Free Trade Association (EFTA) as the European standardisation organisations responsible for developing and defining voluntary European standards. CEN develops European Standards and other technical documents for products, materials, services and processes in a range of sectors, including construction, and the UK participates in CEN through the British Standards Institution (BSI). This is a private and independent body, with a Royal Charter, and was the world’s first national standards body.

BSI is the UK’s national standards body and belongs to CEN, CENELEC, and the International Organization for Standardization (ISO), of which it is a founder member. One of the conditions of its membership of CEN is that, when CEN adopts a standard as a European Standard (EN), BSI – plus the other 33 members of CEN – withdraws any conflicting standards.

So, as CEN has developed its series of 58 structural Eurocodes, standards for construction products, for the energy performance of buildings, for heating, ventilating, lighting, lifts and public health products and systems, the corresponding British Standards have been withdrawn and replaced by the European ones.

The second thing we know is that European Standards will continue to be used in all the other 33 CEN members, not just across the EU, after the UK leaves. So, whatever the agreed basis on which we trade with Europe after Brexit, goods or services coming from Europe will comply with European Standards. For British products and



“It would be a massive undertaking to recreate national standards”

services to satisfy the many requirements to be placed on the Single Market, even if the UK is no longer a part of it, they will need to meet the standards, and almost always be CE marked.

The third thing we know is that the BSI is very firmly and publicly committed to the ‘single standards model’ for Europe. In other words, while the UK will leave the EU, the BSI does not plan to leave CEN – and the indications are that CEN does not want the BSI to leave.

We also know that it would be a massive undertaking for BSI to embark on recreating national standards – and we know this is just not going to happen. Take the 58 structural Eurocodes for construction for example; they took 40 years to produce and some experts made careers out of their development. The cost to British business of its input to the Eurocodes runs easily to 10s of millions of pounds. On top of those 58 standards, there are around 1,500 standards and test methods – developed over the past 25 years or more – to underpin the Construction Products Directive and, now, the regulation of the same name.

Quite simply, nobody is going to reinvent those wheels. No significant employer is going to release the experts that would be needed for the task, and BSI is not going to ask them. First, because it does not have the resources to deliver it; second, because it would likely be the quickest way to be invited to leave CEN; and third, because it really does not make any sense to do this.

Finally, there is much talk of a trade deal between the UK and the US, and our respective leaders have recently met for talks. America will want to do a deal that gives US businesses access to the UK market, so we can be sure they will be keen for mutual recognition of standards between the US and the UK. So, in a UK freed from the power of the CE marking, we could be recognising standards from across the Atlantic, instead of writing or using conflicting standards of our own – and that would be a big step into a known unknown.

## References:

- 1 Comité Européen de Normalisation. CEN brings together the national standardisation bodies of 34 European countries, including the 28 current EU members, the three EFTA members – Iceland, Norway and Switzerland – plus Macedonia, Serbia and Turkey.



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# A fresh approach to helping everyone breathe easier

As occupants become increasingly aware of the effects of the indoor environment on their wellbeing, filtration will become more important in buildings, argue Pete Carvell and Mohamad Tabatabaee, of Battle McCarthy

While most of us would much prefer to be sunning ourselves on a beach, exploring snow-topped mountains, or simply strolling in our local park, we typically spend up to 90% of our lives indoors.

As building services engineers and designers, we take pride in creating exemplary environments for living and working. We often excel in the fields of daylight, ventilation, and visual and thermal comfort, yet the current political hot potato – namely, the failings of our government to tackle illegal air pollution – has proved a problem for us to solve.

How many of us are familiar with pages 33 and 43 of Approved Document F? The performance criteria for dwellings – also applicable to offices – states that exposure to nitrogen dioxide (NO<sub>2</sub>) should not exceed 288 µg/m over a one-hour average, and 40 µg/m over a long-term average. More importantly, how many of us know that outdoor ambient NO<sub>2</sub> levels in many of our cities are often four times above this?

NO<sub>2</sub> is directly attributable to 6,000 deaths annually in London alone<sup>1</sup>. As discussion of these issues moves further into the public domain, forward-thinking engineers are faced with the choice of tackling the problem or leaving ourselves open to potential liability claims.

As a nation, we are slowly waking up to the fact that, in our cities, ‘fresh air’ supplies are often far from fresh. As an industry, we need to recognise this and spread the word.



**“Engineers can either tackle the problem or leave ourselves open to liability claims”**

To tackle the problem, government and local authority focus has, until recently, been on reducing harmful emissions of NO<sub>2</sub> and the equally hazardous particulate matter (PM)<sub>2.5</sub> at source, and encouraging green infrastructure. Should current policy and the introduction of ultra-low-emission zones (ULEZ) progress, it is unlikely that we will achieve the target legal limits for outdoor air in our cities until 2021 – and it is proven that green infrastructure is far less efficient than mechanical filtration solutions when it comes to improving the quality of our indoor air.

Air-quality monitoring at all stages of a project is critical, and we must work with data from a variety of sources to build up a comprehensive picture. Unfortunately, air-quality monitoring data has a huge amount of catching up to do before we can treat it as we would weather data.

Without exemplary levels of air-quality monitoring and control, there is a strong argument that natural and mixed-mode strategies may be viewed – for the foreseeable future – as a poor choice compared to full mechanical-ventilation systems with appropriate levels of filtration and purification applied.

Filtration may also help improve outdoor air quality. We can consider every building as a lung, ‘breathing in’ polluted outside air and ‘breathing out’ processed and filtered indoor air of an improved quality – albeit with additional carbon dioxide (CO<sub>2</sub>), total volatile organic compounds (TVOCs) and

	Strategy			
	Air conditioned in line with F9 and activated-carbon filtration		Air conditioned	
	Typical practice	Good practice	Typical practice	Good practice
£/m <sup>2</sup> NLA per year	£30.34	£30.34	£29.65	£20.48
£/m <sup>2</sup> NLA per year	£2.81	£1.94	£2.75	£1.90
Energy (kWh electricity equivalent/m <sup>2</sup> NLA per year)	301	227	294	222

Applying activated-carbon filtration in line with F9 filters to tackle PM<sub>2.5</sub>. Figures derived from 2015 Real Estate Environmental Benchmarks<sup>3</sup>

**PETE CARVELL**  
and **MOHAMAD TABATABAEE** are associate engineers at Battle McCarthy

other internally sourced pollutants. As a couple of dramatic examples, if designers of Heathrow's new terminal for the third runway install appropriate levels of filtration, then the volume of air 'scrubbed' clean could be up to 20 times more than the volume of air associated with the ground exhaust emissions of the 600 daily flights from the terminal. Also, if every retail space in Oxford Street was to install an activated carbon filter within its ventilation system, it would be equivalent to the air-cleaning capability of planting green infrastructure over an area the size of Hyde Park.

So why aren't we applying such filtration technology on a grander scale? It is a question of air-quality compliance and health versus energy compliance, and the associated cost.

Where careful positioning of our fresh air intakes is not sufficient, BSEN 13799:2007 recommends installing activated carbon filters to remove NO<sub>2</sub>; these are also 90% effective at removing sulphur dioxide (SO<sub>2</sub>). Used alongside F9 classified filters to remove PM2.5 and PM10, the impact of such filtration – in terms of associated pressure drop – is a major consideration for engineers, particularly when retrofitting within an existing system.

An increase in specific fan power is unavoidable and, when it comes to designing energy efficient mechanical ventilation, there is very little we can do to compensate for unusually high pressure drops in a well-designed and installed system. The other consideration we have is cost, in terms of energy, installation and maintenance.

Replacement activated-carbon filter costs are approximately 40-60% of the filtration unit value. While some manufacturers are claiming their filters will last up to three years, we are more inclined to believe that a typical filter, installed in an area of poor air quality, will last around six to 12 months. This can soon become a considerable cost, and schools and hospitals – where these levels of filtration are most required – may be hardest hit.

The impact of energy costs is less of a concern. Where closer comfort control is valued and a mechanical strategy has been adopted, the associated energy costs of installing appropriate filtration are minimal.

The current market trend for health and wellbeing, within our industry – and on a wider scale – is impossible to ignore. Coupled with a significant drop in the take-up of renewable technologies on construction projects in 2016<sup>2</sup> (admittedly associated with cuts in funding), this suggests consumers and building occupants value their own health and wellbeing above energy savings. The appropriate levels of filtration and air purification are costs we must not devalue or ignore.

#### References:

- 1 *Understanding the health impacts of air pollution in London*, Kings College London
- 2 Glennigans, 2016
- 3 Data developed from *2015 Real estate environmental benchmarks*, Better Building Partnership

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# SILENT PARTNER

The minimalist architecture of the Design Museum's new London home meant its building services had to be silent and hidden from view. **Andy Pearson** explains how ChapmanBDSP overcame the challenges

**T**he 1960s, concrete former home of the Commonwealth Institute has been given a new lease of life as the site of the Design Museum. The building, in west London, retains its distinctive saddle-shaped roof but, beneath the copper-covered, hyperbolic paraboloid hat, the interior has had a radical makeover by architectural designer John Pawson.

The entire internal structure is new. Pawson's pared-back design is arranged around a giant, oak-lined atrium, which is open to the roof. Two generously proportioned galleries have been created on the ground floor and on a newly excavated lower-ground floor, to house temporary exhibitions. Flights of wooden steps, meanwhile, lead visitors through the atrium to the upper floors, containing a gallery for the museum's permanent display, a library, a restaurant and a members' room.

The problem for ChapmanBDSP, the project's building services engineers and lighting designers, was to develop a flexible services solution that complemented Pawson's minimalist interior, while also offering a comfortable environment for visitors that meets the requirements of Breeam Very Good.

'Servicing a building with "invisible" services was the most challenging aspect of this project,' says Phil Parkes, a director at ChapmanBDSP. 'It meant the design had to be progressed in far more detail than is usually required at each stage, to ensure the



The copper-covered, hyperbolic paraboloid hat of the Design Museum



## 49dBA

noise level at 1m from  
the chillers, fitted with  
acoustic attenuation

### PROJECT TEAM

**Client:** Design Museum  
**Interior design:** John Pawson  
**MEP and lighting design:** ChapmanBDSP  
**Project manager:** Gardiner & Theobald  
**Cost consultant:** Turner & Townsend  
**Main contractor:** Willmott Dixon Interiors



The entire internal structure of the former Commonwealth Institute has been changed

architectural details were not compromised.'

The engineers were appointed in late 2010 and, because of the complexity of the base build – which included supporting the roof from a temporary structure while the existing interior was removed – they benefited from having additional time to 'bottom out' design details with the interior designers. 'The internal engineering services had to be invisible – behind acres of immaculate, plastered ceilings – but remain accessible for maintenance, so the interior designer was very involved in the details of all visible elements of the design,' says Parkes.

Heating, cooling and fresh air are supplied to the gallery spaces via a displacement ventilation system. 'Traditional ventilation systems, which supply air at high level, normally require exposed air terminals,' says Parkes. 'This was not an option for the designer, who wanted clean, clear finishes'.

So instead, a false wall was created to conceal the vertical supply ducts, which drop down from the ceiling void above. The bottom section of this wall is designed to act as a supply air plenum, to distribute the air evenly along its length.

'Gallery ventilation and cooling is delivered

via a displacement ventilation system to each of the three main exhibition spaces,' says Parkes. 'However, with floors having to be capable of supporting anything from a Formula One car to a JCB digger, this had to be fed within perimeter walls and supplied via continuous, skirting-level shadow gaps [space between the wall and floor].'

In the galleries on the ground and lower-ground floors, air is extracted at high level through discrete openings in the ceiling. However, for the museum's permanent-display gallery on the upper-most floor – which has no ceiling – extract ductwork is discretely located above the ceilings of the rooms surrounding it.

'The displacement system works, as it combines meeting the demands of a minimalistic interior design approach – with the need for a flexible space – with varying



## "Servicing a building with 'invisible' services throughout was the most challenging aspect of this project" – Phil Parkes

fresh air and cooling requirements,' says Parkes, who adds 'Strict humidity control was also required by potential exhibitors.'

The galleries' air handling units (AHUs) are designed to maintain temperatures at 22°C +/- 2K and at a humidity level of 40-60%, largely in line with CIBSE Guide A1, 2015. However, there is no attempt to control humidity in the upper-floor gallery, which is open to the atrium. Instead, ChapmanBDSP agreed with the museum that, if any moisture-sensitive items were exhibited, these would be housed in an environmentally controlled display case.

Each gallery is served by a dedicated AHU located in the building's basement. Generally, supply and return air ducts are routed at high level through the double-height basement and up through the building via vertical risers at either end of the museum. 'The building's listed façades and roof mean that the main ventilation intake and exhaust are located in the ground, with a large intake plenum on the south side of the building and a similar exhaust plenum on the opposite side,' Parkes says.

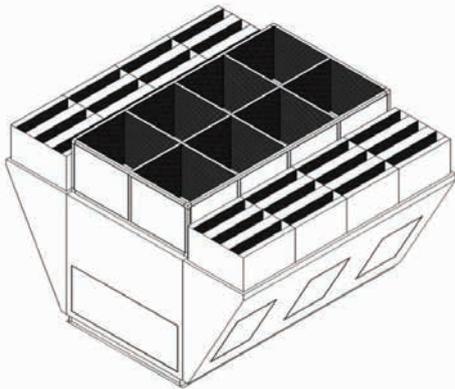
Each of the seven AHUs is individually connected to the plenums, as are the smoke-extract systems, which are located in a common basement plantroom. 'Coordination was extremely challenging, bearing in mind the design was completed before the common uptake of 3D-drawing packages within the industry,' he adds.

Heat is delivered to the AHUs via two heat exchangers, which connect to a district heat network. As a result, the building has no boilers. 'The museum benefits from an LTHW connection off the local district heating main, which is also used to serve the surrounding residential development,' says Parkes. 'The same residential development also provides the grey water used to flush the toilets in the museum.'



» People and lighting are the main cooling loads in the galleries. The chilled water supply to the AHUs is from two 400kW air-cooled chillers, which are hidden in an 8m-deep pit in the external landscaping, because the building's listed status prevented the engineers from installing ventilation louvres in the façade or the roof. The chillers are linked to the main basement via pre-insulated flow and return pipework and armoured supply cables, which are buried below the landscaping. 'I've never put chillers into the ground like that before,' says Parkes.

Because of their proximity to the nearby residential development, the chillers are fitted with acoustic attenuation. The only modification needed to accommodate this was in the design of the acoustic attenuators [see sketch]. Acoustic attenuation was critical,



Uninsulated chiller, hidden in an 8m-deep pit in the external landscaping

as the museum is surrounded by the new Holland Green residential development. A strict noise level of 49dBA at 1m was achieved, while maintaining only vertical air movement on and off each chiller due to their buried arrangement,' Parkes explains.

While displacement ventilation is employed in the galleries and in the basement auditorium, fan coil units (FCUs) are used to maintain comfort conditions in all of the other rooms. 'Fan coil units provide the ideal solution for this building – they are compact, easy to conceal and have the capability to cater for a wide range of loads,' says Parkes. 'Each area required a slightly different environmental approach and added to the complexity of the MEP jigsaw puzzle – albeit that the one common factor throughout is the minimalist interior design and the desire for "invisible" services.'

### Lighting showcasing

Flexibility is the key to ChapmanBDSP's lighting solution for the two big exhibition spaces on the ground floor and the newly excavated lower-ground floor. 'The scheme has been developed to complement architectural designer John Pawson's reconfigured minimalist interior aesthetic, and to be flexible enough to be adapted by the Design Museum to illuminate its future exhibitions – whatever they may be,' says Graham Large, head of architectural lighting at ChapmanBDSP.

The systems for both spaces make extensive use of lighting tracks and LED spotlights. 'Because exhibitions will change quite regularly, the client was adamant that we use a solution based on spotlights incorporating on-board dimmers,' says Large. It is similar to the system in the museum's previous premises, which enabled the focus and light level of each spotlight to be set without having to refer to the lighting control system.

The LED spotlights have a fixed colour temperature of 3,000K, chosen to complement the museum's pale, oak-panelled walls and to work with the objects exhibited. 'We discussed the use of variable white light with the Design Museum, but – on the basis of the additional level of control required – it was agreed to work with a single colour temperature,' says Large.

»

**"The LED spotlights have a fixed colour temperature of 3,000K, chosen to complement oak-panelled walls"**



The museum's oak-lined atrium is ringed by walkways that lead visitors up towards the spectacular curved roof



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» The designers were also freed from the constraints of having to control the UV content of the lighting system because, adds Large, 'very few exhibits will be fugitive material, such as short-life printed pamphlets or images'. 'We've used LEDs throughout the gallery so there is no forward UV content; however, if the museum does have a fugitive picture, for example, it can isolate this within the exhibition and light it gently – say, at a maximum of 50 lux – by using the spotlights' on-board dimmers.' In addition, the track-and-spot system incorporates linear LED fittings, primarily to provide light for the cleaners and for when the exhibitions are being set up – but they can, if necessary, be used as supplementary lighting for exhibitions.

The track-and-spot solution also features in many of the museum's reconfigured interior and circulation spaces, arranged around the building's spectacular oak-lined atrium (see panel 'Museum lighting – worth the

The museum's oak-lined atrium is ringed by walkways that lead visitors up towards the spectacular curved roof



hyperbole'). Lighting in the Members Bar and in the restaurant areas on the second floor have a colour-tuneable system for the downlighting. 'This creates a cooler environment during the daytime, cross-fading to a much warmer ambience for late afternoon and evening use,' Large says.

The lighting fixtures and the luminaire/blind control system were supplied as a package by Concord Lighting, and ChapmanBDSP's scheme has ensured that the Design Museum is now also a showcase for contemporary lighting design

'There were a lot of challenges in meeting the requirements of the client, planners and a very exacting architect,' says Parkes. 'Personally, it has been one of the most intense and challenging experiences on a single project – more than five years from feasibility to completion – but being at the opening [in November] made it all worthwhile; realising exactly why the architect had been so unswerving in his attention to detail.' **C**

### MUSEUM LIGHTING – WORTH THE HYPERBOLE

The building's square-shaped atrium is the focus of John Pawson's design for the interior. It is ringed by walkways that take visitors up towards the curvaceous roof and the Design Museum's other attractions, including its restaurant, library and education spaces. The additional lighting allows the circulation spaces also to be used as exhibition areas.

Windows ring the atrium to throw daylight onto the building's spectacular roof, which dominates the space. ChapmanBDSP carried out daylight studies to ensure the natural light could be controlled, particularly when the atrium is used to house exhibitions. Daylight levels and glare are managed using motor-driven blinds, operated by the building's Lutron lighting control system. With the blinds raised, daylight accents the giant roof throughout the day; after dark, it is lit using artificial light.

Pawson's design for the interior ensures that the entire roof is visible, including the structural beams that support it. 'The roof has been lit subtly, as we were very conscious that it does not need a lot of help – it already commands visitors' attention,' says Large. 'Our aim was to showcase it to ensure it does not overpower the atrium'. Twelve projectors – six on either side – illuminate the underside of the roof, and there is a row of linear LED battens around its perimeter. The main roof-supporting columns are uplit from floor-recessed, adjustable projectors, fitted with egg-crate louvres to help control glare.

'The parabola roof has a matt-concrete finish that soaks up light, so we had to use projectors that would normally be used to illuminate building façades,' says Large.

Each projector has 96 LED heads and two different beam angles are used – 15 and 30 degrees. Both types are fitted with barn doors to prevent light spillage. The projectors provide a single-colour light, with a colour temperature of 3,300K. 'That gave us the benefit of a warmish colour and plenty of output,' says Large.

