

# **CIBSE** **JOURNAL**

**#Build2Perform**

January 2018

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## No going back



Dame Judith Hackitt didn't pull any punches. In her interim review of fire safety in the aftermath of the Grenfell tragedy, she called for 'universal cultural change' in the construction industry. After four months leading the review, Dame Judith says she has been shocked by some of the practices she has heard about in the industry. 'The mindset of doing things as cheaply as possible and passing on responsibility for problems and shortcomings to others must stop,' she says.

There is a sense of urgency in Dame Judith's report and, despite it being an interim review, seven recommendations have already been made. She

says Building Regulations are not fit for purpose as they stand, and recommends they be structured to offer a more streamlined, holistic framework. Dame Judith acknowledges that this will take time, but has called on the government to simplify immediately the Approved Document Part B governing fire safety.

She says there needs to be a 'golden thread' for all complex and high-risk building projects, so that design intent is preserved through to operation. Industry is familiar with the concept of soft landings and the idea of a feedback loop from operation to design. Dame Judith's report will give this renewed impetus – especially as she says that responsibility for ensuring buildings are fit for purpose must rest 'clearly with identifiable senior individuals and not be wholly dispersed through the supply chain'.

Projects will require oversight throughout their life-cycle, and organisations – such as Hampshire County Council – that track projects from design to operation will attract keen interest (see 'Ready for take-off', *CIBSE Journal*, August 2017).

A recommendation that developers ensure there is a formal review and handover process ahead of occupation reinforces this view, and offers further motivation to ensure specifications survive the procurement process.

Dame Judith wants rigour applied to modifications and upgrades to complex buildings, and – during the next phases of her review – will look at how BIM could help digitise transfer documents.

The importance of worker competency is also highlighted in the report, which calls on professional and accreditation bodies to unite to establish a robust, comprehensive and coherent system covering all disciplines. Work on this will begin at a spring summit announced by Dame Judith.

It will start a process that, hopefully, ushers in a new era in which UK buildings become much safer and more efficient places to live and work.

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CIBSE's technical director looks at the impact of forthcoming data protection regulations



**Clara Bagenal George**  
How collaboration across the industry influenced the new London Plan



**Julie Godefroy**  
CIBSE's head of sustainability on what the EU Withdrawal Bill could mean for the environment



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## HSE launches network for construction

The Health & Safety Executive has launched the Construction Industry Advisory Network, to bring together a wider representation of organisations and workers from across the sector. It will also act as a platform for sharing good practice and will seek to 'reach and support' organisations that need to improve their health and safety.

## Heat network users pay less

End users supplied by heat networks pay less, on average, than other heating customers, according to the government's first heat network consumer satisfaction survey.

Carried out by independent researchers between April and July 2017, the survey asked consumers about their experience of systems, pricing and billing, and customer service, and received more than 5,000 responses.

It found 'significant variation' in the prices paid by heat network end users, but said they 'were likely to pay less than non-heat network consumers'.

'While there are issues affecting the sector that need addressing, heat network consumers were just as satisfied, overall, with their heating systems as non-heat network consumers', the survey said.

## Cundall's Esu is named young woman engineer of the year

Ozak Esu has won the Young Woman Engineer of the Year award from the Institution of Engineering and Technology (IET).

Based at Cundall's Birmingham office, the 26-year-old electrical engineer uses her free time to promote diversity, and tutors disadvantaged youngsters in maths. She was also recently named by *The Telegraph* newspaper as one of its 'Top 50 Women in Engineering under 35' and, earlier this year, jointly won the IET's Mike Sargeant Career Achievement Medal for Young Professionals.

As well as highlighting female engineering talent, the IET awards seek to find role models who can help address the UK science and engineering skills crisis by promoting engineering to girls and women.



# Industry told to collaborate on skills ahead of Grenfell summit

## Dame Judith Hackitt announces spring summit to address competency issues

Professional and accreditation bodies must come together to raise the levels of competency in construction, according to a key recommendation in Dame Judith Hackitt's interim review of fire safety following the Grenfell Tower tragedy.

The review states that raising levels of competence within the industry should be led by professional bodies. Work on a new system would be launched at a summit in early 2018, said Dame Judith, whose recommendation calls on bodies 'to demonstrate they are capable

of establishing a robust, comprehensive and coherent system covering all disciplines'.

Dame Judith said a system was needed to ensure competency was measurable and transparent, and offered a means of recourse for substandard work.

'This is a challenge to the current, less rigorous and disjointed approach to registration or certification, which allows many individuals to practise with questionable qualifications or without a requirement for competence to be assessed and accredited,' said Dame Judith.

The recommendation wants professional bodies to work together to 'develop a joined-up system covering all levels of qualification for relevant disciplines'. This will give a framework for regulation mandating the use of qualified professionals who can prove their skills are up to date.

Dame Judith added: 'I would ask these bodies to work together now to propose such a system as soon as practicable.'

Professions covered include: engineers; fire engineers; fire risk assessors; fire safety enforcing officers; building control inspectors; and those responsible for installing and maintaining fire-safety systems.



## Author of landmark report dies

Sir Michael Latham, author of the 1994 *Constructing the team* report into construction – and an Honorary Fellow of CIBSE – died in November. His report created the Construction Industry Board (CIB) and led to the Housing Grants, Construction and Regeneration Act 1996.

Sir Michael was elected MP for Melton in February 1974 and, after boundary changes, continued as MP for Rutland and Melton from 1983 to 1992. Before entering parliament, he worked for the Federation of Building Trades Employers – a forerunner of Build UK – and, after 1992, chaired: the CIB; the CITB Construction Skills; the Major Contractors Group; the Joint Industry Board for the Electrical Contracting Industry; Wilmott Dixon; and the European Construction Institute.

His funeral was held in Gretton on 20 November, which would have been his 75th birthday.

## Labour savages retentions abuse

The Labour Party has condemned the abuse of cash retentions by construction companies.

Bill Esterson MP, a member of the party's frontbench business team, said he was appalled by statistics – released by the Department for Business, Energy and Industrial Strategy – which revealed that small and medium-sized enterprises (SMEs) had lost £700m in retention payments because of upstream insolvencies in the past three years.

'This works out at almost £20m per month, £4.5m per week and £900,000 per working day,' he said. 'For an industry that

mainly comprises SMEs, to haemorrhage this amount of cash is truly shocking. It amounts to a massive drag on a key sector that is being encouraged by this government to invest in digital and manufacturing technologies.'

A private member's bill that requires cash retentions to be lodged in a deposit scheme will go before the House of Commons on 9 January. This was welcomed by Rudi Klein, CEO of the Specialist Engineering Contractors' Group, who said there was 'a real urgency to address this issue in light of the precarious financial position of some of the top UK contractors'.



## Grenfell review calls for 'universal shift in culture'

### Dame Judith Hackitt says regulatory system must be more robust

There needs to be a change of focus from doing work for the 'least cost' to ensuring buildings remain safe throughout their full life-cycle, according to the leader of the independent review of Building Regulations and fire safety in the wake of last summer's Grenfell Tower tragedy.

Dame Judith Hackitt has called for a 'universal shift in culture' across the construction sector to tackle the systemic failings that have been highlighted by her review. She has also criticised the complexity of the guidance documents used to support the regulations, which she said were flawed and overly detailed as a result of being 'created in silos'.

Speaking at the unveiling of an interim report into her committee's findings, Dame Judith said the regulations and guidance documents were well

intentioned, but were 'difficult to penetrate' and – as a result – open to misinterpretation. She told the BBC that there was an opportunity to make the regulatory system much simpler, so it would 'guide people to the right answer, rather than presenting them with all that information'.

This would be a key focus during the next stage of her review, added Dame Judith, who recommended that government should improve the clarity of Approved Document B, the regulation that governs fire safety, immediately.

She also said there needed to be renewed focus on managing buildings throughout their operational life, so that any changes to the original design do not compromise safety and performance.

'If you get it right first, that's a good start – but, even then, you have to have good systems in place to ensure change is managed properly,' she added.

### Industry responds to interim report

CIBSE has announced it is already looking to work with other professional bodies to address Dame Judith's call for a better system for recognising professional competence.

The Institution of Occupational Safety and Health (IOSH) commended the report's call for higher competency requirements. Shelley Frost, director of strategic development at IOSH, asked: 'Without adequate training, will someone know the importance of checking areas out of site?'

Local Authority Building Control chief executive Paul Everall supported the Hackitt recommendations and said: 'It was an indictment of the current system that building control surveyors may not know what is being delivered on site, by which supplier, or even how to identify it.'