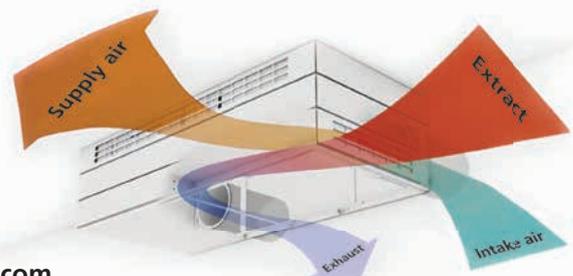
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# JUST THE TICKET

Good design, monitoring and control have ensured The Hive library in Worcester has comfortably beaten its energy targets. **Afroditi-Maria Konidari** and **Ian P Knight**, of Cardiff University, look at how proactive building management and low-energy design reaped results

**A**s its name suggests, The Hive, in Worcester, is a busy hub of work and social activities, for people of all ages and interests. It opened in July 2012, and is the UK's first integrated public and university library, as well as hosting: a local history centre, records office and archive; an archaeological centre; exhibition areas; a business centre; reading and learning spaces; council customer services; and a café.

Such multiple uses – and the fact that the number of visitors is double the design occupancy, at around 900,000 per year – has made it a challenge to meet the building's design aims, utility performance targets, and its social and environmental goals. In its first three years of operation, however, The Hive – which won the CIBSE Building Performance Award for new-build project (more than £5m) in 2013 – significantly bettered its design utility performance targets, thanks to its low-energy design and proactive building management. This article highlights the importance of occupant-related loads in achieving this, and of separating the energy consumed by building services from the occupancy energy consumption when evaluating the performance of constructions in the nearly zero energy building (nZEB) era.

The Hive took part in the IEE-funded project iSERV, and its performance was assessed between December 2012 and December 2015, as part of Afroditi-Maria Konidari's doctoral thesis. Operational energy and sensor data was recorded at 10-minute intervals and, together with building assets data, was processed through the K2n iSERVcmb analysis framework and platform. This analysis was

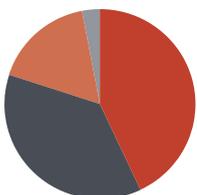
supplemented by data collected via post-occupancy evaluation (POE) surveys and indoor environment quality (IEQ) field measurements. The following is a summary of how The Hive's operational performance compared with its design targets, applicable standards and professional guidelines.

## Building overview

The five-storey building – clad in copper aluminium alloy – is made of reinforced concrete and has a cross-laminated timber roof. While it is a multi-use facility, the library and circulation areas occupy 62.5% of the 13,253m<sup>2</sup> floor area.

The key client requirements were connection, integration, inclusivity, wellbeing and sustainability. As a result, it was designed as an innovative and sustainable 'social landscape' that would promote curiosity and exploration, and allow free user movement around the building. It had to meet these aims while also achieving utility performance targets and a mix of social and environmental goals (see Table 1).

Hive electricity reductions (kWh) 2013-15



- 294,653 Small power
- 219,257 Lighting
- 69,456 HVAC
- 9,562 External lighting, lifts and balance

Figure 1: The Hive's electricity saving, by end use, during the period 2013 to 2015

From its peak in 2013 to the end of 2015, The Hive's annual electrical use was monitored by end use – from AHUs, cold generators, pumps, dehumidification and terminal units to lifts, lighting and small power. The major reduction occurred in the building's small-power use, which accounted for approximately 87% of the 448,385.3kWh savings. These improvements were achieved by control and equipment changes, plus insights from the monitoring systems. The electricity-use reduction amounts to a remarkable 42% from its peak in May 2013 – a saving made possible by the building design, monitoring and the controls installed. At the end of the monitoring period, The Hive consumed 50kWh·m<sup>-2</sup>·year<sup>1</sup> of electricity about half of its design target.

Most (73%) of The Hive's 221 internal floor areas are naturally ventilated, with the rest mechanically ventilated. The building's normalised annual electricity use for 2015 bettered nearly all the potentially applicable industry – as well as other – published benchmarks relating to design and servicing. This included a pro-rata CIBSE Guide F (ECON19) Office benchmark derived from those for naturally ventilated and mechanically ventilated offices respectively (see diagram on web version of article at [www.cibsejournal.com](http://www.cibsejournal.com)). It also matched a 'good' standard benchmark produced from the K2n iSERV platform, which is generated for the specific mixture of spaces, activities and services in the building.



The Hive's measured annual gas and biomass use also comfortably met design aims, at 76% and 84% of their targets respectively in the same year. Its target for percentage of harvested rainwater use to total water use was also met, though its actual water consumption per design occupant exceeded the design targets. However, when the number of visitors – which amounted to double the design occupancy – was considered, The Hive met its water targets per occupant.

So the measured data shows the building meets all of its designed utility performance targets (see Figure 2).

### Achieving the performance

The significant savings made since The Hive's opening were achieved primarily through better control of energy-intensive end uses, and by taking advantage of the building's design and innovative



Table 1: The Hive's performance against targets to the end of 2015

TARGET	ACTUAL to the end of 2015	
Carbon performance asset rating of a 50% improvement on minimum standard for Part L 2006	Achieved	✓
Electricity use of 105 kWh·m <sup>-2</sup> ·year <sup>1</sup>	-50 kWh·m <sup>-2</sup> ·year <sup>1</sup>	✓
Biomass-generated heat of 38 kWh·m <sup>-2</sup> ·year <sup>1</sup>	-32 kWh·m <sup>-2</sup> ·year <sup>1</sup> delivered biomass heat into the building	✓
Fossil fuel consumption of 5 kWh·m <sup>-2</sup> ·year <sup>1</sup>	-3.8 kWh·m <sup>-2</sup> ·year <sup>1</sup>	✓
Water use of 2.5m <sup>3</sup> ·occupant*·year	-4 m <sup>3</sup> ·occupant*·year (-2m <sup>3</sup> ·m <sup>-2</sup> ·year) <sup>2</sup>	✗
Potable water use of 1.5m <sup>3</sup> ·occupant*·year	-2.25 m <sup>3</sup> ·occupant*·year (-1.15m <sup>3</sup> ·m <sup>-2</sup> ·year) <sup>2</sup>	✗
Harvested rainwater use of 1m <sup>3</sup> ·occupant*·year or 40% of total water use	-1.73 m <sup>3</sup> ·occupant*·year (-0.9m <sup>3</sup> ·m <sup>-2</sup> ·year) <sup>2</sup> estimated harvested rainwater -43% of total water use	✓
Archives should meet BS5454	Archives conform to BS5454, but not without challenges during summer months	✓
Healthy environment	Maintained healthy conditions for sensitive social groups, according to WHO standards, during majority of opening hours	✓
Maximum use of daylight to minimise electric lighting to <30% of total building electricity use	-28% of total electricity use with mixed lighting conditions according to space	✓
Maintain quietness levels in extensive study areas	Noise levels above comfort standards, with indoors and outdoors noise a concern for surveyed occupants Technical testing before the building's opening confirmed it met acoustic design parameters	✗
Building designed to be a didactic building, educating staff, users and visitors	-52% of surveyed staff and -63% of surveyed visitors stated The Hive increases their wellbeing. -55% surveyed staff and -72% of surveyed visitors stated The Hive supports their productivity. -60% surveyed staff and -81% of surveyed visitors stated The Hive meets their work needs in a satisfactory manner -67% surveyed staff and -84% of surveyed visitors overall rated The Hive as satisfactory	✓
Linking of the fine-tuning of the services and user energy management will allow areas of unnecessary energy consumption to be targeted in conjunction with user support	-42% reduction in electricity consumption since May 13 -84% reduction in natural gas consumption since Jan 14 -24% reduction in heat energy consumption since Feb 14 (biomass & gas)	✓

### References:

- 1 Not including biomass fuel and assuming gas usage for peak loads and backup only.
- 2 Calculated considering that the design occupancy amounts to 1,457 people, which is around 450,000 visits per year. Actual visits are double this, at around 900,000.

Occupant\* is the design occupancy (1,457 persons), which amounted to half of the actual numbers of visitors recorded after the building's opening

» systems. Some savings were identified by analysing the K2n platform, which showed performance by system and activity served. Actions taken during the period 2013-15 were:

- **Reducing small-power use:** Lowering the demand of idle PC stations accounted for 50% of the total electricity savings
- **Reducing lighting use:** Improving system control; installing LED lights on bookshelves and daylight-linked dimming in library and office areas; removing personal controls and reverting to central management; optimised control of external lighting. These accounted for about 38% of total electricity savings
- **Reducing HVAC use:** Improving the chiller, AHU fan inverter and pump control accounted for about 12% of the total electricity savings
- **Increasing the use of biomass:** Overall heat demand reduced by about 11%, accompanied by a gas-use reduction of around 68% from 2014 to 2015. It is not clear that this heat-demand reduction was influenced by the change of fuel type
- **Harvesting rainwater:** This accounted for 43% of the total water use by the end of 2015.

Additional savings were achieved through the river-water cooling system, which uses

a nearby watercourse as a heat sink. Once operational problems related to river-water abstraction were overcome, the system saved the equivalent of 1.1% of The Hive's electricity use in 2015 compared with the energy consumed by the building's cooling system during the first two years. This was accompanied by a reduction in the chillers' energy use of approximately 21% from 2014 to 2015.

The key lessons learned from this project about data collection were:

- Energy-management systems must record data at precise time intervals, so that operational issues can be identified. Despite significant investment in a large-scale metering and sensor network, the data required extensive processing to be usable for this study
- Having a robust contextual framework into which the operational data can be fed enables targeted actions to be taken. The K2n iSERV platform provided this framework for this study.

### Internal conditions provided

Low utility consumption alone does not make a good building, so IEQ assessments were also undertaken. These showed that the energy efficiency obtained at The Hive was not at the expense of healthy indoor conditions. The majority of the monitored areas maintained healthy conditions during opening hours and met comfort standards.

Maintaining comfort conditions – as specified by CIBSE guidance – for the activities housed by the building did present a challenge for some spaces because of the nature of their design. For example, most monitored spaces experienced cooler conditions than the operational temperatures recommended by CIBSE. However, this did not seem to affect visitors' perceptions or enjoyment of the facilities negatively. Staff were slightly more critical, possibly because of a perceived reduction in the control they had, as well as the conditions.

The IEQ field measurements also highlighted:

- Slightly low relative humidity (RH) from winter to summer
- Varying lighting conditions
- Noise levels exceeding CIBSE comfort standards.

In agreement with these measurements, the POE surveys noted local issues with ventilation, RH, air temperature, and a lack of personal controls in specific work areas. Indoor noise levels were also identified as a problem by all occupants. But the surveys also offered evidence of end users' satisfaction with all general building aspects and indoor conditions, as well as with most of their specific work-area conditions.

The Hive's design – plus the large and diverse visitor groups – have led to issues of noise and transfer within some open-plan spaces. These are not considered design-performance failures, but rather exemplify the inevitable design trade-offs in open-plan, mixed-mode buildings when they are occupied by real people.

It is likely that energy use in parts of the building might rise slightly in the near future, to achieve a balance between the design conditions for activities hosted and the need to meet low-carbon ambitions. The data shows there is reasonable headroom in this consumption to exceed design targets comfortably.

### Conclusion

In operation, The Hive readily met and improved on its utility performance design targets, while also achieving almost all of its social and environmental aims. It has demonstrated what is possible in an operational building housing a variety of activities when good design, monitoring and control co-exist. **CJ**

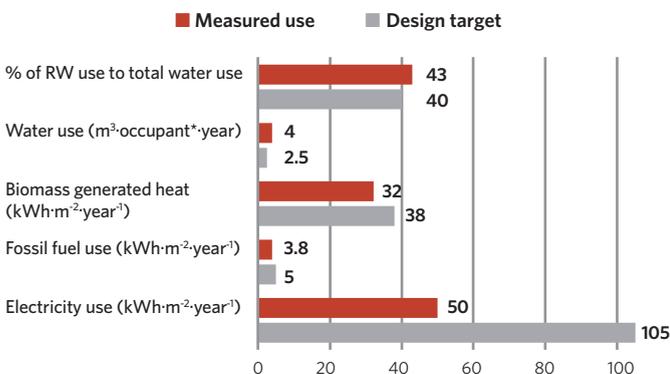
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■ **iServ** – [www.iservcmb.info](http://www.iservcmb.info)

■ **PROFESSOR IAN P KNIGHT** is a professor at the Welsh School of Architecture, Cardiff University, and director at K2n. **AFRODITI-MARIA KONIDARI** is an architect engineer and researcher at the Welsh School of Architecture, Cardiff University



Measured use against design target



Occupant\* is the design occupancy of 1,457 persons.

Figure 2: The Hive's performance against utility design targets to the end of 2015



## Future features

March 2017	Air conditioning Acoustics	August 2017	Heat pumps Healthcare
April 2017	Water heating Data centres Schools & education facilities supplement	September 2017	Air conditioning, air movement & ventilation Heat recovery systems
May 2017	Air conditioning, air movement & ventilation Commercial heating supplement	October 2017	Pipework, pumps & valves Hotel & leisure facilities supplement
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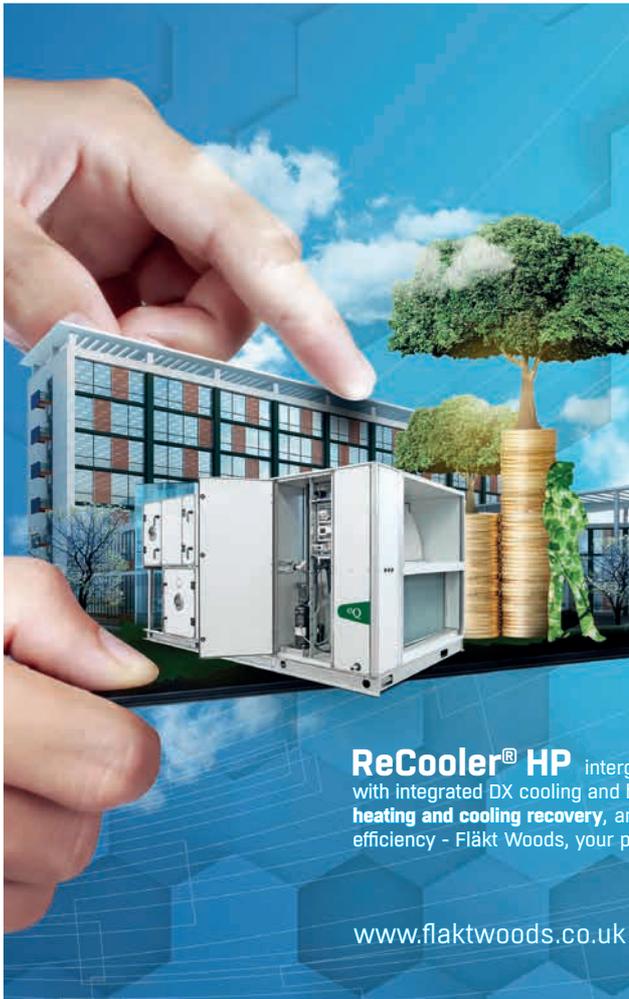
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# THE TRUE COST OF DESIGN

A new database tool is helping designers assess the environmental impact of their specifications. **Andrew Cooper** looks at how Hammerson is trialling the tool to assess the CO<sub>2</sub> impact of a retail extension in Didcot

**A**pproximately 10% of all UK carbon emissions are associated with the manufacture and transport of construction materials. These emissions are all upfront, contributing towards global warming before the building is opened. Yet measuring embodied carbon has often been thrown in the 'too hard' basket because of the difficulty in obtaining transparent and comparable data, and to implement consistent and auditable frameworks and processes within a reasonable budget. There is also a lack of policy drivers to measure and control embodied emissions in building projects.

However, European developer Hammerson has measured embodied carbon to inform the design processes on a new retail development in the UK – and used a cost-effective tool to do so. Hammerson plans to add to its portfolio of 58 UK, Irish and French shopping centres and retail parks, with an extension to the Orchard Centre in Didcot, Oxfordshire. The proposed scheme is targeting a 'very good' Breeam assessment and has a number of sustainable design principles, including an urban drainage scheme and a green roof.

To increase its chances of achieving a 'very good' rating, Hammerson has – for the first time – used Impact modelling to calculate the environmental impact of the proposed development, to achieve credits under the MAT01 Life-cycle impacts assessment issue. Impact is a specification and database for software developers to incorporate into their tools, to allow consistent life-cycle assessment and costing in property. It takes quantity

information from building information modelling (BIM) and multiplies this by environmental impact and/or cost 'rates'. It is based on the BRE database on environmental impacts and, by making this more widely available, the costs of embodied-carbon assessments are significantly reduced. It was also developed with integration into Breeam in mind.

Using it can gain up to four credits for UK Breeam assessments and up to six credits for international Breeam assessments. In the case of the MAT01 Breeam issue, Impact can unlock two exemplar credits.

Richard Quartermaine, environmental manager at Hammerson, says the company wants to make significant reductions to all areas of its carbon footprint, and the least well understood is the embodied carbon of its development activities. 'Using Impact allows us quickly and consistently to assess the embodied carbon of a project at an early stage – to raise awareness among the design team and inform its decision-making'

Envision is undertaking the Breeam assessment for the project, and Andrew Cooper CPEC has been appointed to do all the Impact modelling. An energy model was developed by the building services engineer using



Percentage of UK carbon emissions linked to the manufacture and transport of construction materials

The Orchard Centre could reduce its environmental impact by 6% to 7% by implementing the study's recommendations



## PRODUCT LIFE-CYCLES

'Cradle to gate' is an assessment of a partial product life-cycle from resource extraction (cradle) to the factory gate, covered by Modules A1 to A3 as described in BS EN 15978:2011 Sustainability of construction works – Assessment of environmental performance of buildings – Calculation method. This captures the environmental impact from the product life stage (pre-construction).

'Cradle to grave' is the full life-cycle assessment from resource extraction (cradle) to use phase and disposal phase (grave).

IES VE software. This was used for the energy strategy, to comply with Part L and to calculate Breeam energy credits. The model was also issued to the Impact modeller to undertake the life-cycle impacts assessment.

The first task was to check the suitability of the model for an Impact assessment. Models must be constructed using the ApacheSim (DSM) format – in Energy Performance Certificate (EPC) terms, this is considered to be Level 5. The geometry must also be extremely accurate; discrepancies that may have a minimal impact on the built emissions rate (BER) could have a significant impact on a life-cycle assessment by affecting material quantities. For example, if the height of each floor of a 10-storey building with a floor plate of 1,000m<sup>2</sup> is 25mm out in a model, this is unlikely to have a significant effect on predicted energy consumption or the BER. But 10 x 1,000m<sup>2</sup> x 0.025m equates to 250m<sup>3</sup> of material. Assuming the floors are concrete, the concrete alone would amount to around 100 tonnes of embodied CO<sub>2</sub> as an inaccuracy. Add steel reinforcement and/or steel decking to this, and the amount increases.

Having assessed the model, and made minor adjustments to ensure its suitability, a study was implemented to identify the construction details and materials. Material data was imported from the BRE library into the model. The scope of the study covered the mandatory building elements detailed in Breeam Assessor Guidance Note GN08, which include piled foundations, lowest floor construction, steel frames, all upper floors, roofs, windows, and internal walls and partitions. Having determined the environmental impacts, an advisory report was prepared for Hammerson.

The software can measure a number of environmental impacts, including acidification of land and water; fossil-fuel depletion, human

**“There are not yet academic studies offering peer-reviewed benchmarks”**



**IMPACT & BUILDING SERVICES**

To carry out a building life-cycle assessment (LCA), background data – known as an environmental product declaration (EPD) – is required for each of the products/systems ultimately specified, and for the alternatives considered during design process. The resource needs to be in a format that is useful to building designers. In the UK, this exists for building fabric in the shape of BRE’s Green Guide and, more recently, Impact tools – but none exists for building services.

The lack of building services data may lead some LCAs to rely on assumptions about the constituent materials of various components/systems – so results derived from this kind of approach are likely to have a high degree of uncertainty. Many components are complex and highly engineered from a wide range of substances, and sourced from a complex international supply chain. Without intimate production knowledge, it is very difficult to make estimates with any certainty.

As the use of poor-quality data will still yield results, this could serve to delay the realisation by the industry of the need for good-quality data. As such, BRE believes it is preferable to exclude services from LCAs until a robust source of building services LCA data/EPD is available.

toxicity, and global warming potential. In this case, the primary metric that Hammerson wished to adopt was embodied CO<sub>2</sub>, and benchmarking was used to advise on whether the proposed scheme had a high or low impact.

Monitoring the embodied carbon emissions of different types of buildings is a relatively new field of research, and there are not yet regulatory standards or academic studies offering peer-reviewed benchmark values. However, the RICS document *Methodology to calculate embodied carbon of materials, 1st edition* provides some useful benchmarks for cradle-to-gate embodied carbon emissions. The MAT01 study is based on cradle to grave – and the RICS benchmark is regarded as indicative only – but, for completeness, metrics were supplied to Hammerson for cradle-to-grave and cradle-to-gate emissions. (See panel, ‘Product life-cycles’)

The study concluded that the impact of the Orchard Centre is within an expected range, based on the nearest matching RICS benchmarks of between 750 and 935 kg CO<sub>2</sub> per m<sup>2</sup> for comparable buildings (Table 1). It recommended interventions that could lead to a reduction in the project’s environmental impact of between 6% and 7% – amounting to more than 1,000 tonnes of embodied CO<sub>2</sub>. CJ

■ **ANDREW COOPER** is an independent property and energy consultant

The Orchard Centre (cradle to grave) kgCO <sub>2</sub> /m <sup>2</sup>	The Orchard Centre (cradle to gate) kgCO <sub>2</sub> /m <sup>2</sup>	RICS benchmark retail mall/ shopping centre (cradle to gate) kgCO <sub>2</sub> /m <sup>2</sup>	RICS benchmark high street retail/ district centre (cradle to gate) kgCO <sub>2</sub> /m <sup>2</sup>
1,209.67	883.00	935.00	750.00

**Table 1: A comparison of the Orchard Centre with the nearest matching RICS benchmarks**

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## HOW LOW SHOULD YOU GO?

Optimising energy efficiencies from commercial plant is often a complicated operation that comes down to specifying the most suitable boilers for the application. Elco's **Gavin Watson** explains how water content can play a key role

**D**esigning a commercial heating system can be a complex task for any building services engineer, and optimising running costs is always put at the top of the priorities list. It makes perfect financial and environmental sense to do so, whether specifying new commercial boilers for an office building in the heart of a city, or for a school refurbishment project.

Almost all modern condensing units perform very well, and their ability to integrate with more sustainable technologies makes them a fantastic option for today's commercial buildings. However, with a wealth of options in the boiler market, deciphering the differences between models can be challenging.

Data-table comparisons can give an overview of a commercial boiler's performance curve, but they don't always highlight the wider factors that need addressing. To understand performance and ultimate running costs, building services engineers can benefit from examining specific aspects of boiler design – namely, the water content of a unit and the efficiency of a boiler over its life-cycle.

When looking at water content, it is important to note the distinct difference between low water content (LWC) boilers and high water content (HWC) derivatives. Of course, there will always be installations that suit one type of unit over another. Each system calculation needs to take into account the building type, use profile and a number of predicted start-up occasions. When considering the weight/volume of water contained in an HWC appliance, however, there are some stark differences.

It's worth outlining a typical scenario to highlight how LWC and HWC boilers can differ.

A typical HWC unit with an output of 1,048kW at 80/60°C has an average water content of around 1,100 litres and a gross heat input of 1,190kW. The time taken to bring the mass of water from an ambient standby temperature of 20°C to a flow temperature of 80°C is 264 seconds, with an energy input of 87.3kWh. Consequently, the carbon emissions per heat-up occasion are approximately 16kgCO<sub>2</sub>. More notably, the cost to heat the water content from 20°C to 80°C, at a rate of 4.9p/kWh, is £4.28.

Keeping the above analysis in mind, the same calculations can be performed for a typical modern, premix, gas-fired LWC condensing boiler with a similar gross heat input and output. The boiler has a heat input at maximum rate of 1,183.2kW and a far lower water content of 117 litres (kg equivalent). The time taken to bring the mass of water from an ambient standby temperature of 20°C to a flow temperature of 80°C is 28.3 seconds, with an energy input of 9.3kWh. This produces a mere 1.7kg CO<sub>2</sub> and costs just £0.46 per heat-up occasion.

Comparing the two boiler types highlights a stark difference in both emissions and heat-up cost, with LWC versions costing a tenth of an HWC derivative (see graph, page 36). The main figures to note are the carbon emissions and cost per heat-up occasion. From an environmental perspective, there >>



**£4.28**

The cost of heating  
1,100 litres of water to  
80°C with a HWC boiler

**£0.46**

The cost of heating  
117 litres of water to  
80°C with a LWC boiler



An LWC boiler



» is a vast difference in pollutants, with carbon emissions around 89% higher per cold-start heat-up. Likewise, the cost per heat-up is almost 10 times more, which could have a significant effect on running costs over a typical boiler's operating lifetime of ten to 15 years.

Of course, the importance of these figures is directly proportional to the type of application in which a boiler is operating. For buildings where only one cold start-up per week is required, the cost implication is nominal (<£200 per year). However, if a boiler is required to cold start on multiple occasions – such as five times a week at a large school – the cost implications are far greater, amounting to a £1,000 difference per year. Extended over a 10-15 year life-cycle – allowing for a modest increase in utility prices of 1% per year – the difference in running costs alone is £10,500-£16,100. At this point, a low water content boiler becomes the far more cost-effective option.

A common – yet inaccurate – claim against LWC boilers is that they suffer when under low loads. This assertion is based on the premise of a high volume of freshly heated water being circulated back to its return port via the low loss header (boiler-system interface).

Because HWC boilers don't require a minimum water flow, they are often seen as a superior option. However, since January 2013, the Ecodesign Directive has required the use of high-efficiency pumps and, to comply, manufacturers of LWC appliances supply speed-controlled pumps. These match the heated water mass delivery to the load requirement, so avoiding recirculation and impairment of the boiler's capability to operate in condensing mode.

Another factor to consider in the LWC v HWC debate is the associated weight from an unrestricted water flow in an HWC unit. To quantify these differences, the HWC boiler used in the example above would have an installed weight of 3,664kg, compared with 1,527kg for the LWC unit. Bearing in mind that three or four of these units

## “The handling requirements of heavier units during installation and removal phases may have an impact”

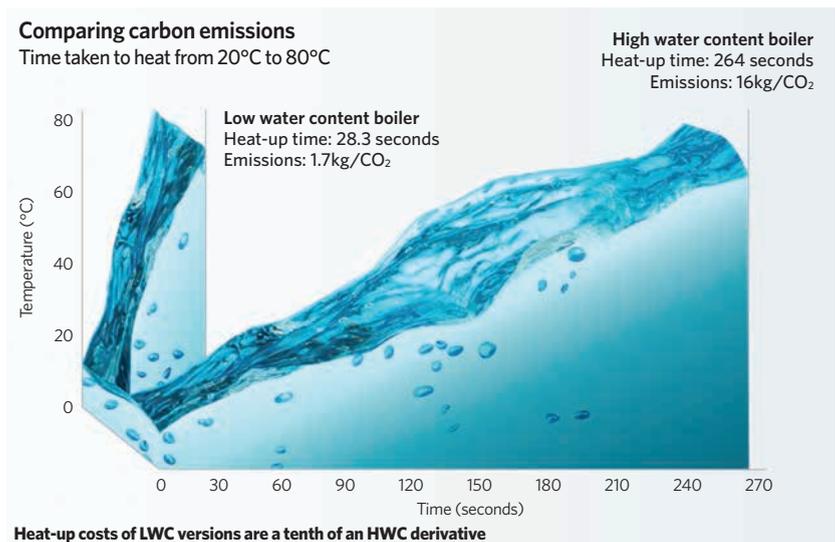
could be installed in cascade, the total weight implications could be critical. And this extra weight has an effect throughout the lifetime of the boiler, by placing additional load on a building's structure, thereby limiting siting options for the units in a commercial property. The handling requirements of heavier units during installation and removal phases may also have an impact.

There are many factors to take into account when specifying low or high water content boilers. Although there will not always be a 'one size fits all' approach, the overall running costs and carbon emissions of a boiler have to be high on the specification agenda.

A commercial boiler specification should always be the most appropriate for the building's requirements, and should prioritise energy efficiency in the design and installation stages. By simply considering the overall efficiency levels of the boilers, there is unlikely to be much difference. Likewise, doing a seasonal efficiency calculation – based on the methodology given in the *Non-domestic building services compliance guide* – reveals that there is little distinction between the two boiler types.

However, as demonstrated, wider aspects of boiler design can be critical. The cost per heat-up occasion favours an LWC unit, ensuring it will remain a popular option for most commercial installations. **CJ**

**GAVIN WATSON** is a sales director at Elco heating solutions





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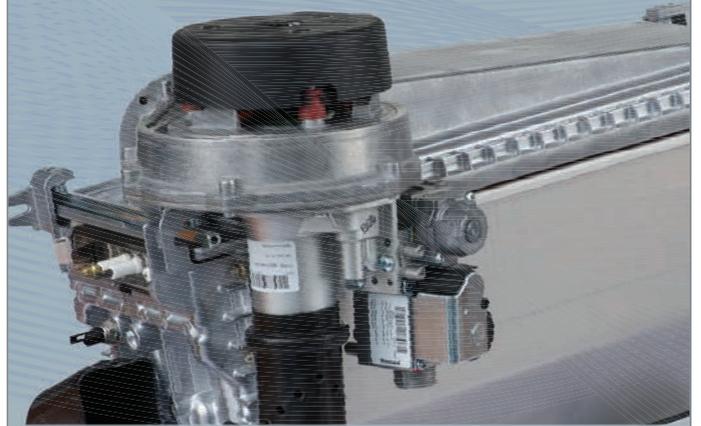
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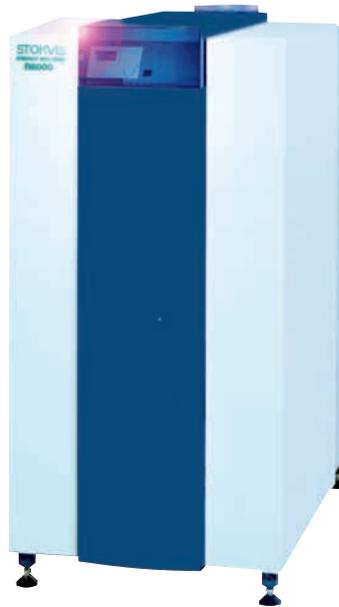
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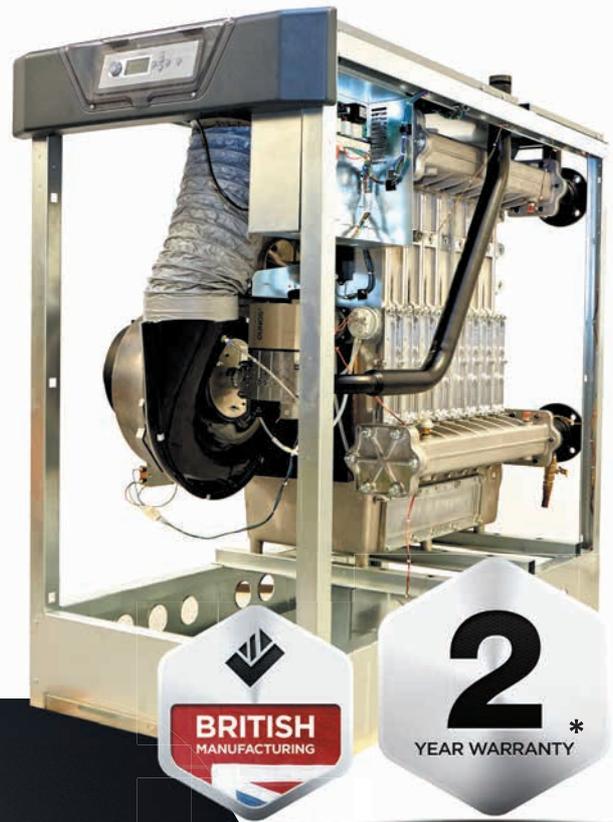


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# FROZEN ASSET

Stockholm's Tele2 Arena boasts a cooling system that turns artificial turf into ice. Now, after an upgrade using heat exchangers, freezing times have been cut by 30%.

Alex Smith takes to the ice

**T**he Tele2 Arena in Stockholm is the ultimate multipurpose stadium. Not only does it host two Swedish first division football teams, international music concerts and motorsports, but it can be transformed into an ice rink for major skating events.

A system of pipes embedded in special artificial turf enables the stadium operator, SGA, to freeze water distributed from three perforated pipes laid along the length of the pitch. The same network of pipes channelling warm water can be used to help melt the ice after the event. The quality of the resulting ice surface means it can host top winter sports, including the Swedish final of bandy, an 11-a-side game similar to ice hockey, but played with a ball rather than a puck.

The Tele2 Arena has a capacity of 30,000, and hosts about 300 events a year. To maximise its revenue-earning potential, it is paramount that SGA Fastigheter switches between events with the minimum of delay. The laying of ice presented a problem,

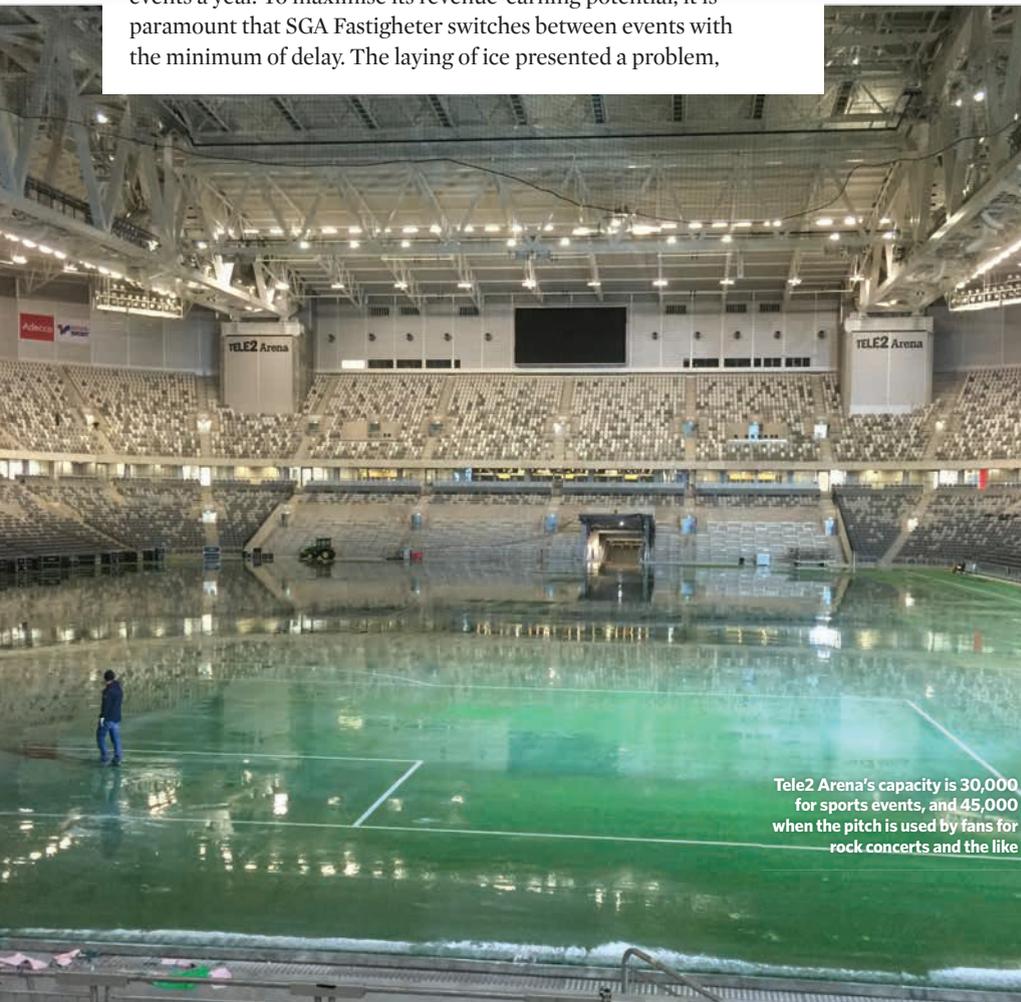
because it took longer than originally planned. As well as losing days when the stadium could be used for other events, the excessive time spent freezing the surface meant SGA was wasting time on resources, including manpower and energy use. It was also spending more on the leasing of temporary chillers, which were positioned on an access road outside the stadium.

'It was taking five to six days to lay the ice and it was giving us a lot of problems', says Conny Håkansson, head of real estate operation at SGA, whose challenge was to reduce the amount of time spent laying the ice.

To understand the factors affecting freezing time, Håkansson turned to the IDA internal climate and energy (ICE) simulation tool. A consultant used the software to identify the main factors affecting the ice-freezing time, such as air temperature and velocity, and water flow and temperature.

The most important impact on freezing time was the temperature of the water in the pipework. For the ice to freeze more quickly, the temperature had to be lowered – but the cooling temperature of the water was limited by the freezing point of the 30% bioethanol used in the system. This had a freezing point of -20°C, which was higher than the -24°C that the evaporator in the chiller was producing. Pushing for lower temperatures would have resulted in freezing in the chillers. Changing the bioethanol to a refrigerant capable of lower

»



Tele2 Arena's capacity is 30,000 for sports events, and 45,000 when the pitch is used by fans for rock concerts and the like

## DISTRICT COOLING IN STOCKHOLM

In summer, the Tele2 Arena uses Stockholm's district cooling system, which has a capacity of 270MW. It is operated by Fortum Värme, which is 50% owned by the city.

Water from the Baltic Sea supplies about 50% of the energy in the summer; the rest is from rock storage, centralised chillers and heat pumps. In winter, energy is recovered from the network using heat pumps and put into a district heating system.

Pipework is in the ground or tunnels, except for a small section in the sea, which connects the two largest systems and the rock storage. Supply and return cooling pipes generally run alongside pipework for heat networks.

Businesses can sell cooling or excess heat into Fortum's systems, and the price of the energy is set 24 hours in advance.



Installing the Sweb BPHEs

» temperatures was not an option, according to Håkansson. 'It is not easy to remove the bioethanol and replace it with something else. We would have to clean the whole system and there are 80km of pipelines,' he says. 'It is time-consuming and costly. The system would have to be vacuum-cleaned to remove all the liquid.'

Håkansson thought that hydraulically separating the artificial turf's cooling circuit from the chillers might enable SGA to use another refrigerant with a lower freezing point. He asked brazed plate heat exchanger (BPHE) manufacturer Sweb to calculate the cooling necessary to reduce the freezing time using an additional circuit. This would run between new BPHEs and the temporary chillers using refrigerant with a lower

**"As well as losing days when the stadium could be used, the excessive time spent freezing the surface meant SGA was wasting time on resources"**

freezing point – in this case, 40% ethylene glycol, which freezes at -30°C. The lower temperature of the refrigerant could then be transferred to the artificial turf's cooling circuit via the BPHEs.

To substantially reduce the freezing time, Sweb calculated that eight BPHEs would be required to give a total cooling load of 2,600kW. The modular design of the BPHE enabled SGA to deliver the units through a 90cm-wide door on a hand truck, before connecting them in their final position. However, suitable places to install the BPHEs were limited. 'Their 10,960kg combined weight meant that an area in the plantroom had to be found where beams could bear the weight,' says Håkansson.