## Dame Judith's recommendations

- Restructure Building Regulations and immediately improve clarity of Approved Document B, on fire safety
- Professional and accreditation bodies must establish a multidisciplinary qualification system to ensure those working on complex buildings are competent to do so
- Fire and rescue service advice should be taken into account by building control bodies, designers and commissioning
- Developers must ensure there is a formal handover process
- Building control must insist fire safety information is provided by the person completing the building work
- Fire-risk assessments should take place annually or after significant alterations
- Government should significantly restrict 'desktop studies'



## Senior individuals must be held to account

Those responsible for high-risk and complex buildings should be held to account for the commission, design and build of their projects, according to Dame Judith Hackitt's Building Regulations and Fire Safety interim report. It said: 'Responsibility and accountability must rest with clearly identifiable senior individuals and not dispersed through the supply chain.'

The report added that there should be a responsible 'duty holder', who can be held to account for the performance of 'all those to whom subcontracts are let at all stages in the life of the building'. There also needed to be a 'golden thread' for complex projects to ensure the original design intent is preserved and recorded, with any changes going through a formal review process with competent people who understand the key features of the design.

## Industry told not to rely on compartmentation

Fire safety in tall buildings should not be reliant on compartmentation, according to the interim report, which said there needed to be appropriate risk-mitigation measures in place in case compartmentation was breached during building use.

The report refers to extra staircases, smoke ventilation and sprinkler systems as possible fire-protection methods, and calls for the proper testing and certification of products, plus oversight of the quality of installation work.

Government should also 'significantly restrict the use of desktop studies' to approve changes to cladding, it added.

## Firm's urged to learn from workplace safety

The transformation of workplace safety should be a blueprint for an overhaul of the design, build and operation of high-rise buildings, according to Dame Judith Hackitt's interim report.

With an effective regulatory framework, Dame Judith – who was chair of the Health & Safety Executive (HSE) for 10 years – saw 'industry respond to the challenge of improving its performance in managing the safety of its workforce.'

She spent time in the chemical industry and said construction could learn lessons from this sector. Chemical projects had to be properly reviewed to ensure changes to specifications were properly managed, but the same systematic, controlled approach to construction was often absent, she said. 'There is plenty of good practice, but it is not difficult to see how those inclined to take shortcuts can do so,' added Dame Judith.

## Heat pumps pass 10 million mark

Latest figures from the European Heat Pump Association (EHPA) show that as many as 10 million heat pumps have now been installed throughout Europe.

Although heat pumps' share of the potential thermal solutions market remain 'modest', the EHPA said it was growing at increasing speed. They had already made a significant contribution to the energy transition, it added, as 'more heat pumps mean greener and smarter energy, fewer emissions and cleaner air'.

The installation of 10 million heat pumps equated to: 333GW of storage capacity; 165TWh of heat produced; 106TWh of renewable energy delivered; CO<sub>2</sub> reductions of 27.1Mt; and energy savings of 135 TWh.

'Today, we celebrate what we have accomplished so far – but, tomorrow, more heat pumps will be needed,' said EHPA secretary general Thomas Nowak. 'The new energy system will require further integration of technologies and sectors, and we need policy-makers to facilitate this change.'

## Big battery turned on

The world's largest lithium ion battery is now operating, to support the electricity grid in South Australia.

It was built by Tesla, whose founder, Elon Musk, claims the 100MW battery is three times more powerful than any other battery operating today.

'This is history in the making,' said South Australian Premier Jay Weatherill, adding that the battery would prevent a repeat of an incident last year, when the whole state was left without power.

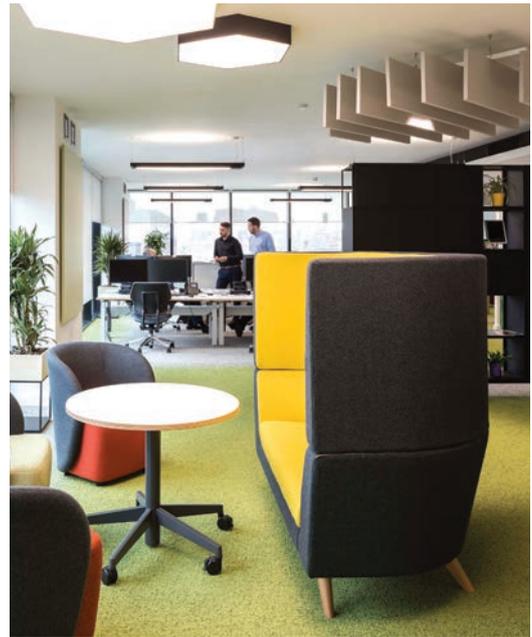
## HILSON MORAN DOES WELL

Hilson Moran's new Manchester office is the third UK building – and the first outside London – to achieve the Well Certification Gold standard.

The Well standard is a performance-based award system that measures how a project's design and operations can benefit occupants' health and wellbeing.

Hilson Moran's office earned its rating based on seven categories of building performance: air, water, light, nourishment, fitness, comfort and mind. A 'great deal of emphasis' was also placed on the look and feel of the interior space, said the company.

The reduction of volatile organic compound emissions from fit-out materials is a key requirement of the standard, and air quality is monitored continuously for pollutants and CO<sub>2</sub> levels. Hilson Moran's in-house team also used digital modelling to reduce noise levels.



## BEIS backs facility for digital Britain

### Centre to support delivery of government's Digital Built Britain Strategy

The government is investing £5.4m in a new centre of excellence for digital solutions in the built environment. The Centre for Digital Built Britain is a partnership between the Department for Business, Energy and Industrial Strategy (BEIS) and the University of Cambridge,

'to support the transformation of the construction sector using digital technologies to better plan, build, maintain and use infrastructure'.

It will have a particular focus on the digital tools, standards and processes that make up building information modelling (BIM), and will continue the work of the Digital Built Britain Programme and the UK BIM Task Group.

BEIS said the centre will 'support delivery of the government's Digital Built Britain Strategy', which seeks to 'digitise the entire life-cycle of our built assets, finding innovative ways of delivering more capacity out of our existing social infrastructure, dramatically improving the way these assets deliver social services, for improved capacity and better public services'.



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# Government pledges £600bn for infrastructure projects

## Programme aims to 'skill up and scale up' the industry for challenges ahead

The government has announced a £600bn programme of infrastructure and construction projects, plus a plan to boost the industry's productivity that could result in savings of £15bn a year.

Its latest National Infrastructure and Construction Pipeline has added £100bn to the 2016 version of works planned for the next decade in the public and private sectors.

Andrew Jones MP, exchequer secretary to the Treasury, said this amounted to a record infrastructure investment and that the government was working with the industry 'to skill up and scale up for the challenges ahead'.

The government accounts for a quarter of all construction projects, and said it will use this purchasing power to 'drive innovation and encourage firms to invest in modern methods and technology', to improve their productivity. Its Transforming Infrastructure Performance

programme was launched alongside the pipeline and explains how the government aims to help construction improve its performance to streamline delivery of the projects.

'Off-site manufacturing... can reduce waste by 90% and speed up delivery times by more than half,' explained the government. 'A school that typically takes a year to build could be done in just over four months.'



## Cash boost to cut costs and emissions

As part of its Industrial Strategy, the government has agreed to invest £170m over three years to help the construction industry commercialise building engineering technologies and improve productivity - so that it can deliver better-quality housing and infrastructure.

The money, plus £250m from the sector, will help realise the ambition of cutting construction costs by a third - and greenhouse gas emissions by 50% - by 2025, said Business Secretary Greg Clark. 'The agreement embodies our vision for a modern Industrial Strategy, with government and industry working together towards the common goal of higher productivity and a more skilled workforce, with more earning power,' he added.

Clark said poor productivity was holding back economic growth and that the strategy would address 'the weaknesses that stop us achieving our potential', and support the 'five foundations of productivity: ideas, people, infrastructure, business environment and places'.

## Chancellor in push for off-site manufacturing

More off-site construction will be used in public infrastructure schemes from 2019, after a pledge made in November's Budget.

'The government is taking steps to improve the cost-effectiveness, productivity and timeliness of infrastructure delivery, [and] will use its purchasing power to drive adoption of modern methods of construction, such as off-site manufacturing,' a post-Budget statement announced.

The Chancellor, Philip Hammond, said the departments for transport, health, education, justice and defence would adopt 'a presumption in favour of off-site construction by 2019 across suitable capital programmes, where it represents best value for money'.

## HS2 and housing to help market rebound

Construction output is expected to bounce back in the new year, despite a major dip in the third quarter of 2017.

Government figures showed a fall of 1.4% in activity in the three months to October last year, but future orders are looking healthy as a result of public infrastructure and housing contract awards. HS2 helped to push future work figures up by 37% - the highest quarterly surge since 1987. There was also a nearly 10% rise in new housing orders, after a fall of more than 4% in the previous quarter.

These promising signs follow almost six months of falling construction output because of a contraction of the commercial market, and a fall in refurbishment and maintenance work.

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# Passive design to halve energy use in Omani city extension

## Masterplanner claims Madinat Al Irfan will be blueprint for low carbon cities

A new city extension for 280,000 people in Oman is set to halve energy and water use at no more than the 'business as usual' cost.