Flow and return pipework is connected from the BPHEs to the temporary chillers on the stadium access road, where large acoustic drapes, hanging from the stadium, protect residents from the noise of the plant when in operation.

With the BPHEs installed, SGA was able to lay the ice in around 60 hours – 30% faster than previously – which resulted in substantial savings in manpower, energy and leasing costs.

SGA was also keen to reduce the time it took to melt the ice, and Håkansson wanted the 11cm build-up to thaw in less than 24 hours. To speed up the process, he calculated that it would be quicker to remove the top 3cm with 'ice-harvesting' machines – vehicles towing scrapers – before relying on heat in the ground and the stadium to melt the ice buildup in the artificial turf.

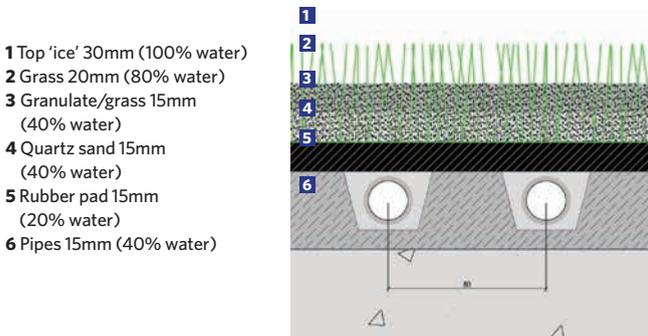
Håkansson calculated that it would take 10 hours to scrape away the top 3cm of ice and 6.4 hours to melt the remaining 8cm. In reality, the latter part of the operation took 11.4 hours, because the heat from the lighting, ground, hot water, and ventilation was not as great as expected.

As well as reducing freezing times, Håkansson says there is an opportunity to use the heat generated by the BPHEs during cooling elsewhere in the building – or of directing it into Stockholm's district heating system. 'We also look at effective energy solutions in a building,' says Håkansson. 'It's up to our imagination – we are always having ideas.' **CJ**

## SMOOTH AS ICE

SGA Fastigheter specified an artificial grass system from Spentab. It has pipes incorporated in the rubber substrate to freeze water discharged from pipes temporarily laid over the playing surface. The rubber coating acts as an insulation layer, which prevents warmth from the soil under the buildup from melting the ice.

The flow and temperature of the water discharged from pipes running the length of the pitch must be carefully controlled. If there are temperature or flow rate differentials across the surface, there will be undulations in the ice. There is the added complication of a 17cm fall in height from the centre to the long edge of the pitch. Flow sensors in the pipes ensure water is flowing at a consistent rate, and the depth of the ice is measured at 30 regular points on the surface to ensure the layers are flat.



The hi-tech Stockholm stadium has a transparent façade and a retractable roof

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# POWER OF GOOD

The capacity to decarbonise the energy used to heat buildings and for transport is huge, say TÜV SÜD Wallace Whittle's David Davies and Alex Pepper

**B**e lean, be clean, be green. This is the order of priority for generating low carbon heat in new developments in London, as stipulated by the 2008 London Plan. But should we always follow this mantra? It makes sense to put lean measures first, but fossil fuel-burning CHP engines are considered 'clean' in the plan, and is it right that they should be selected ahead of 'green' renewable technology?

In the July 2016 edition of *CIBSE Journal*, Keepmoat's Nigel Banks wrote that – after the future decarbonisation of electricity – CHP will become the worst option in terms of CO<sub>2</sub> reduction. In August, the CIBSE Homes for the Future Group held a debate on heating for modern homes, outlining different visions of a gas or electric future, which left the audience divided.

In our office, energy strategies for London-based, large residential projects have written themselves in recent years, with CHP district heating the predictable outcome. However, there is a sense within the industry that change is inevitable.

## Carbon factors

TÜV SÜD has calculated the carbon intensity of different technologies as the carbon factors for grid electricity are expected to reduce. Figure 1 shows that, as electricity decarbonises, it doesn't make sense to continue burning fossil fuels in CHP engines to displace grid electricity that is dominated by renewables and nuclear power. It also calls into question the wisdom of basing our



energy-strategy decisions on historical carbon factors, rather than the carbon factors probable during the systems' operational life.

The future carbon factor of the grid is uncertain. The recent reduction in carbon intensity has a lot to do with the price of gas – and, in turn, global politics – so there is a risk that the electricity carbon factor will fluctuate like the stock exchange. But surely we should plan for meeting the targets of the Climate Change Act 2008 – and, regardless of the price of gas, lowering carbon intensity is necessary to achieve this.

## Hydrogen gas grid

Figure 1 also includes a hydrogen boiler option. The idea is to transport hydrogen – created by a steam methane reformer (SMR) – on the gas grid, instead of natural gas. This raises the opportunity to capture up to 90% of the carbon dioxide (CO<sub>2</sub>) created during the process, which could then be transported and collected in large CO<sub>2</sub> storage facilities.

The transition from a gas to a hydrogen grid is an overwhelming concept because so many factors have to be considered. For example:

- Would the changeover take place street by street – and how long would the downtime be?
- How would the change be funded?
- Hydrogen energy transmission capacity is approximately 20% lower than methane, so either it must be distributed at a higher pressure so pipe sizes need to increase, or demand needs to decrease.
- There are safety issues. Hydrogen is odourless, colourless and burns with an invisible flame. Unlike with mercaptans in natural gas, a suitable odourant – that will not separate from hydrogen – has yet to be identified. The flame can, however, be coloured red with an



## 75GW

estimated peak energy demand for heating UK homes

## CCS MADE EASY

The simplest and most common process of carbon capture and storage (CCS) is scrubbing the flue gases that leave the SMR process in an absorber tower, by contact with monoethanolamine (MEA), a liquid that binds with CO<sub>2</sub>. About 90% of CO<sub>2</sub> can be collected using this method. The MEA liquid is then heated by the excess steam from the SMR process to separate the CO<sub>2</sub> again. The MEA is sent back to the absorber tower, while the CO<sub>2</sub> gas is compressed for transportation.

of heat pumps and greater building-fabric efficiency. The UK's transportation needs are even greater, at 55mT, but this reduces to a 23mT demand for electric vehicles, because of their higher efficiency.

The domestic heating and hot water demands, which peak in winter and in the morning/evening, will need to be met by building more power stations. By adjusting for seasonal and daily variations, we have calculated an estimated peak demand for heating the UK's homes of 75GW. To put that into context, the peak demand in recent years has been 59GW (February 2012), so a lot more power stations, pylons and substations will need to be installed.

Electric vehicles can be charged overnight using existing power-station capacity, have less seasonal variation and, potentially, help balance the grid using dynamic demand-management technology. Assuming the 23mT is distributed evenly over the year, the power required is 30GW.

So, if we can only afford to upgrade the electricity infrastructure for vehicles or homes, the priority should be vehicles

»

**"The government needs to be decisive and set a clearer course to the 2050 climate change target"**

extremely dilute strontium solution.

If the transition was achieved, the benefits would be:

- No carbon monoxide poisoning from faulty boilers
- Fewer distribution losses compared with the electricity grid
- Lower carbon emissions than natural gas and today's electricity grid

The H21 Leeds City Gate study aims to determine the feasibility – technically and economically – of converting the existing natural gas network in Leeds to 100% hydrogen. To balance the supply from SMR facilities with the fluctuations of demand, it proposes to store hydrogen in salt caverns in Teesside and East Riding. This may be a viable solution for Leeds, but other UK regions may not have suitable options for large hydrogen storage.

The H21 Leeds report calculated a carbon factor of 0.086kgCO<sub>2</sub>/kWh for converting the city to hydrogen, complete with carbon capture and storage (CCS). This correlates to a 58% carbon saving compared with natural gas.

As areas of the North Sea are being depleted of natural gas, they could be converted into viable CO<sub>2</sub> stores. The infrastructure costs mean there is an economy of scale – the more cities that convert to hydrogen, the lower the cost per user of CCS. But is CCS merely a transition technology that allows us to burn every last drop of fossil fuel and delay an inevitable transition to electricity? Is it worth the investment and upheaval to build a hydrogen infrastructure, if it will be short-lived?

### Expanding the electricity grid

When thinking about the future of heating our buildings, we need to consider transport, which must also decarbonise if the UK is to meet targets in the Climate Change Act 2008. The capacity of our existing electricity grid is limited; do we expand it to heat our homes, or to fuel our vehicles, or both?

UK power stations produce 30 million tonnes of oil-equivalent electricity per year, and the gas infrastructure provides domestic buildings with 25mT. If the nation's domestic heating was converted from gas to electricity, the 25mT demand should reduce to 10mT through the use



» because the carbon reductions would be larger for every MW of additional capacity.

Another benefit of electrifying transport is a reduction in air pollution. Whereas the products of combustions from buildings are directed, by flues, away from pedestrians or occupiers, vehicles emit pollution at low level, in and among pedestrians.

If we are to electrify transportation and the heat for our buildings, services engineers need to design heating and hot water systems in a way that reduces peak demand. This means less instantaneous generation and greater use of hot-water storage, thermal mass and Passivhaus performance. People should also be incentivised by different day/night electricity tariffs.

### Hydrogen and electric transport

Electric vehicles are slowly increasing their market share and London already has buses powered by hydrogen fuel cells, albeit with hydrogen mostly shipped from the Netherlands.

The world has spent more than a century refining the internal combustion engine, which is now up to about 30% efficiency, so future improvements are likely to be incremental and far from the theoretical maximum of 58%. Clearly, the internal combustion engine is not part of our low-carbon future. So the question is, hydrogen or electricity?

Hydrogen without CCS and electric vehicles have similar carbon factors but – when CCS is added – the emissions of the hydrogen vehicle are 79% lower than the petrol alternative. Meanwhile, electric vehicles could lower emissions by 93%, based on 2035 predictions for the grid (Figure 2).

The key benefit of reducing air pollution in cities is also realised with both the electric and hydrogen options. The switch from petrol to hydrogen transport is easier to implement than converting the gas grid, because individuals can be incentivised to buy a hydrogen vehicle. It is also more suited to those who park their car on the street and so have no means to charge an electric car.

We believe the low-carbon future of heating our homes is predominantly electric, but the transition will be very slow, unless a clear national strategy to upgrade the

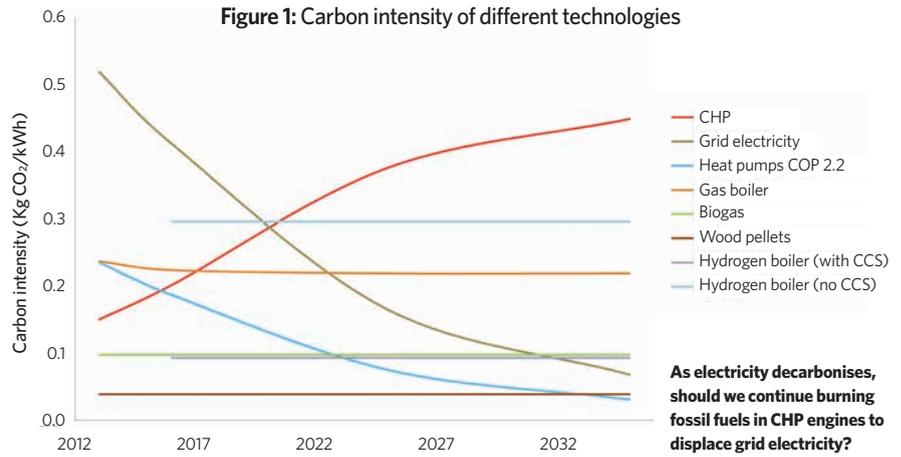
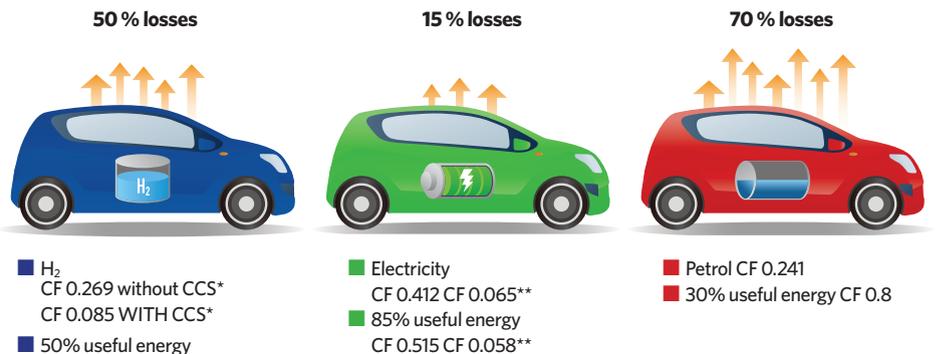


Figure 2: Comparison of hydrogen and electricity approximate carbon emissions



Carbon Factor (CF) is in kgCO<sub>2</sub>/kWh \* Carbon capture storage \*\* 2035 prediction  
**Emissions of the hydrogen vehicle, with CCS, are 79% lower than the petrol version, while electric vehicles could lower emissions by 93%**

capacity of the grid is outlined. The disbanding of the Department of Energy and Climate Change raises concerns about the likelihood of getting this direction, or of joining up the thinking between the construction and transportation industries.

### And the CHP?

Changing the vehicles we drive appears to be a simpler logistical exercise – and more rewarding in terms of carbon savings – so should be the government's priority. There is probably space for hydrogen and electric vehicles in our low-carbon future.

As shown in Figure 1, CHP doesn't make sense. Biomass and solar thermal can still play a part, but will be limited in urban areas. District heating systems are valuable because they make the switch from gas to electricity simpler – the key is ensuring that the distribution losses of these systems are managed.

One thing is clear, the government needs to be decisive and set a clearer course to the 2050 climate change target. It needs to state what the future capacity and carbon emissions of the gas and electricity networks will be, so we can advise our clients about which system to install. We also need the Building Regulations and regional planning policies to be revised accordingly.

A draft London Plan consultation is scheduled for autumn 2017, and TÜV SÜD will be campaigning for a change from the 'be lean, be clean, be green' mantra. The investment costs of a low-carbon electricity grid and/or hydrogen economy are vast, but the cost of doing nothing is worse in every way. [C](#)

■ **DAVID DAVIES** is associate director and **ALEX PEPPER** is a sustainability consultant, both at TÜV SÜD Wallace Whittle

### COOKING WITH HYDROGEN

Hydrogen hobs for cooking could be designed to be more efficient than gas hobs as the pan could be placed directly in the flame without fear of incomplete combustion or carbon deposition. Because hydrogen generates more water than methane, a hydrogen oven will keep meat moist, but pastries may be soggy.



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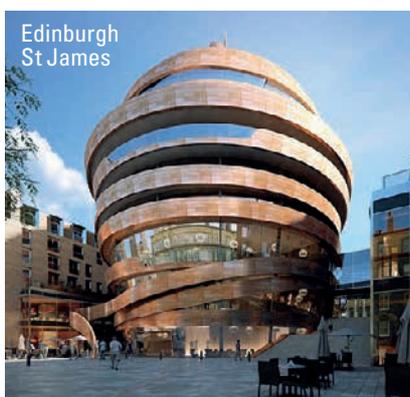
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CIBSE Journal is written and produced by CPL (Cambridge Publishers Ltd) Tel: +44 (0)1223 378000. www.cpl.co.uk  
1 Cambridge Technopark, Newmarket Road, Cambridge CB5 8PE.

**Editorial copy deadline:** First day of the month preceding the publication month

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What it takes to be a digital engineer

# Adapt to survive



Building services engineers enjoyed another year of inflation-busting pay rises in 2016, but wage growth is starting to level out after a sharp increase in the wake of the last recession.

Our exclusive Hays salary survey, on page 55, found that wages increased by 3.5% on average last year, well ahead of the 2.8% average increase for the construction and property sector overall.

But wage growth has slowed since 2015, when everyone was recruiting and there was real competition for skills, which fed into salary inflation. The cooling of the labour market reflects, in part, how employers have become more savvy about responding to hiring pressures.

The survey found that 22% of building services employers feared a lack of talent would thwart their business objectives – and that Brexit, which could shrink the pool of non-UK people working in the sector, could exacerbate these shortages. Meanwhile, the fall in the value of the pound is making the UK less attractive for overseas workers.

Ray Upjohn, ChapmanBDS chief executive, believes consultants are also facing competition for digital engineers from contractors keen to gain BIM expertise.

Our feature on adapting to the digital revolution (page 60) investigates what it takes to be a digital engineer, and how firms of all sizes are ensuring their employees embrace the technology, to make the most of its potential and set themselves apart from competition.

On page 50, we meet young professionals who have changed career to become building services engineers. The industry will have to start fishing from a wider pool of talent in this way to alleviate the acute skills shortfall in the UK, which is likely to be exacerbated by Theresa May's impending 'hard Brexit'.

■ **LIZA YOUNG, DEPUTY EDITOR** lyoung@cibsejournal.com

# Welcome from CIBSE

CIBSE is committed to encouraging young people to enter the industry. It wants to ensure there is a skilled, enthusiastic and passionate community of engineers ready for the challenges ahead.

This annual careers guide highlights what a career in building services engineering offers, and what impact you could have in shaping the world in which we live and work.

As a building services engineer, you'll have the chance to develop a range of skills and talents, realise your potential, and pursue career opportunities in the UK and overseas. At the same time, you'll have the satisfaction of knowing you are making a difference to the way people experience buildings, and to the environment.

There are many routes into the industry, and many paths once you've entered it, and CIBSE will be able to help support you through the lifetime of your career. It gives all full-time engineering students free CIBSE membership for the duration of their course, with a small fee for those studying on a part-time basis. As a member, you can access a wealth of resources and publications through the Knowledge Portal, as well as by joining the Young Engineers Network.

Membership means CIBSE can support you as you gain chartered status and progress your career. Most of all, the institute wants to see more young people entering the industry and making the most of the opportunities it offers. For more information, visit [www.cibse.org](http://www.cibse.org)

# Smart choices

Skills shortages and major new construction projects mean Britain needs more highly qualified labour. But graduates aren't the only ones in demand. **David Blackman** meets four professionals who changed career to become building services engineers

**B**uilding services was suffering from an acute skills shortage even before the UK's vote to withdraw from the European Union (EU). The Royal Academy of Engineering has estimated that Britain needs 182,000 new engineers of all kinds per year – and demand within building services will be fuelled by major infrastructure projects such as Hinkley Point C nuclear power plant and the HS2 high-speed rail network, when they come on stream.

The shortfall is also likely to be exacerbated by the result of last June's EU referendum. Skilled labour from the rest of the European Union has plugged skills gaps in recent years, but that may become more difficult if migration rules are tightened post-Brexit.

As a result building services will need to start fishing from a wider pool of talent than it has in the recent past.

Angela Ringguth, CIBSE's professional development consultant, says the institute is keen to encourage new routes to becoming chartered building services engineers – such as the apprenticeships that the government is currently so keen to champion via its new levy on employers.

'We want people to understand that there is more than one way into the profession,' she says, pointing out that many of those in the industry's senior echelons entered via the professional qualification route, rather than through a university degree.

*CIBSE Journal* has spoken to some young engineers who have taken the roads less travelled into building services. **CJ**

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- Electrical repair and rewinder
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- Estimator
- Façade engineer
- Facilities manager
- Fitter/welder
- Gas fitter
- Heating and ventilating engineer
- Highway electrical systems installer
- Industrial and commercial plumber
- Installation electrician
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- Lighting expert
- Maintenance electrician
- Project engineer
- Public health engineer
- Quantity surveyor
- Refrigeration engineer
- Satellite systems engineer
- Service and maintenance engineer
- Sheet metal weathering specialist
- Site supervisor



# 182,000

The number of new engineers of all kinds that the Royal Academy of Engineering estimates Britain needs per year to alleviate the skills shortage



LAUREN CHOONG



Working in the recruitment industry doesn't sound like an obvious entry route into building services – but that's what Lauren Choong was doing before she joined Ramboll as a graduate engineer.

Both of her parents worked in design, so engineering was in Choong's blood. In addition, the girls' grammar school she attended in Kent specialised in the subject.

But, having gone on to study mechanical engineering at Manchester University, she didn't move straight into the field when she graduated in 2011. 'The market wasn't so great, so I thought I would take time out to travel.'

While working in a local restaurant to earn money to travel, Choong was offered a job by a customer who ran a recruitment business. 'I hadn't considered recruitment as a career path, but thought I would be stupid to pass up a job opportunity.'

The agency she worked for was involved in the construction industry, which piqued her interest in the building services side of engineering. 'I was having conversations with guys who were on site and I was getting more and more interested in what was happening on projects.'

When applying for building services jobs, Choong admits she was nervous about competing with people who had just graduated, with more up-to-date technical knowledge than hers. But this didn't prove a hurdle. She believes the interpersonal skills she developed in recruitment have proved invaluable when working in cross-disciplinary construction teams.

'Half of what we do is communicating effectively. Recruitment taught me a lot about how to get people on board,' she said.

As for her advice for would-be building services engineers thinking about entering the profession, Choong says a good first step is to attend events such as London's Open House weekend, to see inside buildings. 'It's not just engineering; it's helping architects to express their design intentions.'

JOSH BULLARD



When he was growing up, Josh Bullard's dream was to work in Formula 1 racing. Keen to find a way into the industry, he followed in his father's footsteps by taking an engineering degree.

However, while studying aeronautical engineering at Bristol University, Bullard took a module on sustainability and stumbled across building services – prompting a radical change of career path. 'The projects I wanted to do were those that can build a better society, such as public buildings.'

After graduating, Bullard landed a job as an environmental design engineer at Mott MacDonald. He says making the transition from aeronautical to building services engineering was relatively straightforward, as there was crossover in terms of basic principles, such as understanding thermodynamics and heat flows. 'The core elements are very similar. The hardest thing was understanding a lot of the technical jargon, like soffits.'

Bullard has remained in Bristol, where he now works as a senior building performance engineer at Hydrock. He doesn't believe he is disadvantaged vis-à-vis his peers who took a more specialised degree, arguing that a lot of buildings services can only really be learned on the job.

But he believes getting advice is crucial. 'The earlier you can think of it the better; find a mentor who can help you along that journey.'

JAMIE ARBON



These days, Jamie Arbon – an engineering technician at Hoare Lea – can be found working on high-end residential and office projects in London. But his first job after leaving school at 16 was as a hod carrier for a local bricklaying company in his native Essex.

While working there, he gained an apprenticeship as an electrician, and built on this with a testing qualification. However, Arbon – now 26 – soon realised he didn't want to spend the rest of his career on building sites.

'When I was onsite I was working with guys who were a lot older than me. They were moaning that they hated the job; I didn't want to turn into that person.'

With his eyes on a white-collar job, and having developed an interest in the design side of construction, Arbon enrolled on an electrical engineering HNC at a college in Notting Hill Gate, London.

Three years ago – and halfway through the course – he joined Hoare Lea, which sponsored him to take a CIBSE-accredited part-time HND at South Bank University. He is currently midway through the penultimate year of the five-year course.

Arbon says the biggest project he has worked on while at Hoare Lea is a 12-storey office block at 245 Hammersmith Road, in west London. While on the project, the engineer who had been supervising him left the firm, which meant Arbon taking on additional responsibility, including extensive liaison with utility companies and the local council.

His advice for those aiming to make the transition from an apprenticeship to building services? 'Make sure you find a company where you can carry on with your studies and, hopefully, get the opportunity to go to university.'

"The projects I wanted to do were those that can build a better society, such as public buildings"

NICK AGOPIAN



Nick Agopian entered building services after taking a degree in civil engineering at University College London.

At secondary school, he admits he was torn between wanting to be an architect and an engineer. He eventually plumped for the latter because he was better at maths and sciences than art.

He found a way of marrying the two after taking a module in environmental engineering, which

interested him so much that he chose the building services role in his final-year team project.

This involved designing a sustainable building that used a combination of natural and mechanical ventilation for heating and cooling. 'When I delved a bit deeper into the building services world, it was more interesting than the other modules.'

Agopian joined ChapmanBDSP as a trainee in November 2013. The most high-profile project he has been involved with is the redevelopment of Battersea power station, where he has worked on phases two and three.

Having moved on from trainee to intermediate mechanical engineer, Agopian doesn't believe that entering building services via civil engineering has hindered his progress. However, he admits to probably spending more time on BDSP's graduate programme than many of his peers.

'Some graduates will be 100% sure that they want to do electrical or mechanical. I wanted to do each a bit longer to make sure I made the right choice.'

'Working with different teams, you get a better idea of what you want.'



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# Making hay

Salaries in the building services sector rose by a healthy 3.5% last year, despite Brexit looming on the horizon. **David Blackman** reports on a jobs market showing strong resilience in the face of European uncertainty

For many British workers, the years since the recession have constituted a lost decade of stagnating wage growth. Construction has proved a rare bright spot though – at least in recent years – and building services staff enjoyed another period of inflation-busting pay rises in 2016.

Salaries increased by an average of 3.5%, according to the latest salary guide and survey of building service employers and candidates, compiled exclusively for CIBSE by Hays. This represented a bigger rise than the average recorded by Hays for the construction and property sector overall (2.8%). Those working in building services also outperformed the 1.8% salary average increase for all UK professions.

Nearly two-thirds (60%) of building services employers told Hays that they had raised salaries in the past 12 months, with the same proportion reporting that they expect to increase them in the next 12 months. Nearly one in six (16%) anticipate these salary increases to be 5% or more.

However, building service company employees clearly still have itchy feet; more than two-thirds (70%) anticipate moving in the next 12 months, which is slightly higher than at this point last year. Just more than half (53%) expect to switch jobs within the next six months.

The relief for employers is that the 3.5% annual wage increase represents a slowdown on 2015, when salary hikes were running at 5% on average, according to Hays.

Richard Gelder, director at Hays Building Services, says things have calmed down since what he describes as the ‘chaotic’ situation in 2015, when building



### Contractors: Directors

Region	Typical 2017	Min 2017	Max 2017
East Midlands	£56,500	£55,000	£70,000
East of England	£55,000	£50,000	£70,000
London	£90,000	£70,000	£120,000
North East England	£52,000	£48,000	£60,000
North West England	£58,000	£55,000	£70,000
Northern Ireland	£64,000	£60,000	£80,000
Scotland	£55,000	£50,000	£60,000
South East England	£72,000	£70,000	£85,000
South West England	£58,000	£55,000	£60,000
Wales	£53,500	£52,000	£60,000
West Midlands	£60,000	£55,000	£75,000
Yorkshire and the Humber	£56,000	£55,000	£60,000
National average	£60,833	£56,250	£72,500

% increase year on year 5%



Before the EU referendum, 97% of building services employers surveyed by Hays expected business activity levels to increase in the next 12 months



More than two-thirds (70%) of employees anticipate moving in the next 12 months, which is slightly higher than at this point last year

» services companies were hiring and reopening regional offices, while new firms were trying to break into the field. 'Just 12 to 18 months ago, there was sense of disbelief about how quickly everything had turned. Everyone was recruiting, there was real competition for skills, and that fed

into wage inflation,' he said. The cooling of the labour market reflects, in part, how employers have become more savvy about responding to hiring pressures, says Gelder: 'Throughout 2016, you have seen employers become a lot more proactive, rather than reactive. They want to do it right by not taking on somebody who is not a good fit for the business, or where the pay is so disproportionate that it will create other management challenges. If you can't contain your staff costs, that becomes a real problem.'

Jay Amin, head of human resources at Hurley Palmer Flatt, agrees that the jobs market has calmed down over the past few months. 'The year before was a bit more challenging. You would make offers and people would make counter-offers. It became a bit of a numbers game and we were being held to ransom.'

Ray Upjohn, chief executive of ChapmanBDSP, believes that salaries have largely levelled out after a couple of years of big post-recession increases. 'The correction process is near the end,' he says, while Philippe Honnorat, UK head of building services at WSP Parsons Brinckerhoff, also feels that salary levels have become much more stable over the past year. 'A new average has been found for each and every role,' he says.

One of the factors underpinning the cooling in salary increases is the additional uncertainty injected into the construction market by

**Contractors: CAD technician**

Region	Typical 2017	Min 2017	Max 2017
East Midlands	£28,000	£27,000	£30,000
East of England	£24,000	£22,000	£26,000
London	£39,000	£30,000	£50,000
North East England	£25,000	£22,000	£26,500
North West England	£28,500	£25,000	£30,000
Northern Ireland	£28,000	£24,000	£30,000
Scotland	£22,000	£22,000	£24,000
South East England	£33,000	£30,000	£37,000
South West England	£30,000	£25,000	£33,000
Wales	£28,000	£24,000	£34,000
West Midlands	£27,000	£22,000	£34,000
Yorkshire and the Humber	£24,000	£21,000	£26,500
National average	£28,042	£24,500	£31,750
% increase year on year 3.90%			

**Contractors: Contract quantity surveyor**

Region	Typical 2017	Min 2017	Max 2017
East Midlands	£42,000	£35,000	£50,000
East of England	£39,000	£33,000	£50,000
London	£55,000	£45,000	£75,000
North East England	£37,500	£35,000	£42,000
North West England	£38,000	£35,000	£40,000
Northern Ireland	£38,000	£30,000	£42,000
Scotland	£40,000	£35,000	£42,000
South East England	£55,000	£50,000	£70,000
South West England	£42,500	£42,000	£50,000
Wales	£40,000	£34,000	£44,000
West Midlands	£40,000	£33,000	£45,000
Yorkshire and the Humber	£35,000	£30,000	£40,000
National average	£41,833	£36,417	£49,167
% increase year on year 3.20%			

**Contractors: Estimator**

Region	Typical 2017	Min 2017	Max 2017
East Midlands	£40,000	£30,000	£45,000
East of England	£42,000	£35,000	£55,000
London	£54,000	£45,000	£60,000
North East England	£35,000	£30,000	£40,000
North West England	£40,000	£38,000	£45,000
Northern Ireland	£33,000	£30,000	£40,000
Scotland	£38,000	£35,000	£40,000
South East England	£55,000	£50,000	£65,000
South West England	£40,000	£35,000	£45,000
Wales	£37,500	£30,000	£40,000
West Midlands	£40,000	£30,000	£45,000
Yorkshire and the Humber	£33,000	£25,000	£35,000
National average	£40,625	£34,417	£46,250
% increase year on year 6%			

**Contractors: Project engineer**

Region	Typical 2017	Min 2017	Max 2017
East Midlands	£35,000	£30,000	£40,000
East of England	£36,000	£32,000	£45,000
London	£45,000	£35,000	£60,000
North East England	£32,000	£28,000	£35,500
North West England	£38,000	£35,000	£40,000
Northern Ireland	£32,000	£28,000	£35,000
Scotland	£38,000	£35,000	£40,000
South East England	£40,000	£40,000	£47,000
South West England	£35,000	£35,000	£45,000
Wales	£34,000	£28,000	£35,000
West Midlands	£36,000	£30,000	£40,000
Yorkshire and the Humber	£32,000	£30,000	£40,000
National average	£36,083	£32,167	£41,875
% increase year on year 3.50%			

**Contractors: Project manager**

Region	Typical 2017	Min 2017	Max 2017
East Midlands	£45,000	£40,000	£50,000
East of England	£45,000	£40,000	£55,000
London	£65,000	£50,000	£75,000
North East England	£42,500	£40,000	£50,000
North West England	£45,000	£40,000	£55,000
Northern Ireland	£35,000	£33,000	£38,000
Scotland	£40,000	£38,000	£47,000
South East England	£60,000	£55,000	£65,000
South West England	£45,000	£40,000	£45,000
Wales	£40,000	£37,000	£42,000
West Midlands	£43,000	£35,000	£50,000
Yorkshire and the Humber	£45,000	£40,000	£57,000
National average	£45,875	£40,667	£52,417
% increase year on year 3.30%			

**Contractors: Senior contracts manager**

Region	Typical 2017	Min 2017	Max 2017
East Midlands	£47,500	£45,000	£55,000
East of England	£50,000	£45,000	£60,000
London	£60,000	£50,000	£75,000
North East England	£40,000	£30,000	£45,000
North West England	£43,000	£38,000	£50,000
Northern Ireland	£45,000	£38,000	£50,000
Scotland	£44,000	£38,000	£47,000
South East England	£60,000	£55,000	£65,000
South West England	£48,500	£45,000	£55,000
Wales	£46,000	£40,000	£50,000
West Midlands	£48,500	£40,000	£55,000
Yorkshire and the Humber	£37,000	£34,000	£43,500
National average	£47,458	£41,500	£54,208
% increase year on year 3.20%			

the UK's vote to withdraw from the European Union. Amin recalls that 'when it [the referendum] kicked in initially, a handful of clients went on hold.' However, these projects have now come back on stream and the firm is recruiting again, she adds. This shows that confidence within the building services sector has proved more resilient than expected in the immediate aftermath of last June's vote.

Before the EU referendum, 97% of building services employers surveyed by Hays expected business activity levels to increase over the following 12 months. Across the construction sector as a whole, a survey carried out by the agency after the vote found that exactly the same proportion of employers expected activity levels to increase or stay the same.

Upjohn agrees that activity levels have 'held up stronger than expected', while Gelder says: 'Most people have fairly busy order books and pipelines of work. Right now, there has been no change.'

The government's announcements on the long-delayed Hinkley Point C nuclear power plant and a third runway at Heathrow Airport have given a major fillip to the infrastructure pipeline.

A rash of opportunistic property investment - often motivated by a desire to snap up UK real estate bargains after the post-referendum devaluation of the pound - has also propped up activity in the commercial sector, says Honnorat.

While this has resulted in a steady flow of new inquiries, he cautions that wider economic uncertainty means there is less confidence about whether projects will be delivered.

There is, Honnorat explains, 'less sense that a project will eventually result in further investment, even in design costs - and, further down the line, in real construction costs - because the whole investment world is pondering how we adjust.'

This probably explains why employers are seeing reduced turnover, despite bullish statements from their staff about moving



**"Most people have fairly busy order books and pipelines of work. Right now, there has been no change"**

**Consulting: Associate**

Region	Typical 2017	Min 2017	Max 2017
East Midlands	£55,000	£50,000	£58,000
East of England	£51,000	£50,000	£65,000
London	£68,000	£60,000	£75,000
North East England	£42,000	£38,000	£45,000
North West England	£53,500	£50,000	£60,000
Northern Ireland	£50,000	£45,000	£55,000
Scotland	£50,000	£50,000	£55,000
South East England	£59,000	£55,000	£63,000
South West England	£55,000	£50,000	£60,000
Wales	£50,500	£40,000	£52,000
West Midlands	£52,000	£48,000	£55,000
Yorkshire and the Humber	£47,000	£42,000	£48,000
National average	£52,750	£48,167	£57,583
% increase year on year 3.10%			

**Consulting: CAD technician**

Region	Typical 2017	Min 2017	Max 2017
East Midlands	£28,000	£27,000	£30,000
East of England	£29,000	£25,000	£37,000
London	£34,000	£30,000	£38,000
North East England	£24,000	£21,000	£25,000
North West England	£28,000	£25,000	£35,000
Northern Ireland	£20,000	£18,000	£25,000
Scotland	£25,000	£20,000	£25,000
South East England	£31,000	£28,000	£34,000
South West England	£28,000	£25,000	£30,000
Wales	£28,000	£23,000	£32,000
West Midlands	£27,000	£23,000	£30,000
Yorkshire and the Humber	£26,000	£22,000	£28,000
National average	£27,333	£23,917	£30,750
% increase year on year 1.90%			

**Consulting: Director**

Region	Typical 2017	Min 2017	Max 2017
East Midlands	£60,000	£55,000	£70,000
East of England	£61,000	£50,000	£70,000
London	£90,000	£80,000	£100,000
North East England	£50,000	£42,000	£54,000
North West England	£65,000	£60,000	£70,000
Northern Ireland	£60,000	£50,000	£70,000
Scotland	£55,000	£50,000	£60,000
South East England	£69,000	£64,000	£74,000
South West England	£55,000	£52,000	£65,000
Wales	£53,500	£52,000	£57,000
West Midlands	£65,000	£50,000	£70,000
Yorkshire and the Humber	£50,000	£42,000	£55,000
National average	£61,125	£53,917	£67,917
% increase year on year 2.70%			

**Consulting: Intermediate design engineer (M&E)**

Region	Typical 2017	Min 2017	Max 2017
East Midlands	£33,500	£30,000	£38,000
East of England	£37,000	£33,000	£50,000
London	£38,000	£32,000	£40,000
North East England	£30,000	£28,000	£32,000
North West England	£34,000	£29,000	£40,000
Northern Ireland	£26,000	£25,000	£29,000
Scotland	£35,000	£30,000	£40,000
South East England	£33,000	£31,000	£36,000
South West England	£37,000	£30,000	£40,000
Wales	£34,000	£28,000	£35,000
West Midlands	£31,000	£25,000	£35,000
Yorkshire and the Humber	£26,000	£22,000	£28,000
National average	£32,875	£28,583	£36,917
% increase year on year 4%			

**Consulting: Junior design engineer (M&E)**

Region	Typical 2017	Min 2017	Max 2017
East Midlands	£26,000	£20,000	£30,000
East of England	£24,000	£20,000	£28,000
London	£28,000	£25,000	£32,000
North East England	£21,000	£18,000	£24,000
North West England	£25,000	£22,000	£26,000
Northern Ireland	£23,000	£20,000	£24,000
Scotland	£27,000	£25,000	£30,000
South East England	£28,000	£26,000	£32,000
South West England	£27,000	£24,000	£30,000
Wales	£25,000	£22,000	£28,000
West Midlands	£23,000	£18,000	£25,000
Yorkshire and the Humber	£21,000	£18,000	£24,000
National average	£24,833	£21,500	£27,750
% increase year on year 4.70%			

**Consulting: Professional quantity surveyor**

Region	Typical 2017	Min 2017	Max 2017
East Midlands	£44,500	£35,000	£50,000
East of England	£47,000	£40,000	£55,000
London	£65,000	£45,000	£75,000
North East England	£38,000	£35,000	£40,000
North West England	£42,000	£38,000	£45,000
Northern Ireland	£35,000	£30,000	£37,000
Scotland	£37,500	£33,000	£41,000
South East England	£61,500	£60,000	£70,000
South West England	£48,500	£45,000	£60,000
Wales	£41,000	£34,000	£45,000
West Midlands	£41,000	£32,000	£50,000
Yorkshire and the Humber	£40,000	£35,000	£45,000
National average	£45,083	£38,500	£51,083
% increase year on year 4.90%			

» At WSP, the attrition rate has fallen over the past 12 months, claims Honnorat: 'People will look twice [before moving] in this environment.' Amin also says turnover is 'slightly down' at her company: 'People are reluctant to move and a bit worried.'

However, perhaps the biggest hiring concern for building services employers is the impact that the UK's withdrawal from the EU will have on their access to skilled labour.

The sector's skills shortage is already acute, judging by Hays' survey, which found that nearly a quarter (22%) of building services employers are concerned that they lack the talent they need to achieve their business objectives. These shortages are likely to be exacerbated if - as looks increasingly likely - Brexit ends the free movement of labour between the UK and the European Union.

'There's a clear pool of non-UK people working in the sector, without whom we would really be struggling,' says Gelder.

Honorat is also worried about the implications of the end of free movement of labour. 'The whole construction industry depends on people prepared to move and work hard. The EU workforce currently based in the UK find themselves wondering what the future holds.'