Madinat Al Irfan, near Muscat, will be built using traditional Omani design principles to reduce the need for mechanical cooling in buildings and take cars off the road.

Masterplanners Allies and Morrison and Arup have introduced narrow streets and a requirement for extension shading to encourage people to walk between homes, shops, colleges and businesses.

Design codes for developers require that window-to-wall ratios be no higher than 20% for all buildings, unless solar gain is mitigated through shading or low G-Value glass.

Consultant Chris Twinn FCIBSE was adviser



to the client, the Oman Tourism Development Company. The masterplan brief included four key metrics: double the area of gross floor area through dense urban form; and cut car, water and energy use against 'business as usual'.

Building is set to start on Irfan by 2019.

■ See case study on page 24.

## Movers and makers



**Phil Draper** will join Cavendish Engineers as operational director, to enhance its technical and energy sector

offerings. He was senior technical and sustainability manager at Broadgate Estates – where he had been since 2011 – and, before that, was a design engineer at EP&T. Draper played a key role in a number of CIBSE award wins and finalists at both firms.



**Gavin Dunn** is to take over as CEO of the Chartered Association of Building Engineers (CABE) in April,

on the retirement of John Hooper. Dunn has been a member of CABE since 1999 and was appointed to the board in 2014. He is currently an executive director at BRE, where he is responsible for its building-performance business.

**Sweco** engineering, environment and design consultancy has expanded its London office to support business growth.

The company, which now has 25 employees in the capital after opening in 2015, has relocated to new offices in Farringdon. It plans to double its London headcount to 50 in the coming year.

The new office will offer a full range of multidisciplinary services across buildings, transportation, energy, environment, asset management and water.

**Colt**, a specialist smoke-control, ventilation and climate technology contractor, manufacturer and maintenance company, has relocated its offices and factory to new premises in Havant, Hants. The 50,000ft<sup>2</sup> facility contains a range of sheet-metal-working machinery, as well as Colt's fabrication and assembly machinery for smoke-control vents, louvres and dampers.



## UK TEAMS LEAD ON WORLD'S LARGEST BOTANIC GARDENS



UK-based consultancies Arup, Grimshaw and Haley Sharpe Design (hsd) are delivering the engineering, landscaping, architecture and interpretative designs for the new Oman Botanic Gardens. Covering more than 420 hectares, the project – in the foothills of the Al Hajar mountains – includes two biomes and is aiming for LEED Platinum status. The ancient seabed is still visible on the site, and Arup and Grimshaw have worked with the existing natural ridges and ravines to design the buildings and walkways.

## A new twist on clean air

A new Nuairie product aims to simplify the way air pollution is kept out of homes.

The IAQ-Valve combines a standard MVHR supply air valve with a carbon filter, in a ducted ventilation system. Polluted air passes through the G3 filters inside the MVHR system, where particulates, pollen and dust are removed. This air then goes through the carbon filter valve on the supply leg of the ducting. Nuairie claims the filter valve can capture up to 91% of NO<sub>2</sub> and other harmful pollutants, and says a 'twist and clip' bayonet fixture means it's easy to maintain.

## FG brings Midea to UK

Midea air conditioning products are being made available in the UK, thanks to FG Europe's exclusive distribution deal with the Chinese manufacturer.

From February 2018, Midea will offer a full range of low-global warming potential (GWP) R32 refrigerant, split and multisplit products.

Through FG Europe's MI Partner programme, Midea products will come with a 10-year warranty. FG's UK offices, in London and Newcastle, will also make a contribution to first-year service costs.



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## IN BRIEF

### New digital engineering modules

Three new digital engineering (DE) online learning modules have been launched by CIBSE. They are designed to enhance the knowledge and abilities of engineers and technicians working digitally in all aspects of BIM and digital engineering.

Each module – DE1: Pre-Qualification Questionnaires; DE2: Employer's Information Requirements; and DE3: BIM Execution Plans – offers two hours of training content. Six further modules will be released in 2018.

On completion of all nine DE modules, learners will be awarded a certificate in CIBSE Basics of BIM. CIBSE is offering *Journal* readers up to 45% off the new modules. Find out more at [www.cibse.org/DE-launch](http://www.cibse.org/DE-launch)

### Inclusivity goals

The CIBSE Board has approved the Inclusivity Panel's proposed goals for the coming year.

These are: improving awareness and understanding of inclusivity and diversity across CIBSE and embedding these concepts within the Institution's strategic aims; improving the breadth and quality of data captured about 'protected characteristics' from both staff and members; and increasing the proportion of female members and registrants.

These aims have been chosen to give a mix of 'quick wins', long-term capacity building and – in the case of the third goal – targeted actions to address a particularly acute issue.

The panel is now developing specific actions against each of these aims. The finalised action plans will be submitted to the board for review and approval in January.

### Let's be friends

The CIBSE Facebook page has been launched – hoping to be a hub of interesting, on-the-pulse content to browse on the go.

CIBSE will be bringing you articles, industry news, videos, polls, debates and events that we think you're sure to 'Like'.

Find us at [www.facebook.com/CIBSE](http://www.facebook.com/CIBSE) and like our page.

# Hanbury shines at Young Lighter of the Year

## Finalists Amir Nezamdoost and Seren Dincel also recognised

Matt Hanbury, founder of Lightly Technologies, has been named Society of Light and Lighting (SLL) Young Lighter of the Year 2017.

The announcement was made at the Lux Awards 2017 dinner in November.

Hanbury impressed the judges with his presentation and paper, *Ultra-thin surface light sources: Picking up where OLED stalled*, during the LuxLive exhibition. He also took the prize for the best-presented paper.

Other finalists included Amir Nezamdoost, who won the Best Written Paper Award for his paper *A new manual blind-use pattern for annual energy and daylight simulation*, and Seren Dincel, of AF Lighting, with her paper *City lighting in Scandinavia – design approach and methodology*. Each finalist gave their 15-minute presentation to a full audience at LuxLive on 16 November.

Judging the awards were Mark Sutton Vane, on behalf the Lighting Education Trust (LET); Dr Peter Boyce; John Aston and SLL president-elect Iain Carlile.

Now in their 23rd year, the awards offer a unique platform for young lighters to illustrate their knowledge and research on a lighting subject, hone their presentation skills, and raise their profile within the industry.



From left: Comedian and Lux Awards host Hal Cruttenden; SLL president Richard Caple; Young Lighter Matt Hanbury; and Mark Sutton Vane, judging on behalf of the LET

## Calling all young lighters

Entries are now open for the 2018 Young Lighter of the Year competition. The contest, open to anyone with an interest in light and lighting, acts as a forum to help promote young people.

The winner receives £1,000, with a second prize of £250 for best paper, and £250 for best presentation.

Anyone under 30 years old on 11 May 2018 – the deadline for entries – is invited to take part.

For details email [sll@cibse.org](mailto:sll@cibse.org)

## LR&T stalwart Peter Boyce is named Lux Person of 2017



Dr Peter Boyce, the long-serving editor of the lighting industry's peer-reviewed journal *Lighting Research and Technology (LR&T)*, was named Lux Person of the Year 2017 in recognition of his outstanding contribution to lighting research.

Over a 50-year career in lighting research, Boyce has become a world authority of the interaction of people and lighting. Author of the seminal work *Human factors in lighting*, as well as numerous papers, article and book chapters, his insights have informed standards and practices for decades.

He is a Professor Emeritus at Rensselaer Polytechnic Institute in Troy, New York, where he conducted research on: visual performance; visual comfort; circadian effects; emergency lighting; perceptions of safety; and lighting for driving.

Boyce is a fellow both of the Society of Light and Lighting, and of the Illuminating Engineering Society of North America, and, in 2008, took up the editorship of the quarterly journal *LR&T*.

SLL president Richard Caple said: 'It was most fitting to see Dr Peter Boyce receive this award. A person that has contributed so much to the lighting industry, and who has influenced directly – or indirectly – most lighting people at some time. A highly worthy award winner.'