As well as the uncertainty surrounding EU employees' residency status in a post-Brexit Britain, the drop in the value of the pound

means the UK is a less lucrative place to work. Honnorat predicts that the EU talent will start to flock back to their home countries, citing as an example Spanish engineers. 'If the Spanish economy rises strongly, some of our people may decide to go back home; people are more mobile than before.'

And this narrowing of the talent pool risks making the UK building services a less vibrant sector. 'These are quite entrepreneurial and dynamic people who bring a different outlook with a different culture and training and a wider set of skills. It makes us richer, so of course we are concerned that - if we have less access to those people - we will suffer.' **CJ**



### THE BIG WINNERS IN 2016

**Junior and intermediate design engineers and quantity surveyors saw the biggest increases in salary last year**

While average pay increases may have eased off in building services, this is not true across the board, says Hays' Richard Gelder: 'Competition for candidates in several areas remains fierce and drives salary increases above the industry average, as counter-offers continue to be prevalent.'

Among those working for contractors, estimators enjoyed the highest salary growth last year - with a national average increase of 5% - followed by directors (5%) and CAD technicians (4%). Within consultancy ranks, quantity surveyors and junior design engineers saw the highest salary increases (5%), while intermediate design engineers (M&E) also experienced an above-average pay rise of 4%.

Gelder says: 'A good design engineer can expect to secure a number of interviews, a competitive salary offer for a new role, and - in many cases - a counter-offer from their current employer to keep them.'

ChapmanBDSP's Ray Upjohn says consultancies face strong competition from contractors to retain staff with BIM expertise, as the technology becomes the norm on construction projects. WSP Parsons Brinckerhoff's Philippe Honnorat, meanwhile, isn't surprised that estimators are in such strong demand. 'Contract prices are all over the place; with the pound dropping, everything you import costs more. It's hard to get hold of certain trades; last year it was bricklayers, this year it's electricians. Somebody who understands the market well removes some of the uncertainty around future prices.'

By contrast, those with expertise in sustainable construction received the lowest average uplift in salary - a meagre 1.2% - but Honnorat believes demand for their services will eventually rebound.

'Sustainable construction will come back because legislation keeps changing and the younger generation is more attuned to the fact that we must do something about it.'

 **£52,750**

Typical national average salary for associate consultant in 2017

#### Consulting: Revit/BIM technician

Region	Typical 2017	Min 2017	Max 2017
East Midlands	£31,500	£30,000	£40,000
East of England	£30,000	£28,000	£38,000
London	£45,000	£40,000	£60,000
North East England	£32,000	£28,000	£35,000
North West England	£35,000	£30,000	£38,000
Northern Ireland	£24,000	£22,000	£28,000
Scotland	£30,000	£25,000	£35,000
South East England	£40,000	£35,000	£42,000
South West England	£35,000	£30,000	£40,000
Wales	£34,000	£30,000	£35,000
West Midlands	£31,000	£26,000	£40,000
Yorkshire and the Humber	£33,000	£28,000	£35,000
National average	£33,375	£29,333	£38,833
% increase year on year 3.20%			

#### Consulting: Senior design engineer (M&E)

Region	Typical 2017	Min 2017	Max 2017
East Midlands	£46,000	£40,000	£50,000
East of England	£45,000	£40,000	£55,000
London	£55,000	£50,000	£65,000
North East England	£43,000	£40,000	£45,000
North West England	£45,000	£40,000	£55,000
Northern Ireland	£38,000	£35,000	£44,000
Scotland	£44,000	£40,000	£45,000
South East England	£53,000	£47,000	£57,000
South West England	£48,000	£45,000	£55,000
Wales	£45,000	£38,000	£48,000
West Midlands	£42,000	£38,000	£45,000
Yorkshire and the Humber	£42,000	£38,000	£45,000
National average	£45,500	£40,917	£50,750
% increase year on year 2.5%			

#### Consulting: Sustainability consultant

Region	Typical 2017	Min 2017	Max 2017
East Midlands	£42,000	£35,000	£45,000
East of England	£50,000	£42,000	£60,000
London	£55,000	£45,000	£60,000
North East England	£40,000	£36,500	£43,500
North West England	£45,000	£40,000	£50,000
Northern Ireland	£25,000	£23,000	£28,000
Scotland	£43,000	£40,000	£50,000
South East England	£42,000	£40,000	£45,000
South West England	£45,000	£40,000	£50,000
Wales	£41,500	£38,000	£45,000
West Midlands	£43,000	£38,000	£46,000
Yorkshire and the Humber	£42,500	£40,000	£47,500
National average	£42,833	£38,125	£47,500
% increase year on year 1.20%			

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**Contact:** EGIS School Office

**Email:** [egis-enquiries@hw.ac.uk](mailto:egis-enquiries@hw.ac.uk);

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**Website:** [www.lcb.ac.uk](http://www.lcb.ac.uk)

**Telephone:** 0113 222 6061

**Contact:** Higher Education Department

**Email:** [info@lcb.ac.uk](mailto:info@lcb.ac.uk)

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**Telephone:** 01509 228529

**Contact:** Mahroo Eftekhari

**Email:** [m.m.eftekhari@lboro.ac.uk](mailto:m.m.eftekhari@lboro.ac.uk) 01509 222606

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### Looking for a Building Services Engineer?

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# Adapt and survive in these digital times

With the data revolution sweeping through the construction sector, building services firms are on the hunt for a new type of design professional. **Liza Young** finds out what it takes to be a digital engineer

**B**ig desks and long rulers were the order of the day when CIBSE digital engineering consultant Carl Collins started in mechanical engineering as a draughtsman; computers were few and far between.

'Back in 1983, we were using the ancestors of the modern 3D building information modelling (BIM) tools – simple CAD applications on computers that were little more than virtual drawing-boards,' he says. 'But, most importantly, we were using computers to interpret and store data, to help eliminate errors and to automate processes. That's when BIM truly started, and when the digital engineer was born.'

So while the 'digital' part of the job title is relatively new, the 'engineer' part has a much longer lineage. 'Engineers have been around for hundreds of years, adapting to the tools that became available,' says Steven Hale, managing director at Crofton Design. 'We went from slide rules to calculators and now to BIM. That's not digital engineering – that's engineering.'

The most valuable part of BIM is the way engineers capture, organise and deploy data, says Collins. 'BIM should not be an expensive add-on to a project, but a way of working that permeates everything we do.' And, if used from the start of a project, BIM can create a platform for true collaboration and accelerate delivery.

## Efficiencies

Crofton deployed BIM software across all engineers' desktops five years ago, and the firm is 'beginning to see a tipping point', says Hale. As well as staff going home on time, they have gained hours of productive time because of an increase in efficiency.

Instead of generating non-recyclable data, a digital engineer only needs to input building information once before it is shared and used by multiple parties. 'Typically, you would do the calculations, draw the schematic and create the schedules. With BIM, those are just different views of the same bit of data, so you no longer have to reproduce that information manually three times,' says Hale.

Manual methods also introduce the potential for human error and propagate any inaccuracies there may be in the original drawings. In BIM, the drawings and schedules are generated directly from the underlying model, ensuring information is always consistent with the design.

When a change is made in the design – for example,

the size of an air handling unit – it automatically ripples down to all related construction documents and schedules. 'Otherwise, you risk fragmentation of data – when schematics and schedules fail to align – and out-of-date information,' says Hale.

'Automation can do the mundane tasks so we can do more important things, like design,' adds Dave Lee, BIM manager at Hilson Moran. 'It also saves time, because architects and engineers can work on projects simultaneously.' A collaborative model prompts interdisciplinary understanding, too, Lee says, breaking down barriers between electrical, public health and mechanical engineers, and architects.

Hale says Crofton's BIM expertise – combined with such a small



market of competitors – has helped the firm secure jobs, particularly on the government's Priority School Building Programme. The drawback? 'It's eye-wateringly expensive,' he says. 'SMEs are struggling because they look at the cost and wonder how the hell it's going to pay them back.'

'It will, but it requires continued commitment to get to where we are. We started the BIM journey at the depths of the recession – we couldn't afford to do it, but we couldn't afford not to.'

Smaller companies need to embrace digital technologies or they will get left behind, says Mark Maidment, director of Skelly & Couch, which invested in BIM seven years ago. 'Companies that do not invest will lose engineers. Unless they have experience working with the tools, they will find it difficult to get jobs in the future,' he adds.

To simplify and standardise some aspects of BIM, CIBSE is developing product data template (PDTs) – a database of manufacturer-prepared fields with values for products and specifications. Designers and contractors can use these to populate their BIM models automatically with component data, to work out energy savings and cost.

The recently launched BIMHawk website and software plug-in allows users to upload PDTs corresponding to real-world products with a full set of industry-recognised parameters ready to be filled in, before importing the model directly into a BIM platform.

### Engineering first

Skelly & Couch and Hilson Moran rank highly those individuals who have experience in using digital packages, but their key criteria for candidates

## “Engineers are hired because of the quality of their designs, not because of their ability to click a button”

are strong engineering principles and a willingness to learn. Training an engineer to use software is much easier than teaching a Revit expert engineering, says Lee. 'Existing engineers have been hired because of the quality of their designs, not because of their ability to click a button – they can be trained up to do that. What we can't teach so easily is the innovative engineering behind it.'

Maidment insists modelling in isolation – without an understanding of what is coming out at the end – is a dangerous activity. Skelly & Couch encourages everyone to do hand calculations in the first instance, to ensure they know that what they're getting from the software packages is reasonable and correct. 'Digital allows us to push boundaries, have confidence in our designs, and instigate things we couldn't have seven years ago. But we need to recognise its limitations,' says Maidment.

### Training

Like Skelly & Couch, which supplements Revit courses with in-house training, Crofton runs weekly BIM workshops on creating schematics and schedules, as well as offering Revit training on Linda.com. 'We have been training for five years and have seen a 15% improvement in productivity,' says Hale. 'Every one of our engineers will need to be able to manipulate data-rich models to work here. Everyone in the business – including me – is learning.'

Hilson Moran, with 150 engineers and a 30-strong CAD department, is also bridging the gap between the two disciplines by creating digital technologists – experts in both engineering and software. 'Our strategy is that everyone – no matter what age – should have digital knowledge, including the CEO,' says Lee, who uses company-wide KnowledgeSmart testing to identify knowledge gaps.

However, there's still a long way to go before all disciplines are on board, adds Hale. Electrical engineers' drawings, for example, use symbols that do not accurately translate into Revit, which allows 3D components to be tagged with data. 'This has been the convention for electrical drawings for the past 60 years, and it will be really hard to unpick,' he says.

Hale believes the terms BIM and digital will fall away in time, as the industry begins to accept these technologies as the norm. 'Many people see BIM as a problem, but we see it as an opportunity to set ourselves apart from our competitors,' he says.

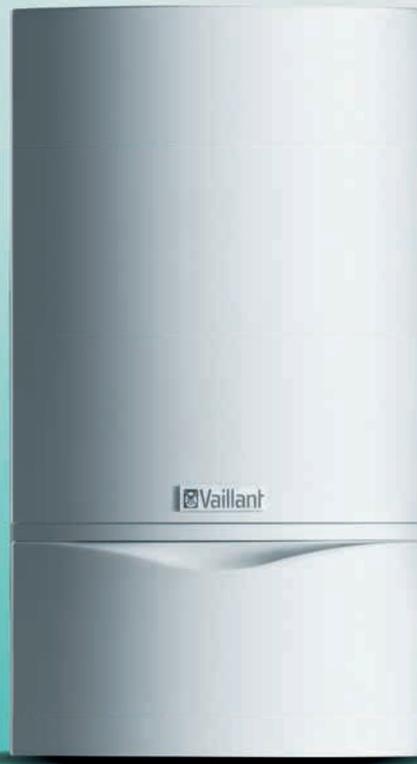
BIM is just data, organised to do different things, adds Collins. 'It's no different to what engineers have always done – solved problems by doing creative things with the tools available. We're all digital engineers, but we need to embrace this role to make the most of its potential.' 

 For more information visit [www.cibse.org/bimroadshows](http://www.cibse.org/bimroadshows)



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## Applying plate heat exchangers to integrate high-efficiency boilers into legacy systems

This module looks at different types of plate heat exchangers used in building services systems, and how they can be applied with new boilers in existing systems

The traditional method of distributing heated water from a boiler to building heating system circuits uses a low-loss header to connect the primary boiler circuit with the secondary distribution. There are, however, circumstances where it is advantageous hydraulically to decouple the primary circuit of the boiler from the secondary circuits of the heating systems, and this can be achieved by replacing the low-loss header with a plate heat exchanger.

This article considers the common types of plate heat exchanger that are used in building services systems, and discusses how they can usefully be applied in place of the traditional low-loss header in existing systems when new, high-efficiency boilers are installed.

The main types of plate heat exchangers (PHEs) used in building services systems are either gasketed (dismountable) units or complete assemblies that have been brazed. The brazed units were originally developed to allow extreme operational pressures and temperatures, but are now commonly applied across many applications. PHEs are available in a range of sizes, capable of transferring from only a few kilowatts (kW) of heat up to several megawatts (MW).

Gasketed PHEs – also known as plate-and-frame heat exchangers – are made of multiple, embossed stainless steel plates bolted together, with interleaving sealing gaskets, positioned between two end frames (as shown in Figure 1). The frames and mounting assembly are designed so they can be taken apart, and rebuilt, for cleaning and inspection. Gaskets between the plates separate the two flows and create the external seal. Gasket failure does not cause the two flows to mix – the gasket is arranged so that such leaks will go to atmosphere. Twin-walled plates are available for applications where it is critical that the two flows should not mix – as might be appropriate for domestic hot water usage. The plates are normally stainless steel and, in the brazed version, would be jointed with copper. The more robust – and lower cost – brazed heat exchangers (such as that shown in Figure 2) are sealed components, so they cannot be deconstructed for maintenance.

Hot fluid flows on one side of each plate, and cooler fluid counterflows on the

other side. Ports at each corner of the end plates act as headers for the fluid. One fluid travels in the alternate gaps (or channels) to the other, and the specific direction of the flow will be dependent on the individual manufacturer's design. The channels in the PHE are formed so that, even at low values of simple Reynolds number, there is turbulent flow, so – in conjunction with the thin, high-conductivity stainless steel plates – they have very good heat-transfer characteristics. Compared with a shell-and-tube heat exchanger, the heat transfer is equivalent to four or five times greater per unit area.<sup>1</sup>

The heat transferred from one flowing liquid to the other through a plate heat exchanger can be determined from  $U A \Delta T_{LM}$  where  $U$  is the average thermal transmittance from one flow to the other ( $W \cdot m^{-2} \cdot K^{-1}$ ),  $A$  is the overall heat transfer area ( $m^2$ ) and  $\Delta T_{LM}$  is the log mean temperature difference of the two flows.

$\Delta T_{LM}$  is determined from the entering and leaving primary and secondary temperatures. For the counterflow plate heat exchanger illustrated in Figure 2 and Figure 3,

$$\Delta T_{LM} = \frac{\Delta T_A - \Delta T_B}{\ln \left( \frac{\Delta T_A}{\Delta T_B} \right)} = \frac{\Delta T_A - \Delta T_B}{\ln \Delta T_A - \ln \Delta T_B}$$





Figure 1: An example of a demountable, gasketed plate heat exchanger (Source: Vaillant/UK Exchangers)

» As well as this relationship being applied to assess PHE design capacities, it is also useful to determine how adequately the heat exchanger is performing during operation – assessing whether it is excessively obstructed or fouled – by taking measurements of temperatures and comparing  $\Delta T_{LM}$  with that of when it was originally commissioned. The plate heat exchange design is able to achieve a large temperature cross and, potentially, a 1K temperature approach because of the counterflow fluid path and high  $U$ .<sup>1</sup>

When PHEs are selected, it is important to obtain advice from the manufacturer, not only to determine basic sizing parameters, but also to take proper account of ‘fouling’ – the accumulation of deposited materials on the plates, which will relate to both the design of the corrugations in the plates and the type of fluid. If a PHE is correctly selected, then the fouling in heating water heat exchangers is likely to be very small, because of the turbulent flow that is required for proper operation. By mistakenly overestimating the likely fouling (and the consequent reduction in the value of  $U$ ) the PHE will be oversized and the resulting water velocity could be lower than ideal – so, ironically, encouraging increased levels of fouling. In some building applications, such as those using cooling tower water, potential fouling can be more challenging and can include crystallisation, sedimentation, and organic material growth.

PHEs require very little maintenance because the high-velocity and turbulent flow of the fluid in the channels keeps surfaces

clear from fouling. Strainers (filters) can be installed in the pipeline before the heat exchanger to prolong its working effectiveness, but must be periodically flushed clean as part of the maintenance programme. If, however, larger particles become lodged in the small spaces between the plates – and so obstruct the flow – back-flushing can be used to attempt to remove the obstructing material.

To maintain operational effectiveness, the dismantling and cleaning of gasketed PHEs is often scheduled as part of an annual maintenance plan. Gaskets on large PHEs are costly to replace, and in-situ maintenance must ensure that the plates are evenly loaded, and kept square and flat – by methodically tightening the bolts to an appropriate torque to secure the pressure plate – to ensure longevity of successful operation. Chemical or ultrasonic cleaning may be required to remove dirt and debris in brazed PHEs after a period of operation. This can be done in situ, if appropriate valve arrangements have been installed.

### Applications of PHEs in building heating systems

PHEs are already commonplace in a number of applications in building systems. They are most often found in combination boilers, where brazed PHEs are used to divert heat from the primary heating circuit to the instantaneous flow of domestic hot water. In commercial continuous flow heating and hot water systems, PHE primaries can be fed from low-, medium- or high-temperature heat sources, including steam. They also form the core of the heat interface unit (HIU), as used for district heating schemes to supply heat to end users.<sup>2</sup>

They are increasingly applied to refurbishment projects where, throughout the life of the system, there will be degradation of the pipework and fittings that will cause particulate matter and limescale (calcium carbonate) to accumulate within the system. Methods are available to remove particulate matter – such as filters, cyclone-type separators and magnetic sludge removers – but, on an older system, it is particularly challenging to ensure the absence of all particulate matter, even after undertaking a comprehensive cleaning and flushing operation.

The resulting boiler performance can be affected. For example, partial blockages of the waterways can produce ‘hot spots’ within the boiler that will affect performance to such an extent that significant maintenance would be required. Older cast-iron boilers with large waterways are less susceptible, and could often cope with such conditions where particulate matter could accumulate at the bottom of the channels without causing a major obstruction. Newer, high-efficiency boilers have smaller waterways, so there is less room within the system for dirt and debris to collect without adversely affecting performance. Condensing boilers are generally installed as part of a sealed, pressurised system, but many older, open-vented systems are not suitable for conversion to sealed operation.

A practical solution is to leave the existing (secondary) system open-vented, while hydraulically decoupling the primary circuit using a PHE, to provide a protected, pressurised primary circuit for the new boiler. The PHE would typically replace the traditional low-loss header, the principal function of which is hydraulically to separate the primary and secondary circuits, as shown in Figure 4.