*LR&T* is available free to CIBSE members at [www.cibse.org/knowledge](http://www.cibse.org/knowledge)



## Yorkshire Awards 2017 winners

**Project of Year - Education**  
(sponsored by Toshiba Air Conditioning)  
Couch Perry Wilkes,  
Worsley Building

**Project of Year - Sport and Leisure Award (DSSR Consulting Engineers)**  
MRB Consulting Engineers,  
Yorkshire Event Centre

**Commercial and Industrial Project of the Year (Brentwood Design Partnership)**  
LEDA, Little Kelham

**Chairman's Choice Award (Hoare Lea)**  
The University of York,  
nominated by NG Bailey as Client of the Year

**Manufacturers' Award (Asset Wisdom)**  
Airedale, Artus hybrid, low energy, fan coil unit

**Contractor of the Year (Anderson Green)**  
Mansfield Pollard

**Collaborative Working Partnership (SES)**  
Waldeck Consulting

**Small Consultancy of the Year (Glen Dimplex Heating and Ventilation) LEDA**

**Large Consultancy of the Year (Ideal Commercial Boilers)**  
Hoare Lea

**Graduate Engineer of the Year Award (MRB Consulting Engineers)**  
Anastacia Kruglova

**Highly Commended: Kieran Lean and Grace McMahon**

**Young Engineer of the Year Award (Silcock Leedham Consulting Engineers)**  
Emily Marnar

**Student Award (Calibre Search)**

■ Sarah Lumb, University of Northumbria

■ Zack Taylor, Leeds Beckett University

■ Jessica Ritchie, The University of Leeds

■ Cameron Noman, Leeds College of Building

■ Florence Maskell, University of Sheffield

■ Nick Darling, Brunel University London

# Double wins for LEDA and Couch Perry Wilkes

**Colin Wilson and Steve Goodhead also get CIBSE medals**

LEDA and Couch Perry Wilkes each won two awards at the second CIBSE Yorkshire Awards, which also saw Hoare Lea retain its Large Consultancy of the Year crown.

Nearly 400 people attended the event at New Dock Hall in Leeds in November, where the focus was on celebrating the achievements of the Yorkshire building services industry.

Trophies were awarded to young and graduate engineers, who had stood out from their peers, as well as awards for projects, small and large consultancies, students, manufacturers and contractors.

Kayley Lockhead, from STEER Group, discussed its mentoring programme to help retain construction students in the industry and support them into their first roles.

Martin Brown talked of restorative sustainability, and fulfilled his role of provocateur by asking the audience to 'imagine if every act of construction made the world a better place'.

Peter Head, executive chair at EcoSequest Trust, spoke of his work, which includes raising US \$150m to re-green the Sahara desert and ensure global sustainable development goals are achieved by having a demonstration region in each of the 200 countries signed up to the agreement.

Rounding up, he asked if Leeds would want to be that region for the UK - a call answered by Tom Riordan, CEO at Leeds City Council, by Twitter, suggesting they should meet.

Retiring committee members Colin Wilson and Steve Goodhead were both recognised for their work and service to the region, with a CIBSE Silver and Bronze medal respectively.

Simon Owen, CIBSE Yorkshire chair said: 'The awards are about outcomes and celebration. Kayley has had more than 40 offers of help, Leeds could be a demonstration region, and Martin has got a lot of people looking at what they do differently.'

'Not only that, we've raised more than £2,400 for our charities, and shown that the industry has a lot to be proud of.'



LEDA collects the Commercial Industrial Project of the Year Award from Jonathan Goodliffe of Brentwood Design Group



Airedale received the CIBSE Yorkshire Manufacturers' Award for the Artus hybrid, low-energy, fan coil unit, from June Lancaster of Asset Wisdom

# Trio of new titles published by Institution

## Three publications to assist engineers in building design and management

CIBSE has recently published three new titles – available to download for free to CIBSE members – on building in cold climates, competency in facilities management and variable refrigerant flow air conditioning.

The new publication *Buildings for extreme environments: Cold climates* is the last of a three-part series reflecting different climate zones, with the other publications covering arid and tropical climates.

With an ever-increasing number of our members working on international projects, or based in locations unfamiliar to them, these documents offer an introduction and give information upon which reasoned judgements may be made or lead to further research being undertaken in support of their professional duties.

*KS21 Competency and competency management systems in facilities management* focuses on the management of building engineering systems in operational buildings.

Management of our existing building stock is suffering from a decline in skilled staff entering the industry. Legislation calls for competent persons to manage risk, but the term competence is rarely clearly defined, creating a corporate dilemma.

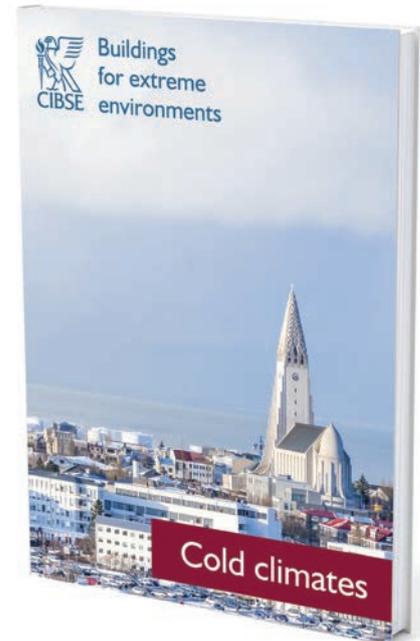
The organisation retains responsibility, and needs to be able to demonstrate its compliance, and competent staff are required to do this. The aim is to demonstrate how to review and apply effective management of competency, which is scalable to any size of organisation.

The KS was prepared by a sub-group of the CIBSE Maintenance Task Group, in association with the CIBSE Facilities Management Group.

*The Guide to variable refrigerant flow (VRF) air conditioning* has been co-produced by CIBSE and the Institute of Refrigeration (IoR).

Manufacturers provide assistance by publishing comprehensive engineering documents and software for their products and systems, but design engineers need to understand the principles of how they work, how to select the best match of indoor and outdoor units, how to size and design refrigerant distribution systems and how the systems can be best commissioned, operated and maintained.

Specifically, the publication offers: an understanding of the technology and its applications; explanations of the differences between VRF and alternative technologies; information on the availability and comparability of systems; information on calculations; and guidance on achieving energy efficient systems; and information on maintenance, training and resources.



■ Copies of all publications can be found on the CIBSE Knowledge Portal at [www.cibse.org/knowledge](http://www.cibse.org/knowledge)

# CIBSE updates its Code of Professional Conduct

As a professional engineering institution, CIBSE sets high standards for its members. On joining CIBSE, all members commit to abide by the Code of Professional Conduct.

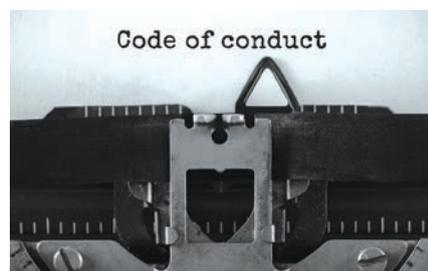
The Code is designed to uphold the dignity and reputation of the profession and to safeguard the public interest in matters relevant to the art, science and practice of building services engineering.

In 2017, the Professional Conduct Committee undertook a review of the Code to ensure it remains relevant. This version includes a clause based on the Engineering Council's statement on whistleblowing to offer better support and clarify employers' obligations. The updated code can be found at [cibse.org/codeofconduct](http://cibse.org/codeofconduct)

The CIBSE Code of Conduct is supported by the best practice outlined in the guidance from the three organisations below:

## Royal Academy of Engineering statement of ethical principles

This statement was produced through



discussions with engineers from a number of different engineering institutions and with philosophers specialising in applied ethics. It is intended to be a statement of the values and principles that guide engineering practice and the codes of practice published by the participating engineering institutions. For details visit: [raeng.org.uk/publications/reports/statement-of-ethical-principles](http://raeng.org.uk/publications/reports/statement-of-ethical-principles)

## Engineering Council guidance on whistleblowing

This guidance is intended to support engineers and technicians when confronted by a

potential whistleblowing situation. It sets out the processes engineers and technicians should follow in raising such a concern and where to get advice. For details visit: [engc.org.uk/whistleblowing](http://engc.org.uk/whistleblowing)

## Construction Industry Council's essential principles for built environment professionals

The *Essential Principles Guide* is an initiative that emerged from the Built Environment Professional Education project in March 2017. It contains six principles to guide, support and motivate all built environment professionals when making decisions for clients, employers and society, which affect the achievement of an inclusive environment. For details visit: [cic.org.uk/networks-and-committees/essential-principles-guide.php](http://cic.org.uk/networks-and-committees/essential-principles-guide.php)

■ At the July 2017 meeting, the Board approved a change to the Professional Practices Committee, re-naming it the Professional Conduct Committee (PCC).



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# A new frontier for data

The probable impact of the forthcoming data protection regulations on technical products and services is beginning to emerge, says Hywel Davies

The pace of technological change continues to accelerate. Nearly 50 years ago, Neil Armstrong took that ‘giant leap for mankind’, and today’s smartphones pack more computing power than an Apollo spacecraft.

In the 20 years since the UK passed the current Data Protection Act, we have seen the explosive growth of email, the worldwide web and the internet, and the rise of social media – all driven by faster and faster connectivity, powering smartphones, tablets and services.

The nature of developing technologies, such as artificial intelligence and machine learning, suggests continuing transformation and further, faster change will be the norm. Cloud computing and the Internet of Things (IoT) are increasingly common in everyday applications. Into this landscape come the European General Data Protection Regulation (GDPR) and the UK Data Protection Bill, which is before parliament and which enables the UK information commissioner’s functions, a direct-marketing code of conduct, and other related purposes.