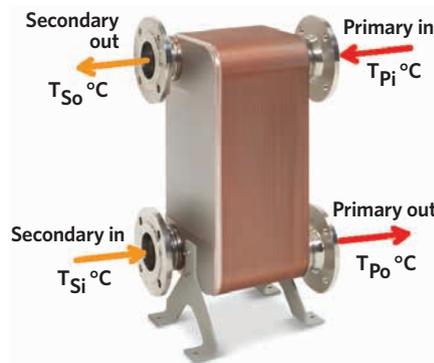


Figure 2: An example of a copper-brazed stainless steel plate heat exchanger, approximately 500mm tall and 270mm wide, that can provide heat exchange of 240kW to 1MW (Photo source: Vaillant)

It is important that the heat exchanger is sized correctly, not only to supply the required heat to the secondary circuit, but also to ensure that the hydraulic resistance can be accommodated by the primary and the secondary system pumps. The pressure drop on the secondary side of a PHE is likely to be between 10kPa and 30kPa. This compares with less than 10Pa in a low-loss header. To place this in context, a typical heating pipework system would normally be sized at a pressure drop of 200 to 300Pa·m<sup>-1</sup>, so the pressure drop through the PHE is equivalent to approximately 40m to 120m of straight heating pipework. The primary side pressure loss of the PHEs should be low enough for a single boiler primary (or ‘shunt’) pump to be able to circulate the water. A higher pressure drop across the PHE

or an increase in the design  $\Delta T_{LM}$  will usually result in a smaller heat exchanger.

Most modern high-efficiency boilers are designed to operate with a fixed operating temperature differential of 20K – for example 80°C/60°C or, for condensing operation, 70°C/50°C or 60°C/40°C. However, older heating systems were often designed to operate on an 11K differential – typically 82°C /71°C or 180°F/160°F. The PHE cannot, of course, increase the temperature of the secondary flow above that of the primary. However, the temperature of the secondary flow can reach to within 2K and 5K of that of the primary flow. In practice, the resulting reduced secondary-water mean temperature – compared with that of the original system design – does not cause problems in normal operation, as many old systems and their heat emitters are oversized, or buildings have undergone some refurbishment, so reducing the heating load from that when the building was originally built. The use of a PHE does not preclude the possibility of running the secondary system with a greater  $\Delta T$  to allow condensing operation of the boiler, but this would require that the existing heat emitters were able to meet the building loads at a lower mean water temperature.

Separating the primary and secondary circuits will mean that, during boiler maintenance, the requirement for draining down will be reduced, and the volumes of replacement, treated make-up water will be lower for the pressurised system, making maintenance simpler, quicker and less costly. The recommissioning of the pressurised system will also be completed more swiftly, as there will be less risk of air being introduced to the system because of the smaller system pipe network.

Properly applied and installed, PHEs can ease the integration and ensure effective operation of new boilers with existing systems. Using the PHE to decouple new high-efficiency pressurised boilers from the main distribution system can protect new boilers from the contamination likely to exist in legacy systems. This also allows the existing pipework infrastructure to remain in place, creating the opportunity for staged refurbishment while keeping the primary heat source in operation. Removing the boiler from the main distribution system will allow more control over the water quality circulating in the boilers, so improving boiler life-cycle operational efficiency, reducing maintenance and potential breakdowns, and maximising useful life.

The use of PHEs in commercial heating systems is reportedly growing<sup>3</sup> as

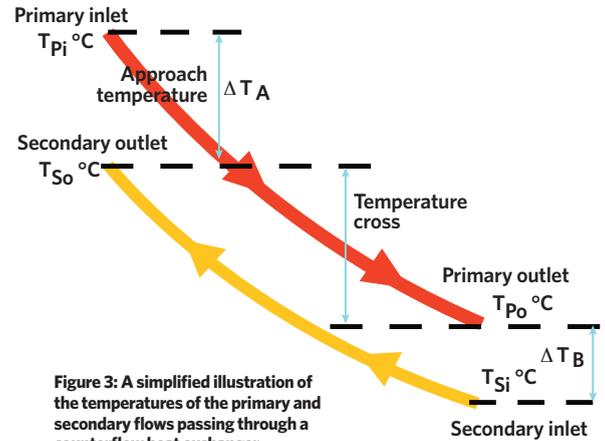


Figure 3: A simplified illustration of the temperatures of the primary and secondary flows passing through a counterflow heat exchanger

awareness about potential applications and benefits increases. There is a dearth of authoritative guidance in this specific application of PHE as a replacement for traditional low-loss headers, so the suggested benefits discussed here are reliant on the experience of manufacturers. Just a few years ago, the use of such technology in this application was extremely rare, but it has now expanded to the stage where a major manufacturer<sup>3</sup> reports that 50% of its commercial applications, where replacement boilers employ existing pipework, now include PHEs in the specification. This range of applications includes hotels, leisure complexes, schools and residential homes.

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Turn to page 66 for references.

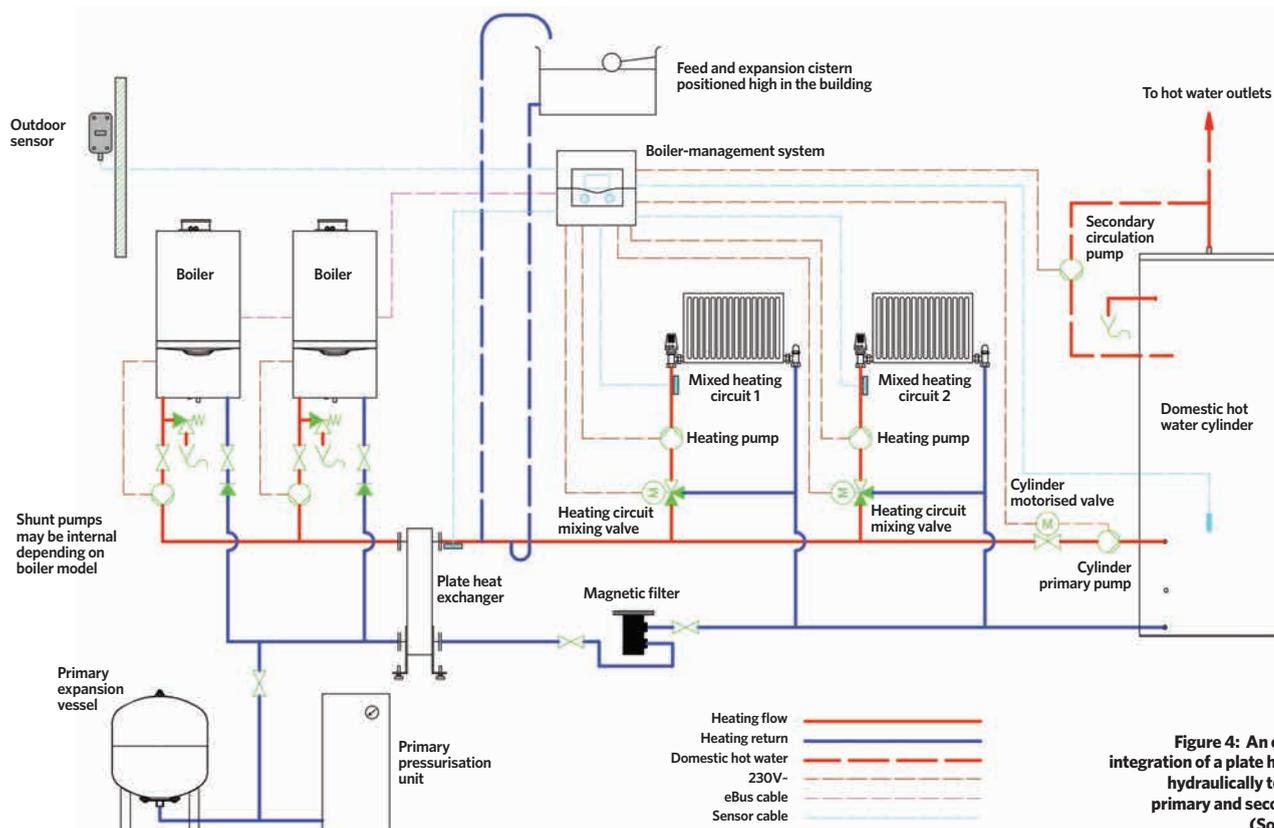


Figure 4: An example of the integration of a plate heat exchanger hydraulically to decouple the primary and secondary circuits (Source: Vaillant)

# » Module 108

February 2017

**1. In the sealed PHE, what is typically used to join the plates together?**

- A Brass
- B Copper
- C Epoxy resin
- D Gaskets
- E Laser welding

**2. Compared with a shell-and-tube heat exchanger, what heat transfer rate per unit area is quoted for a PHE?**

- A One or two times
- B Two or three times
- C Three or four times
- D Four or five times
- E Five or six times

**3. What potential approach temperature for a PHE is noted in the article?**

- A 1K
- B 2K
- C 3K
- D 4K
- E 5K

**4. Which of these is least likely when employing a PHE as shown in Figure 4, compared with a system that uses a low-loss header?**

- A During boiler maintenance, there will be reduced requirement for draining down
- B Following alterations or maintenance, recommissioning of a boiler circuit is likely to be quicker
- C It allows the secondary (main heating distribution) flow temperature to be at a marginally higher temperature than the boiler flow temperature
- D It reduces the amount of contamination in the water being circulated through the boilers
- E The secondary (main heating distribution) can be open-vented while the boiler primary circuit is pressurised

**5. According to reports from a major manufacturer, what percentage of commercial replacement boilers that employ existing pipework now include plate heat exchangers (rather than low-loss headers) in their specification?**

- A 10%
- B 25%
- C 50%
- D 75%
- E 90%

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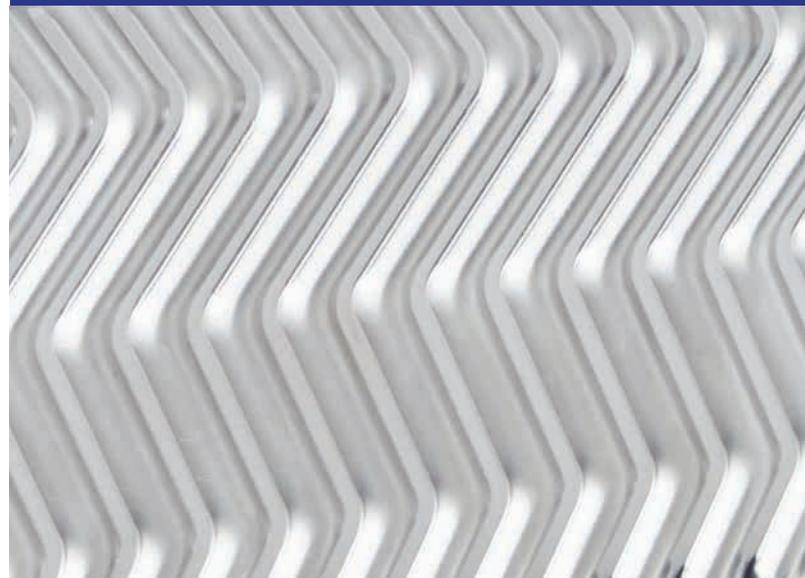
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### References:

- 1 ASHRAE *Systems and Equipment Handbook*, Chapter 48, 2016.
- 2 CIBSE Guide B1 *Heating*, section 1.13.4, CIBSE 2016.
- 3 Private communication from Vaillant.



# PRODUCTS & SERVICES



## ◀ Universal fan coil unit is truly reversible

Advanced Air has launched a new reversible fan coil unit, the design of which has many advantages, not least for the contractor who can now order fan coils without specifying the handing.

On most projects, the handing is not finalised until late in the design process, but many manufacturers cannot start production without this information. With this reversible and universal fan coil, however, orders can be accepted without the handings. This is particularly helpful on fast-track programmes, where handings may not be finalised until days before deliveries have to be made.

Advanced Air can start making – and even finish – fan coil units without the handings, because changing them only takes a few minutes in the factory, or it can be done on site by the contractor or specialist fitters.

■ Visit [www.advancedair.co.uk](http://www.advancedair.co.uk)

## ATAG Commercial called in for ▶ DIY SOS Big Build

Hundreds of tradespeople gave their time, services and materials to transform Blackpool Carers Centre in July 2016, as part of the *DIY SOS Big Build* for BBC Children in Need. This included ATAG Commercial, which donated two Q60 boilers that are supplying the building with highly efficient heating and hot-water services. The range of Q series boilers has been designed for larger homes and properties with high hot-water demands, and offers unrivalled levels of energy efficiency.

■ Visit [www.atagcommercial.co.uk](http://www.atagcommercial.co.uk)



## ✔ Complete super-condensing system for St James's Palace

The Colour Court courtyard, at St James's Palace – the official residence of the Queen – has been renovated several times since the Tudor period. Recently, however, Atlantic Boilers supplied full heating and hot-water systems to the six principal apartments located around the court.

Space heating is furnished by super-controlled silent Q-type condensing boilers, with negligible noxious effluent.

Domestic hot-water demands are met by six Atlantic Espresso plate heat exchanger-buffer vessel modules at minimum primary temperature, backed-up with immersion.

■ Visit [www.atlanticboilers.com](http://www.atlanticboilers.com)



## ◀ Thermal energy storage (TES)

TES is the temporary storage of thermal energy for later use, bridging the gap between energy availability and energy use. TES can reduce the chiller size by 50% simply by spreading the load over a 24-hour period.

TES reduces the running cost by using overnight lower ambient (possible free cooling) and lower electricity costs. It also offers smaller plant space and standby capability using +8-167°C phase change material containers for conventional HVAC&R applications.

■ Call 01733 245 511 or visit [www.pcmproducts.ne](http://www.pcmproducts.ne)

## World's first gas heat pump for domestic use now available in the UK ▶

Environmental Site Supplies (ESS) has launched the world's first gas heat pump for domestic and small commercial use. The Robur K18 is an 18kW mini gas-powered heat pump that offers temperatures up to 65°C for heating and up to 70°C for domestic hot water. It is aimed at larger or period domestic properties, and is ideal for schools, church halls and care homes. A hybrid version, with an integrated boiler, offers a 37kW output.

■ Call 020 8641 2346, email [info@roburheatpumps.co.uk](mailto:info@roburheatpumps.co.uk) or visit [www.roburheatpumps.co.uk](http://www.roburheatpumps.co.uk)



## ✔ HygroMatik offers CIBSE-approved CPD on humidification

HygroMatik, supplier of commercial air humidifier systems, shares its in-depth knowledge of controlled air humidification in a CIBSE-approved CPD titled 'Why humidify?'

The CPD presents humidification systems, including adiabatic and isothermal, and offers insights on indoor air quality and the relative humidity levels required in a range of environments – such as commercial offices, hospitals and museums.

It also showcases absorption distance charts and psychrometric graphs with easy-to-follow calculations.

■ Call 02380 443 127, email [info@hygromatik.co.uk](mailto:info@hygromatik.co.uk) or visit [www.hygromatik.com](http://www.hygromatik.com)



## ◀ Sontay offers more choice with its smart sensors

Sontay, supplier of field control peripheral devices, has expanded its range of high-quality smart communication sensors, to offer system integrators, contractors and building services consultants more choice. After the highly successful predefined range, launched last year, Sontay has created a 'build your own' sensor, with a variety of capabilities depending on the customer's budget and needs. The smart communication sensors start at £75 and the price rises as the proficiencies increase.

■ Email [sales@sontay.com](mailto:sales@sontay.com)

### ✓ Mikrofill at the Royal Exchange, Manchester

When the decision was made to refurbish the Royal Exchange, Manchester, part of the programme of works included pressurising the primary and secondary distribution pipework encompassing the theatre and office areas.

Lancashire-based Walsh IBS installed several pressurisation packages, consisting of the new Mikrofill 3 filling and backflow prevention device, suitable floor-standing expansion vessels, service drain valves, and a factory pre-commissioning.

■ Call 03452 60 60 20 or visit [www.mikrofill.com](http://www.mikrofill.com)



### ✓ Heat interface unit delivers impressive hot-water response

Evinox Energy's ModuSat heat interface unit (HIU) takes about 15 seconds to reach 55°C from the tap opening, offering impressive dynamic response. Using advanced proportional integral derivative (PID) control logic, with pressure independent control valves (PICVs) and a fast-acting actuator, the primary flow rate modulates to match the domestic hot water or heating demand, and responds instantly to the changing loads.

This ensures that end-user comfort is achieved, by providing consistent, safe hot water at the tap. The use of PID-controlled PICVs in HIUs means that only one valve is required for differential pressure control, flow modulation and full energy shut off. This reduces the size and weight of the unit, keeps maintenance costs to a minimum, and increases functionality.

■ Call + 44 (0)1372 722277 or visit [www.evinoxenergy.co.uk](http://www.evinoxenergy.co.uk)



### ✓ Award-winning Holophane 'consistently delivers'

Holophane was named Manufacturer of the Year at the 2016 Lux Awards. The judges said Holophane - which has been trading for 120 years - 'consistently delivers', is developing a suite of 'great' LED products, and is 'embracing the digitisation of lighting' with 'confidence and flair'.

Holophane has designed three international award-winning products - Haloprism, V-Max and High Mast Advanced Optix. All are manufactured at its head office in Milton Keynes.

■ Call 1908 649 292, email [info@holophane.co.uk](mailto:info@holophane.co.uk) or visit [www.holophane.co.uk](http://www.holophane.co.uk)



### ✓ Titon MVHR units enhance energy efficiency at Croydon high-rise

More than 160 ultra-efficient HRV 1.35 Q Plus units, from Titon, have been installed in an array of one-, two- and three-bedroom apartments at the Galaxy House high-rise project in Croydon.

The mechanical ventilation with heat recovery (MVHR) systems were specified by Axis Architects and installed by London-based Woodford Heating & Energy.

The high-capacity, HRV 1.35 Q Plus, continuously running MVHR unit is independently tested by the BRE and maintains an ultra-compact size despite its improved airflow performance.

■ Visit [www.titon.co.uk](http://www.titon.co.uk)



### ✓ Stannah's lift expertise recognised with award

Stannah was crowned Specialist Contractor of the Year at the Builder & Engineer Awards. It is a fitting accolade for the company's major projects and escalator and moving walkway teams, for their outstanding work on UK infrastructure projects, including at Birmingham New Street and Leeds rail stations.

The company - which has 81,000 assets in its national maintenance portfolio - celebrates its 150th anniversary this year, .

■ Call 023 8043 3348 or email [angela@b-v.co.uk](mailto:angela@b-v.co.uk)

### ✓ Sustainable homes feature Rehau heating and cooling

Rehau low energy heating and cooling solutions have been chosen for a development of sustainable homes in Lighthorne, Warwickshire. Rauvitherm pipework connects the nine properties to a ground-source energy collector under the road. A heat pump in each home is generating the low flow and return temperatures required for the Rehau underfloor heating systems. Rehau's flexible heating and plumbing pipework is also supplying hot and cold water.

■ Call 01989 762 600, email [Jo.Trotman@rehau.com](mailto:Jo.Trotman@rehau.com) or visit [www.rehau.co.uk](http://www.rehau.co.uk)



### ✓ Viega's new press-in connector for thick-walled steel pipework

Global manufacturer of press connection, prewall and drainage technology Viega has launched its new Megapress press-in connection in the UK. The system makes adding extra sensors, thermometers, drainage valves or pipe connections to thick-walled pipe installations fast, simple and clean.

Installation is completed in just two minutes, an estimated 80% time saving when compared to welding. The compact size of the connector also allows branches to be added in hard-to-access locations or where space is limited.

■ Visit [www.viega.co.uk](http://www.viega.co.uk)



Waterloo boosts its capacity to support customers

Buildings across the UK need the right air terminal devices to suit each room – and a major investment in its Kent factory by Waterloo Air Products has strengthened its ability to offer a reliable supply of the biggest range of standard and bespoke products available.

The investment has added an additional 1,000m<sup>2</sup> of space, with extra manufacturing workstations, additional warehousing for storing materials and finished products, and a revamped paint shop and packing area.

Call 01622 711 500 or email amie.hill@waterloo.co.uk



Thorn LED-ing the way for students

Thorn Lighting has supplied its Dyana and Alumet luminaires for use in the public area between new student accommodation at Holyrood Campus North, part of the University of Edinburgh. Designed by JMArchitects/Oberlanders Architects, HarrisonStevens Landscape Architects and RSP Consulting Engineers, the postgraduate student accommodation contains 950 en-suite bedrooms, a communal kitchen, four music rooms, a reception, a main common room and a private dining suite.