The UK has triggered Article 50 and – though we don’t yet know the nature of our future relationship with the EU – it is certain to involve businesses in the UK and the EU trading with – and holding data about – each other. So we will have to engage with GDPR and the UK legislation – and GDPR comes into effect on 25 May 2018, when the UK will still be in the EU.

GDPR applies to organisations outside the EU that offer goods or services to individuals in the EU. To use a well-known example to CIBSE members, therefore, it applies to ASHRAE processing data about European members.

So why do we need to pay attention? GDPR moves processing of personal data onto a more rigorous level and gives people more control over their data. According to the Information Commissioner’s Office (ICO), ‘personal data’ means any information relating to an identifiable person who can be directly or indirectly identified from an identifier. This definition covers a wide range of ‘personal identifiers’, including name, identification number, location data, or online identifier, reflecting changes in technology and the way organisations collect information about people. It could also cover images on security systems.

A large business that issues people with smart access cards to move around a corporate office, and collects data on who went where and when, is collecting personal



“Anyone handling personal data needs to think about how they will comply”

data. The data subjects have a right to access that information, and need to give their consent to it being collected. If it is a multi-tenanted office, and the data is collected by the landlord, the employing tenants may need a contract to access the data. When someone leaves – and their access rights are withdrawn – great care will be needed, especially if their leaving is not by mutual consent.

There is a new ‘right to be forgotten’. While this is intended to allow people to have material removed from social networks – perhaps because of embarrassment – or to erase an unwanted past association, it applies to anyone who has had data collected on them with their full consent.

A domestic smart energy meter is collecting personal data. If this is processed by a third party for the utility company, they must have a clear contract that covers all aspects of the use, protection, retention and disposal of the data. If the processor falls short, the utility will be liable, just as if it had fallen short.

If the meter data collector suffers a breach involving personal information, there are strict rules for disclosure – not just to the utility firm, but to customers whose personal data may have been compromised and the ICO. And the deadline is short: in many cases 72 hours.

So what about the IoT? By 2020, 20 billion devices will be connected to it, and many of these will be collecting personal data. This may be pattern-of-use data, which reveals an individual’s personal routine, showing when a home is likely to be vacant. While this is not new, the right to require that data to be removed is – so those developing systems to collect personal data will need to work out how they comply with GDPR.

Finally, GDPR applies to automated and manual filing systems holding personal data – including those where data has been pseudonymised or key-coded, if the coding can be worked out. This means data collectors with large data sets that may be of value for statistical research – such as the major energy-use databases used for energy epidemiology studies – will need to be reviewed carefully, to ensure they do not fall foul of the GDPR.

The regulation comes into force in May and there is no option for postponement. Anyone handling personal data needs to think now about how they will comply – there is no time to lose.

For much fuller guidance on GDPR see [bit.ly/2A10ayF](http://bit.ly/2A10ayF)

For a checklist of 12 immediate things to do, see [bit.ly/2deJ72T](http://bit.ly/2deJ72T)

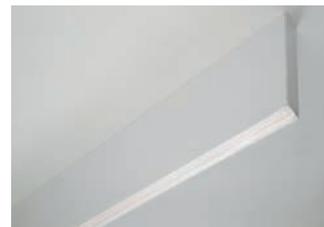
**DR HYWEL DAVIES**  
is technical  
director at CIBSE  
[www.cibse.org](http://www.cibse.org)



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# Achieving a green Brexit

The Withdrawal Bill could weaken the standards protecting our environment as 80% of environmental regulations derive from the EU, says Julie Godefroy

What Brexit means is becoming clearer, and the Withdrawal Bill shows it is not only a matter of politics, but also of engineering principles and environmental regulations. Serious concerns about the bill – including a lack of scrutiny by parliament and the civil society, lower environmental standards and reduced environmental governance – have been raised by environmental and legal organisations, including ClientEarth<sup>1</sup> and the Public Law Project.

In the UK, 80% of environmental regulations derive from EU legislation. Under the current Withdrawal Bill, most of these regulations would be treated as secondary legislation, which is meant to cover ‘small’ legal and technical issues and can be modified by government and civil servants without much debate by parliament and the wider society. This sounds far from the promise that Brexit would bring control back from opaque, distant EU bodies. Decisions may be made without guarantee of impartial advice; they would also be subject to political manoeuvring and electoral cycles, rather than the long-term view and cross-border collaboration required on many environmental issues.

In the series of court cases on air pollution successfully brought by ClientEarth against the UK government<sup>2</sup> for failing to meet obligations under the Air Quality Standards Regulations 2010, for example – with amendment of the regulations being possible via secondary legislation – theoretically, a government might simply attempt to amend air quality objectives with minimal parliamentary or public scrutiny, rather than acting to reduce levels of particulate matters or NO<sub>x</sub>. There is no suggestion that the government is planning such changes, but it illustrates the potential impact of the bill.

Another concern is that the bill could lead to a reduction in standards by failing to retain all EU environmental law, and by removing the wider framework for UK law.

There has been a concern the UK has not properly implemented the Energy Performance of Buildings Directive.<sup>1</sup> Upcoming revisions, even if they come into force before we leave the EU, are likely to be missed too.

In addition, the Withdrawal Bill does not retain elements of the EU Treaties, which are fundamental in setting the context and wider objectives for legal decisions and future law-making, in particular the precautionary principle and polluter-payer principle. It means that, in the future, a UK court could, in theory, rule that the



“Removing the precautionary principle would be a downgrade in standards”

precautionary principle is not written into UK law, so is not binding.

This matters symbolically – the practical application of the precautionary principle is sometimes disputed but removing it without alternative or justification would be a downgrade in standards for the protection of the environment and public health. It would singularly contradict the stated ambition of environment secretary Michael Gove for a ‘green Brexit’.

The Engineering Council and Royal Academy of Engineering’s professional principles state engineers should ‘minimise both actual and potential adverse effects for their own and succeeding generations’. This can be complex to put in practice when technological developments happen fast, knowledge is incomplete, and consequences may only appear in the long-term, as was the case for asbestos.

The precautionary principle does not prevent innovation. Instead, it sets a framework for high standards of responsible innovation, enshrining the need for risk assessments and reviews of scientific evidence. In case of ‘plausible danger’, the burden of proof shifts, so it is not the concerned parties having to prove potential harm, but those seeking the new introduction that have to demonstrate it is safe.

Finally, much of the implementation, compliance and enforcement of environmental law is currently done by EU institutions, and there are no clear replacement plans.

The Withdrawal Bill could have crucial environmental and democratic significance. This needs to be addressed because the environmental issues covered by EU laws are as valid now as when the laws were first introduced – if not more so – as highlighted in the recent ‘Warning to Humanity’ letter signed by 15,000 scientists.

Defra is expected to consult on policy and governance proposals in early 2018. CIBSE will be engaging with the consultation, and members should contact us if they would like to contribute.

You can also let your MP know if the issue matters to you.

Thank you to Dr Tom West, associate researcher at ClientEarth, and Richard Benwell, head of government affairs at Wildfowl & Wetlands Trust, for their advice.

## References:

- 1 ClientEarth, *Report – The Withdrawal Bill: Destination and Journey*, September 2017, [bit.ly/2BGF6B7](https://bit.ly/2BGF6B7)
- 2 The latest is due in February 2018: ClientEarth, News, UK government will face court hearing over toxic pollution, 5 December 2017

**JULIE GODEFROY**  
is head of sustainability  
development  
(maternity cover) at  
CIBSE

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# How collaboration influenced the London Plan

Professional collaboration is key to finding the solutions that will bring about zero carbon cities. Clara Bagenal George reflects on what the London Energy Transformation Initiative has achieved in the past year

Global temperature rise needs to be kept below 1.5°C above pre-industrial levels to avoid catastrophic climate change. If this is to be achieved, all new buildings must operate at net zero carbon by 2030, and existing buildings by 2050. London, as a global city, has a responsibility to help lead this transition to a low carbon future.

Frustrated by the ineffectiveness of energy policy within the capital to drive design solutions that will bring about real change, Elementa Consulting opened a discussion with the built-environment sector. The result was the London Energy Transformation Initiative (LETI), a voluntary network of more than 170 professionals – with support and input from the Greater London Authority (GLA) and London boroughs – which have come together to help put the city on the path to a zero carbon future. The group’s aim is to establish evidence-based recommendations for two pieces of evolving planning policy – the new London Environment Strategy and revised London Plan.

The draft London Plan was published for consultation in November; chapter 9 sets out the policy on carbon emissions of buildings, plus the mayor’s ambition for



**“Disclosure of building energy use is a central component in reducing carbon emissions and running costs”**

London to become zero carbon by 2050. Progressive targets on air quality and the circular economy are also included.

## LETI proposed measures included in the draft London Plan

We are pleased that many LETI energy policy proposals have been incorporated into the draft London Plan:

### Energy-use disclosure

Major developments will be required to monitor and feed back on energy performance – by exhibiting a Display Energy Certificate (DEC), for example, and reporting to the mayor for at least five years. Disclosure of building energy use is a central component underpinning progress in reducing carbon emissions and running costs.

Disclosure brings many benefits, such as:

- An enhanced understanding of the way buildings use energy. This will enable policy-makers, designers and building managers to achieve better outcomes
- Clear metrics of real performance, so incentivising building providers (developers and landlords) to seek the best possible response for real performance, rather than modelled compliance with regulations.

### Zero carbon plan

Proposed new developments must show how they are future-proofed to achieve zero carbon onsite emissions by 2050. Large-scale energy refurbishment works will need to be carried out on most existing buildings – and it is imperative for our zero carbon future that new buildings don’t just get added to the list of properties that need to be refurbished. This means heating and hot-water systems will be selected with future carbon-emission factors in mind.

### Minimising peak demand

Energy-strategy submissions must now show how the development will minimise peak energy demand through installation of smart meters, demand-side response and short-term energy storage. The carbon



LETI’s initial ‘Let’s fix London’s broken energy policy’ workshop

factors of the electricity grid – and, probably soon, the cost – is high at times of peak electricity use. This policy helps to ensure developments do not add significant load during these periods, which will be critically important as more of London's heat generation switches to electric.

### Decarbonising heating

The draft London Plan suggests a new heating hierarchy that must be adhered to by major developments in heat network priority areas. It prioritises the use of secondary heat sources, which are presumed to include ambient loop energy-sharing networks, and heat generation from zero-emission sources. This is in line with LETI's proposed Delivering Low Carbon Heat Hierarchy.

Some key LETI heat network recommendations have not yet been incorporated, however. These include district heating systems having a zero carbon transition plan, and the disclosure of efficiency, distribution losses, costs, and actual carbon factors for all heat networks.

Below, we look at some other LETI recommendations that are expected to create real change, but which have yet to be adopted within the draft London Plan revision.

## LETI measures that could be adopted through draft London Plan consultation

### Absolute energy-use metric

One of the major proposals from LETI is to move away from a CO<sub>2</sub> percentage reduction. As it stands, this encourages a culture of false reporting, with the outdated carbon factors currently mandated, and does not lead to best practice design and performance.

LETI advocates a total consumption kWh/m<sup>2</sup> (energy use) metric – including regulated and unregulated energy – in line with similar international standards. Global best practice includes Toronto's Zero Emissions Buildings Framework, Vancouver's Zero Emissions Building Strategy, the Canadian Green Building Council's Zero Carbon Building Standard and the Passivhaus standard. The kWh/m<sup>2</sup> metric offers a consistent indicator to be measured at each stage of the design process – ultimately, and most importantly, during operation, to allow identification of the most successful approaches.

### Fabric efficiency

The draft London Plan mandates that 10% (domestic) and 15% (non-domestic) carbon-emission reductions be met through energy-efficiency measures. This includes both fabric performance and system efficiencies.

LETI advocates a clearer fabric energy-efficiency target, similar to Thermal Energy Demand Intensity used in the Canada Green Building Council's Zero Carbon Building Standard, or Zero Carbon Hub's Fabric Energy Efficiency Standard (FEES). This is a simple metric that only includes fabric efficiency, rather than a combination of fabric and systems efficiency.

## Building on the LETI movement

As an industry, we need to give a unified response about

## COLLABORATION IS KEY

Since its inception in May 2017, the London Energy Transformation Initiative (LETI) has worked on the basis that collaboration between industry professionals is the most effective way to develop robust energy policy recommendations. It is vital that the industry presents a united, simple approach to policy-makers at a city and national level. LETI is the vehicle that has delivered this. The process is outlined below.

### INITIAL WORKSHOP

'Let's fix London's broken energy policy' workshop – organised by Elementa Consulting – was attended by 110 industry professionals in May 2017. Participants developed ideas and recommendations that could influence London's energy policy. Working at 10 tables, each group focused on a specific theme. Having identified their priorities, a member of each table presented to the room, and then each participant had the opportunity to vote for the ideas they thought most important. LETI's four key priorities were distilled from the group presentations, the dot-sticker voting and the summary notes from each workshop table group. These were then published in a summary report that was submitted to the GLA in July 2017.

### WORKING GROUPS AND LETI TASKFORCE

The priorities that emerged in the workshop formed the basis of four working groups – energy use disclosure; better performance metrics; decarbonising energy and heating; and delivery mechanisms. Each looked at its topic in greater detail and offered robust recommendations for implementation. The LETI taskforce further distilled these into a set of energy policy proposals that the industry could sign up to. This formed the second LETI report, published in September 2017, and 39 organisations – plus more than 200 individuals – have signed up to support the policy proposals. Go to [www.leti.london](http://www.leti.london) to read both reports published by LETI and to see the list of organisations that are supporting its policy proposals.

the direction of the future of heat generation. The draft London Environment Strategy says the UK government will only make a decision on the long-term role of natural gas in 2030. We do not have the luxury of waiting until then to set our trajectory.

### LETI next steps

The London Energy Transformation Initiative will continue to work with the GLA to offer advice on implementation of the new policies in the London Plan, and will organise a wider consultation.

LETI will continue to promote the kWh/m<sup>2</sup> energy-use metric for design phases, in collaboration with the UK Green Building Council (UK-GBC) and the Better Buildings Partnership (BBP). LETI believes this is crucial to designing operational zero carbon buildings today.

It is important that we don't wait for policy to drive decision-making – LETI will be developing a framework for consultants and developers to use at the design stage, to assist operational zero carbon developments.

### How can you get involved?

To help put London on a pathway to zero emissions buildings, email [clara.bg@elementaconsulting.com](mailto:clara.bg@elementaconsulting.com) to get involved with LETI.

Join the likes of BBP, Bioregional, RWDI, Feilden Clegg Bradley Studios, Currie & Brown, Allies and Morrison, Linkcity, ADP, Etude, UK-GBC, PRP, Max Fordham, BDP and XCO2. Sign up your organisation as a LETI supporter at [www.leti.london](http://www.leti.london)

Put together a response to the London Plan consultation by 2 March 2018 at [bit.ly/2z3Mynt](https://bit.ly/2z3Mynt)

■ To find out more about the London Energy Transformation Initiative, visit [www.leti.london](http://www.leti.london)

■  
**CLARA BAGENAL  
GEORGE**  
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Elementa Consulting.

# THE FUTURE WISH YOU WERE HERE?

In our digital age, building services professionals are using futuristic processes and kit to improve design and efficiencies. We look at five innovative technologies set to gain traction in 2018

## 4D VR

Contractor Multiplex is using integrated 4D construction planning platform Synchro PRO 2017 to model 22 Bishopsgate, a 62-storey skyscraper designed by PLP Architecture. The platform allows users to develop their build programmes alongside graphical representations of the proposed works.

Multiplex teamed up with 4D modelling provider Freeform to develop the 4D VR model. This enabled teams to: move through their construction project programmes in a virtual space; attend site, virtually, at any point in the future; and comprehend work sequences.

Consultant Bryden Wood has also ventured into the 4D realm by teaming up with 3D Repo to launch a platform for visualising how construction projects change over time.

Using virtual reality (VR) headsets – such as Oculus Rift and HTC Vive – and 3D Repo's database-driven digital construction platform, the 4D sequence-visualisation tool allows users to access the latest 3D models and make real-time changes and informed decisions.

4D modelling refers to the fourth dimension of time – so a 4D schedule is a 3D model that includes construction sequencing. This allows teams to analyse events on a timeline and see the steps required to complete tasks within the construction process.

The platform uses a component-based database, so information is live and accessible throughout the project life-cycle. MEP engineers can immediately see problematic areas and clashes, while other team members – architects, engineers and the client – know what is happening and can respond quickly.

Use of sequencing within original authoring tools allows a timeline of models to be created, which can be played back in VR. Multiple sequences can be applied to each model, allowing different scenarios and outcomes to be visualised.

## Automated concept design

The building information modelling (BIM) process is revolutionising the building services industry. However, it has had limited impact on design processes carried out at project concept stage – defined by RIBA as Stage 2 – where a 3D building-geometry model is not yet available.

Within Stage 2, an MEP designer is required to complete a final project brief – including design criteria – propose servicing strategies and estimate overall building loads. This is followed by confirmation

of space requirements for plantrooms, risers and main horizontal distribution routes.

Alek Wisniewski, BuroHappold Engineering senior mechanical engineer, and Carl Collins and Richard Vincent, from the CIBSE Digital Steering Group, have developed the concept automation rollout (CAR) process – a best-practice workflow and tool to automate concept design.