Visit www.thornlighting.co.uk



UFAC at 20 Soho Square on track to improve user wellbeing

AET Flexible Space has supplied underfloor air conditioning equipment at 20 Soho Square in London. It provided 25 CAM-C (DX) downflow units, plus Daikin heat pumps and 360 TU4-EC fan terminals, with the system installed over the building's seven floors. Fully conditioned (chilled or warmed) air is fed into the plenum by zonal downflow units, and then into the workspace via fan terminal units (Fantile), which can be adjusted by the users.

Call +44 (0)1342 310 400, email lucy@flexiblespace.com or visit www.flexiblespace.com



Evaporative cooling app from Condair

Condair, formerly JS Humidifiers, has developed an app that determines how much energy could be saved by using in-duct exhaust air evaporative cooling and a heat recovery system.

Using global weather data, the myCoolblue app calculates how much energy is needed annually to cool a building. Taking into account 10 years of historic weather data from more than 300 regions, the app projects how much cooling could be delivered using exhaust air evaporative cooling and how much would still need to be delivered using traditional mechanical cooling.

Visit www.condair.co.uk

Alpha is preferred partner for Aylesbury housing association

Vale of Aylesbury Housing has upgraded its old, inefficient boilers to Alpha's ARES Tec and ProTec boilers. Four servicing blocks benefit from 250KW ARES Tec's, complete with plate exchanger and safety kit. The ARES Tec incorporates self-contained modules, ensuring a greater transfer of heat. Each has its own down-firing, pre-mix burner, fan, ignition and safety controls, to assist in the changing demands of buildings with a number of different occupants. Two ProTec Plus commercial boilers have also been specified.

Visit http://bit.ly/2jwDnUO



New Ereba air-to-water monobloc heat pump delivers top COPs

CIAT Ozonair has introduced a new range of high-efficiency Ereba monobloc air-to-water heat pumps, ensuring low running cost and low carbon heating and cooling for homes and small commercial premises.

Based on a high-efficiency, two-stage rotary compressor, Ereba uses an inverter-driven DC motor to deliver heating efficiencies of up to 4.3 coefficient of performance (COP), certified by Eurovent, giving it an A+ efficiency rating. Units from 4kW through to 21kW are available from CIAT and Toshiba Air Conditioning.

Visit www.toshiba-aircon.co.uk

Grundfos IE5 motors are officially 'super'

Grundfos has introduced the new MGE, with IE5 efficiency. Selecting a pump with these motors incorporated will mean a 10% energy saving, as well as up to a 25% reduction in payback time.

The motors' efficiency exceeds the forthcoming IE3 legislative standards, meeting the strictest IE5 criteria – the highest energy efficiency level for electrical motors. New-generation Grundfos MGE motors – from 0.25kW to 11kW – now qualify as capable of attaining this 'super' status.

The key to MGE motors' performance lies in their state-of-the-art intelligent solutions, as these adapt to the surrounding system and, with the high-efficiency IE5 motor, drive down energy consumption.

All Grundfos MGE-motors in the range of 0.25kW to 11 kW now qualify for the IE5 classification, which came into effect on 1 January 2017.

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**The Triangle with George Fischer** ✓

Cambridge University's International Assessment Group is moving into new premises, where insulated pipework from GF Piping Systems has been specified to help maintain a comfortable indoor environment. The Triangle has been built by main contractor Bouygues, while Allied Mechanical Services was the M&E subcontractor installing the COOL-FIT 2.0 pipe systems that will carry chilled or low temperature hot water around the building.   
**Email [uk.ps@georgefischer.com](mailto:uk.ps@georgefischer.com) or visit [www.gfps.com/uk](http://www.gfps.com/uk)**



**Twin returns for maximum efficiency – introducing Varmax** >

Hamworthy Heating's stainless family, which grew in 2016 with the addition of the wall-hung Stratton mk2 boiler, now welcomes its newest member. The floor-standing Varmax is a powerful, ErP-compliant, all stainless steel condensing boiler, designed for applications with high output requirements. Its long-term reliability is ensured by high-quality, fully welded stainless steel heat exchangers that are less prone to corrosion caused by poor system water quality.   
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**Elementary, dear Watson! Autron LST radiators offer schools high outputs and low running costs**

Innovative aluminium and copper emitters in Autron low surface temperature (LST) radiators contain less than a third of the water found in a typical flat-panel emitter producing the same wattage. As a result, less energy is required to generate heat output. Heat also transfers to a room far quicker and in a more controllable way than with flat-panel radiators or underfloor heating, while the safe-to-touch casings make them ideal for schools.   
 Stepping Stones school, in Surrey, has benefited from the installation of Autron Sovereign LSTs throughout its new Undershaw building. As the former home of Sir Arthur Conan Doyle, the creator of Sherlock Holmes, the building is of marked historical significance.   
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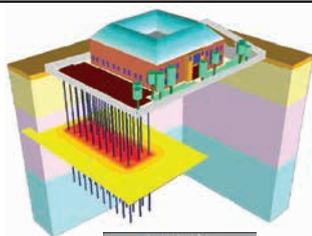
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## SENIOR MECHANICAL & ELECTRICAL BUILDING SERVICES ENGINEERS

Senior Mechanical & Electrical Building Services Engineers required to become part of a multidisciplinary design team at a privately owned building services consultancy in Iver, Buckinghamshire. The purpose built, environmentally friendly office complex is near to Langley main line station and within ten minutes of M25/M4 and M25/M40 junctions.

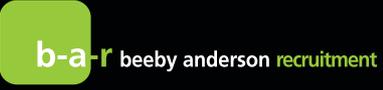
The company's portfolio include projects in healthcare, the MOD/Defence, Government, commercial, education, leisure, retail and residential development, and in the 20+ years they have been established they have built a number of strong and long lasting client relationships which have in turn generated a consistent flow of repeat business.

Within their structured growth plan, the employees are the focus of the approachable and passionate directors, and the opportunity to support and develop the team is the ethos of the business. By providing a technically engaging and varied portfolio of work they have cultivated a stable and happy team which provides a first class and fair service to their clients.

The positions are for articulate, clear thinking engineers who can adopt an environmentally friendly, practical and technically accurate approach to ensure the successful completion of each commission. The applicants will be degree qualified in building services or environmental engineering and electrical engineering as applicable and already be chartered or working towards it. Ideally they will be an accredited CIBSE Low Carbon Consultant with knowledge of renewable technologies. They should have a minimum of ten years' post-graduate experience within main stream consultancy and be able to take ownership for a wide variety of projects from preparing feasibility studies to undertaking complex designs within a whole range of buildings. They will have a practical approach to engineering, be familiar with Hevacomp and proprietary lighting design software and have a basic understanding of AutoCad. They will have the ability to take projects from conception to completion including site visits, attendance at meetings and taking financial control to meet client expectations.

The positions offer the right candidates an opportunity for real progression both professionally and within the company. Salary negotiable.

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For further information and to apply, please call us on **+44 (0)203 176 2666** or email [cv@b-a-r.com](mailto:cv@b-a-r.com)

### Associate Mechanical Engineer

**London, to £65k + bens**

A global CIBSE award winning client urgently seeks an Associate to strengthen their 60 strong MEP team. You must be hungry to progress, preferably chartered with 10 years' minimum experience and have a business winning personality. You will be required to build relationships with key clients including main contractors and developers, working on high profile, prestigious and challenging projects. Ref: 4124

### Principal Electrical Engineer

**London, £45 - £55k + bens**

Have you been thinking about finding a new challenge that presents the opportunity for personal development and progression? I have a strategic role that requires a forward thinking person who is passionate about innovative design in modern buildings and is keen to run their own teams and division. You will be an experienced engineer within Building Services who has a steady career history working for design consultancies. This position is a chance to work with one of the UK's leading engineering firms that have a highly regarded reputation for excellent project delivery and first class employee benefits. Ref: 4084

### Public Health Engineer

**City of London, £65 - £75k + bens**

An award winning international multidisciplinary consultancy are looking for a Public Health Design engineer to work on multi-million pound commercial, healthcare, laboratory, and university projects in the UK and overseas. You will play a major role in leading the dedicated Public Health department including future direction, you will work directly with key clients and closely with the CEO. This role offers a good salary, attractive benefits, and career development to board level. Ref: 4083

### Senior MEP Cad/Revit Tech

**West/Central London, to £55k + bens**

Outstanding opportunity evolving into BIM lead specialising in REVIT MEP within a consultancy established in the 70's. This is a multi-project sector position including exposure to global property management schemes. You will lead projects and mentor with support. You will be the layer between the design team and your own. Excellent package including travel to and from work. Ref: 4117

### Senior Mechanical Engineer

**London, £35p/h**

A London based CIBSE Accredited design consultancy are looking for Senior Mechanical Engineer to assist them on a residential mixed use development project. This assignment will last a minimum of six months with a strong possibility to extend under the right circumstances. You will need to be degree qualified and ideally be Chartered. Ref: 4108

### Senior Public Health Engineer

**Central London, £40 - £42 p/h**

An international consultancy that is at the forefront of building high performance buildings with a focus on sustainable design has created an opportunity for a Senior Public Health Engineer to join the well-established team in London. You will have the opportunity to work on some of the most iconic buildings across the globe that are pushing the boundaries of MEP design within the built environment. Ref: 4127

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Ref No: EDN04028.

Closing Date: 15 February 2017

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## Mechanical Engineer



Ref: LANCS07034

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37 hours a week - County Hall, Fishergate, Preston

This is an exciting and challenging role for enthusiastic and experienced Mechanical Design Engineers to provide innovative low energy mechanical design solutions.

We offer opportunities to work on your own engineering projects, such as boiler and heating replacements and to work as part of our in-house multi-disciplinary teams of Architects, Surveyors, Electrical and Structural Engineers.

We have a wide range of building projects including new schools, extensions, as well as major refurbishment and renewal of premises throughout Lancashire.

See further details including the role profile and person specification at [jobs.lancashire.gov.uk](http://jobs.lancashire.gov.uk) and search 'Environmental Services' under job type.

Benefits include a local government pension scheme, a generous holiday entitlement and flexible working hours.

**Informal discussion:** Please contact Neil Richards on 01772 533287 or Andrew Howorth on 01772 539770.

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# CIBSE JOURNAL



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**Senior / Associate Electrical Design Engineer - Oxford**

£50K to £70K plus excellent benefits

An internationally renowned MEP consultancy working on awarding winning projects is looking for a high calibre engineer with experience of database projects to join their prestigious office. The successful candidate will ideally be Chartered, or at least registered with the IET /CIBSE and have an exemplary career track record.

**Mechanical Design Engineer - Southampton**

£32k to £40k plus excellent benefits

An opportunity has arisen within a dynamic Building Services consultancy for a Mechanical Design Engineer. The successful candidate will join a reputable consultancy working on projects including educational, science and research and commercial projects. This is an opportunity to join a company that promotes continuous professional development and a positive working environment.

**Senior / Associate Mechanical Design Engineer - Oxford**

£45k to £60k plus excellent benefits

The new office opening of a well-established Building Services Consultancy offers the opportunity for a technically astute Mechanical Engineer. With an Electrical Director in-situ they are looking for an experienced Engineer to work within the industrial, residential, commercial and leisure markets. As the leading mechanical resource within this office candidates must be confident in their technical ability as well as having the gravitas to create and lead a team.

**Senior Mechanical Design Engineer - Bristol**

£40k to £48k plus excellent benefits

With a focus on dynamic sustainable design this consultancy offers their clients a truly contemporary service with state of the art BIM support throughout all stages of the design process. We are looking for a Senior Mechanical Engineer who is capable of working on a range of projects that include Medical Facilities, High End Retail, Educational Projects and Warehouses.

**Principal Fire Engineer - London**

£45k to £55k plus benefits

An award winning consultancy operating within the built environment is looking for a fire engineer to join their well respected team. Being 150 strong in London you will be a technically strong engineer capable of running your own projects and team. You will be someone who likes to think outside the box and create innovative fire engineering solutions. Both standard and flexible benefits package available.

**Sustainability Engineer - North London**

£28k to £32k plus benefits

A medium sized building services consultancy (50 strong) is currently recruiting for an engineer to join their sustainability team. Working in the residential and commercial sectors, candidates will need to be qualified and accredited in EPC for New Build and be strong users of IES. Candidates will gain an advantage if they carry qualifications for BREEAM, EPC Residential and Code for Sustainable Homes. The consultancy offers an excellent benefits package.

**Electrical Design Engineer - Bradford**

£38k plus pension

An opportunity for an Electrical Design Engineer is available to join a reputable Bradford based M&E consultancy on a permanent basis. They have over two decades of trading behind them and a talented team of 15, which allows them to work on multi million pound projects currently within the healthcare and education sectors.

**Principal Mechanical Design Engineer - Manchester**

£50k plus flexible benefits

A large multi-disciplinary consultancy, that have been operating for over 100 years, is looking to appoint a Senior/Principal Mechanical Engineer in their Manchester office. This role will allow you to put your own ideas in to practice and help develop and build the Building Services division in the North West.

**Associate Electrical Design Engineer - London**

£50k to £60k plus benefits

This architecturally led consultancy requires a strong project delivery expert to join their environmental team. Working on some of the most iconic projects in the UK and Middle East you will be technically strong with a keen interest in Revit and BIM. You will need to carry a minimum of 10 years' experience and be able to lead a team of multi-discipline engineers and sustainability experts. Desirable candidates will be chartered.

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For more information please contact [martin@conradconsulting.co.uk](mailto:martin@conradconsulting.co.uk)

Or, for a confidential chat, call us 8am to 8pm on **020 3159 5387**

## INTERNATIONAL AND NATIONAL EVENTS/ CONFERENCES

### CIBSE Building Performance Awards

7 February, London  
Join host Matt Dawson MBE, on the night to celebrate excellence and achievements in building performance, and network with more than 700 guests from across the built environment sector. Book your place now. [www.cibse.org/bpa](http://www.cibse.org/bpa)

### BIM Roadshow

23 February, Bristol  
1 March, Edinburgh  
From pre-concept to completion, BIM Roadshow will demonstrate real-world application of digital technologies and workflows. Dates through to May.

### CIBSE ASHRAE Technical Symposium

5-6 April, Loughborough University  
Booking is now open for the 2017 Technical Symposium, themed 'Delivering resilient high performance buildings'. More than 60 peer-reviewed papers will be presented over the two days. [www.cibse.org/symposium](http://www.cibse.org/symposium)

### CPD/MCC TRAINING

For more information, visit [www.cibse.org/mcc](http://www.cibse.org/mcc) or call 020 8772 3640

### Fire sprinkler systems: design

8 February, London

### Energy efficiency building regulations: Part L

9 February, Birmingham

### Building services overview

10 February, London

### Designing water-efficient hot and cold supplies

21 February, London

### Mechanical services explained

21-23 February, Manchester

### Building services explained

22-24 February, Birmingham

### Standby diesel generator

23 February, London

### Emergency lighting

24 February, London

### Energy surveys

3 March, London

### Electrical services explained

7-9 March, Manchester

### Energy efficient building regulations: Part L

8 March, Manchester

### Sanitary and rainwater design

8 March, London

### Electrical distribution design

9 March, London

### High voltage (11kV) distribution & protection

10 March, London

### Gas safety regulations

10 March, London

## ENERGY ASSESSOR TRAINING

For more information visit [www.cibse.org/events](http://www.cibse.org/events) or call 020 8772 3616

### Air conditioning inspector

8 February, London

### ISO 50001

31 January-2 February, Bristol

### ISO 50001

28 February-2 March, London

### Heat networks

1-2 March, Edinburgh

### Air conditioning inspector

16 March, Manchester

### LCC building operations and DEC

28 February-2 March, London

## CIBSE GROUPS, SOCIETIES AND REGIONS

For more information about these events visit: [www.cibse.org/events](http://www.cibse.org/events)

### North East: Technical meeting

7 February, Newcastle

Technical meeting with speaker Gareth Kane.

### East Midlands: Boiler factory visit

7 February, Newark

### ILEVE: LEV – extracting the best practices

7-8 February, Hinckley

A joint ILEVE and Chartered Society for Worker Health Protection (BOHS) two-day event, delivering insight and debate into topics affecting local exhaust ventilation control and its role in the reduction of industrial disease.

[www.cibse.org/ileve](http://www.cibse.org/ileve)

### West Midlands: Variable air control

8 February, Birmingham

Technical seminar with speaker Steve Law from Trox.

### East Anglia: Lighting and health

9 February, Suffolk

Presentation discussing relationship between light and health, with Henrik Clausen from Fagerhult Lighting.

### e-Luminate Cambridge

10-15 February, Cambridge

Supported by Society of Light and Lighting, the theme for the 2017 e-Luminate Cambridge Festival is 'play'.

### Home Counties North West and FM Group: Better building performance – collaboration, investigation, analysis, results

15 February, London

With speakers exploring a deeper understanding of users' needs; the FM

response; POE investigation, analysis and improvement.

### Home Counties North West and IET: Intelligent buildings – a surprising introduction

21 February, High Wycombe

Professor Derek Clements-Croome presents his latest research on whether intelligent buildings can offer alternative HVAC solutions.

### South West: Energy, policy and technology

22 February, Bristol

23 February, Plymouth

Ant Wilson, director of sustainability and advanced design, Aecom, will present on current energy consumption data, government and European policy, and update on available energy solutions.

### Merseyside and North Wales: The future of steam in the healthcare sector

23 February, Liverpool

With speakers Daniel Wells and Nigel Poole, of Spirax Sarco. The first 20 delegates will receive a free copy of *TMS8: Design and operation of modern steam systems*.

### SLL Masterclass

23 February, Manchester

30 March, Bristol

Continuing the lighting knowledge series, focusing on human responses to light.

### Home Counties North East: BIM Edge debate

28 February, London

With chair Dr Anne Kemp, and speakers Les Copeland, CIBSE, and Helen Taylor, RIBA.

### Home Counties North West and WiBSE: Work, career and inclusivity – you and the Equality Act

2 March, London

Seminar looking at the Equality Act.

### East Midlands: Annual dinner

3 March, Nottingham

With guest speaker Ian Irving.

### East Midlands: BIM update

7 March, Northampton

### West Midlands: LED lighting technology

8 March, Birmingham

CPD seminar, with speaker Roger Sexton, Xicato, and Thomas Bray, Holders Components.

## COMING SOON



Ant Wilson, Aecom Energy, policy and technology, 22 Feb



Les Copeland, CIBSE BIM Edge debate, 28 Feb

## Ecobuild

7-9 March, London

This free-to-attend conference and exhibition returns to ExCeL to showcase the latest products and technologies, while delivering a high quality conference and seminar programme.

Bringing the theme of regeneration to life, Ecobuild 2017 will be transformed into an 'immersive' city, complete with a main street, distinct destinations, and special feature attractions. Central to the experience will be Regeneration Drive, running through the middle of Ecobuild, linking different aspects of the exhibition and showcasing the very best examples of innovation and creativity from across the built environment.

CIBSE will be at the heart of the exhibition, with its stand situated right on the main street (stand number C191). CIBSE will be hosting one-to-one membership workshops and showcasing latest projects.

For more information and to register visit [www.ecobuild.co.uk](http://www.ecobuild.co.uk)

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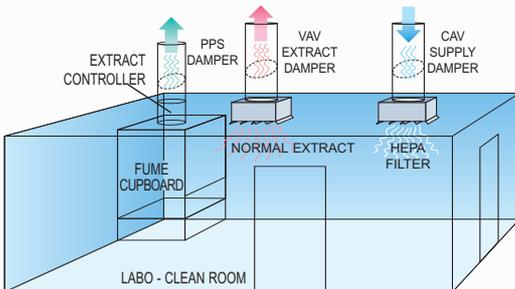


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