It is a system of logically separated, interlinked spreadsheet templates that use a tabular format with single-point-of-data entry and modular principles. Instead of following a traditional narrative approach, the process is based on digital storytelling.

The final results are presented in the form of tabular schedules, colour-coded layout diagrams and room data sheets – thereby demystifying MEP design for other disciplines and eliminating confusion, missing information and human error.

'All data can be easily exported to the BIM model, once it is available,' says Wisniewski. 'It also allows for in-depth results analysis and benchmarking. CAR workflow proved to be a great time saver, relieving designers of "reinventing the wheel" with long and repetitive tasks, so they can focus on what they love – engineering.'

## “CAR workflow relieved designers of ‘reinventing the wheel’ with long and repetitive tasks, so they could focus on what they love – engineering”

Tyneside buildings, including Gateshead College and the Sage Gateshead concert venue.

### Offsite construction

Prefabrication of services is not new, but – until now – offsite manufacturing has been associated with the delivery of rectilinear pods and modules, dropped into a frame like pieces of Lego. However, more offsite manufacturers are winning contracts for less conventional builds – for example, the Gasholders London project in King’s Cross, London, a circular building housing 145 apartments.

MEP services contractor SES Engineering Services worked with main contractor Carillion to build the modular systems for the circular corridors. It used Revit to design the pipework in corridors, which required 10-degree bends in 100mm steel pipework every 2.5 metres. As well as these circular modules, SES factory-built 270 service cupboards, which included heat interface units, HVHR units and underfloor heating. Revit was used, with COBie data requirements, which will enable the client to offer its facilities management supplier a data-rich model of the building.

SES estimates the build time for the Gasholders was reduced from 29,000 to 10,000 hours, enabling early testing and commissioning of services. The firm also provided prefabricated services to the curved, precast modules used to build the new 2.7km-long Queensferry Crossing, spanning the Firth of Forth in Scotland. This proves that factory construction is possible on the most complex projects if design is closely coordinated with offsite companies from the outset.

### Acceptance testing in heat networks

The use of operational data to understand and improve the performance of HVAC equipment is becoming increasingly prevalent in building services. Sister companies FairHeat and Guru are the pioneers of data monitoring in heat networks, and they are now using Guru’s data-monitoring software to test heat networks at the commissioning stage.

This acceptance testing records how the heat network is performing at the point of handover from developer to client. It looks at how the system is working during standby and water and space-heating delivery, and will check how fast the hot water is passing through to the tap.

Acceptance testing will also expose networks that have not been commissioned properly, because the client has proof. Until now, clients have no comeback, because they cannot tell whether the network is working as designed.

In addition, say FairHeat and Guru, the data can be used at an earlier stage to optimise system design.

The Department for Business, Energy & Industrial Strategy is creating a compliance standard – expected later this year – to encourage all developers to undergo a form of acceptance testing that results in systems working perfectly at handover. [C](#)

### Battery storage

The main power applications for large batteries were used in balancing services for grid transmission and distribution systems. However, batteries paired with renewable energy sources – such as solar PV systems – are now being used in community energy schemes.

Applications such as ‘islanding’, where batteries are used with renewables in isolated grids, ‘peak shaving’ and the ‘behind-the-meter market’ – which allows consumers to store and use the power they generate – are possible with batteries. One such scheme, set to go live this summer, is Europe’s largest community energy battery installation, at the Trent Basin housing development in Nottingham (see page 38). Power generated by PVs on the 560-home development will be stored in a giant 2.1MWh battery, sized to be future-proof.

The second phase of the project will incorporate a heat pump network and thermal store – also powered by the PV and battery – and revenues will be earned from grid and heat sales. This will allow price arbitrage to be used, consistent with the carbon mix of the grid – for example, importing at night and exporting at some points of the day. The battery will also be used to supply or absorb power from the grid under a frequency-response-type contract.

Centrica is also working on a commercial battery-storage scheme at Gateshead Council that can store and release power on demand, as well as support the National Grid. The project has been designed to store or release energy for the Gateshead District Energy Centre, and will respond to any fluctuations in demand in less than a second.

Once commissioned, Centrica will manage the project under a 10-year contract, offering various flexibility services for the grid to help keep the national electricity network in balance. In time, it will also be used to help meet peaks in local demand, supplying electricity through a private wire to council-owned buildings and well-known

# SHADES OF THE PAST

Madinat Al Irfan, in Oman, is set to redefine sustainable design in the Middle East.

**Alex Smith** talks to the masterplanners behind a city aiming to halve energy and water use by allying smart building with traditional Omani design principles

**T**he client's competition brief for a new city in the Middle East sounded more like an academic exercise than the requirements for a real masterplan.

'Create a city for 280,000 people that uses half the normal amount of energy and water, yet doubles available floor space and costs less than business as usual. Oh, and halve the number of cars as well.' This wasn't an exercise for students, however; these were the key performance indicators for a major new conurbation in Oman.

Madinat Al Irfan is a city extension for Muscat, which will have more than 2,000 buildings, 14 mosques and 17 schools. It is positioned between the Gulf of Oman to the north and the Al Hajar mountains to the south, and will be unlike any other modern city in the region. Rather than featuring towering glass-and-steel skyscrapers connected by eight-lane



highways, it will be a low-rise, densely populated city built on traditional Middle Eastern principles of architecture – narrow streets, lots of shading, and low water use. The steep-sided valley – known as a *wadi* in Oman – running through the site won't be built on, but will be enhanced to create an identity for Irfan based on its local climate and heritage.

Irfan is designed to be a post-petroleum city, where people can walk to shops, schools and places of work, rather than rely on cars. The long-term goal is for a new Oman light rail transit to stop in Irfan, further reducing the need to drive. In the context of the high-rise cities typical of the Middle East today, the aspiration sounds fanciful. But if governments are to reduce carbon emissions by up to 70% by 2050 – and achieve net zero emissions by 2100 – then cities like Irfan will have to be the norm.

## The client brief

Specialist built-environment adviser Chris Twinn FCIBSE devised the masterplan brief with the client, the Oman Tourism Development Company. His years of experience working on low-carbon developments in China and the Middle East led to RIBA recommending him for the job.

If sustainability is considered at the start of a project, it should incur less – not more – cost than 'business as usual' (BAU), says Twinn. 'Attention, at the earliest stage, to building form, microclimate and transport infrastructure can vastly reduce energy loads,' he adds.

'My argument is it should cost less because you're using less stuff [HVAC equipment]. That's why sustainability targets were in the brief – it reduced costs. I've managed to get fairly advanced levels of sustainability into other projects because sustainability is less than BAU. We are



The wadi in flood, with terraces and villages above terrace plantations on the right bank, and densely populated, mixed-use buildings on the left

GUIDING PRINCIPLES

- Learn from the past to inform the future
- Create places of distinct character
- Create a comfortable environment for pedestrians
- Provide an integrated transport system
- Create active, mixed-use places
- Create an integrated, sustainable community
- Celebrate the natural landscape
- Embrace quality and diversity in buildings
- Complete at every stage
- Smart-city concept
- Provide a catalyst for change

The winning masterplanning team added five more principles, including making the most of the site's strategic location close to the international airport and between the sea and the mountains. The team wanted to design villages that were sympathetic to the wadi (deep valley) that runs through the site, and came up with the term 'string of pearls' to describe how a cluster of developments with their own character would be built along the wadi.



entering a cost-constrained world – there aren't that many rich benefactors around.' Twinn says engineers must be aware of the financial cost of their designs to stand a chance of influencing designs. 'As an engineer, I learned that if you wanted more than three conduits, it was cheaper to go for 50mm x 50mm trunking,' says Twinn, who believes – in the UK – quantity surveyors (QSs) have taken away responsibility for costs from engineers. 'In most other countries, services engineering is not a separate discipline of QSing,' he adds. The client helped Twinn achieve the sustainability KPIs for Irfan because it wasn't interested in the 'highest, tallest, or biggest', but wanted a cost-conscious, energy-efficient design in a world with ever-scarcer resources. 'You have to communicate these ideas in non-engineering terms,' Twinn says. 'We discussed the cultural background of buildings in Oman, where streets are high-density, narrow and self-shading, and where you keep the sun off the glass.' That was much more

Section view of block showing the extra lettable space created when facade overhangs are incorporated. Basement car parking is reduced from four to two levels

» easily understood than calculations about solar gain, he adds.

It's also vital to consider the physics and passive measures in the brief, says Twinn. 'As an engineer, you have to explain the principles of what you want to achieve before the architect starts the design. As soon as they put pen to paper, they are on the defensive.'

To alert designers to the benefit of thermal mass in reducing energy loads, it needs to be quantified before models are built, because 'models don't tell you what thermal mass is doing,' says Twinn, who successfully worked with Hopkins Architects to use thermal mass to control the environment at the Inland Revenue Centre in Nottingham.

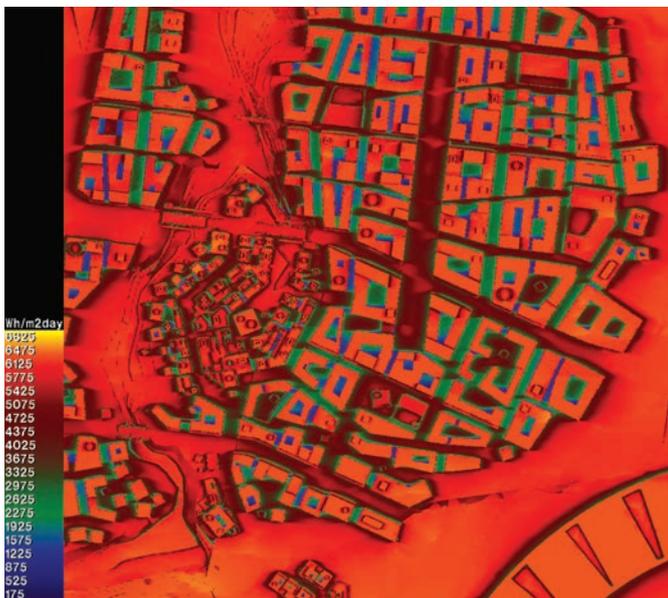
As well as the four KPIs – less water and energy use, fewer cars, and more available floor space – the masterplan competition brief contained 11 guiding principles to encourage the design of a walkable, low-carbon city. (See panel, 'Guiding principles').

**The winning masterplan**

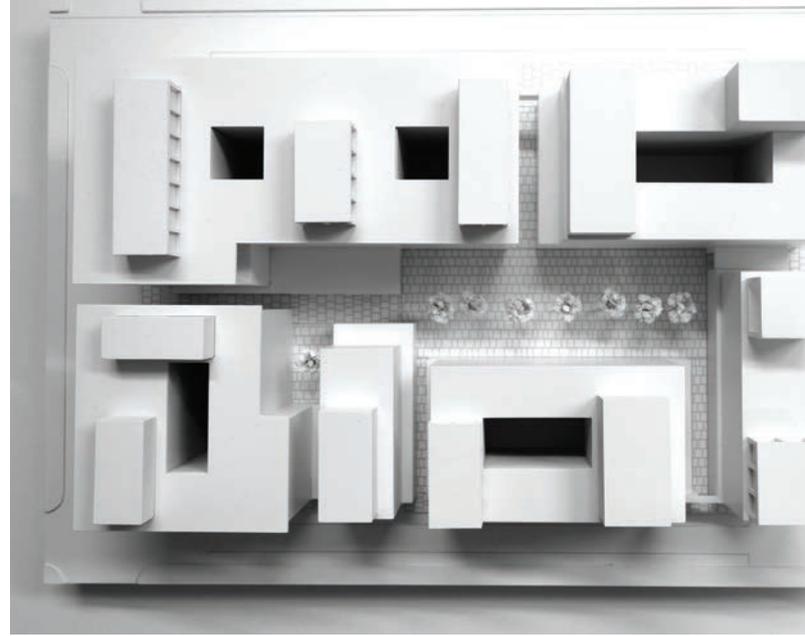
Twinn helped judge the competition entries with design-review panel Cabe and – in a blind assessment – they chose the submission of UK consultants Arup and Allies and Morrison. The judges were impressed by how closely they followed the brief for a site-sensitive design, and not imposed a western style of architecture. 'Some entries featured big avenues and significant areas of grass, and were very orthogonal,' says Twinn.

The winning masterplan has a cluster of villages along the *wadi*, linked by 15 new bridges to more mixed-use areas on a plateau. It stuck to the principles of high-density design with narrow streets and self-shading buildings, featuring airtight, insulated properties with

■ Allies and Morrison partner Alfredo Caraballo is the lead designer on the masterplan



Solar modelling helped to determine street orientation. Narrower streets are east to west

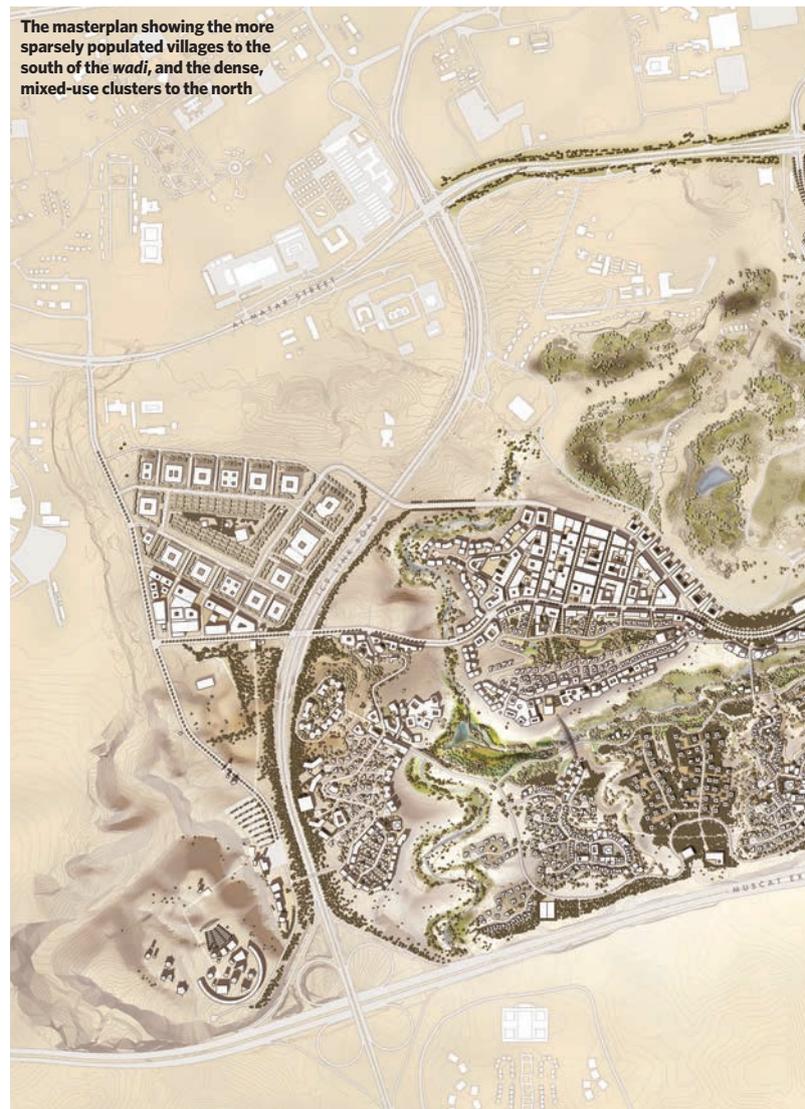


Model of a block showing wind and pedestrian pathways between the buildings

limited glass. The *wadi* will become a natural park, featuring a steep-sided bank on one side and terraces of traditional plantations – such as figs – on the other. (See panel, 'Halving water use').

**Density**

To inform the design of a 'walkable city' in the Middle East, the masterplanning team did extensive modelling of the microclimate to ascertain the optimum orientation, size and height of buildings. Blocks featuring jetties and colonnades were modelled to give a thermodynamic comfort rating for streets, says Arup site development engineer Richard Totten. 'We did studies on how long you can walk without shade at different times of the day,' he says. 'The analysis concluded that 80-100m



The masterplan showing the more sparsely populated villages to the south of the *wadi*, and the dense, mixed-use clusters to the north

was the maximum comfortable walking distance when in the sun.'

A requirement of all entries in the client's brief was to state the amount of 100% shaded walkway that would be provided per square kilometre of masterplan. The idea was to encourage a far denser building form.

Shading doesn't just encourage walking, it also helps lower the cooling loads in buildings – and the colonnades offer an opportunity to increase lettable floor area. 'You can build over them,' Twinn says.

'It's the opposite to what you would do in Britain,' says Allies and Morrison's associate director Peter Ohnrich. 'Here, you want to open up [the street] to get the sun in, but – at Irfan – you have a wide street corridor at the base, but you reduce the opening higher up [to create shading]'. Areas of high density also save energy in the infrastructure, adds Totten. 'We're not distributing power and water over such large areas. We have concentrated loads, so losses are reduced. It means district cooling is a possibility,' he says.

A more walkable city with narrower streets means fewer vehicles. Surface car parking is banned and only two storeys of parking beneath buildings is permissible, leading to significant cost savings.

**Design codes**

The masterplan offers architects and developers flexibility over the choice of materials and styles, but strict parameters must be adhered to.

"The shading doesn't just encourage walking, it also helps lower the cooling loads in buildings"

**CARBON AND CAPITAL COSTS**

Arup and Allies and Morrison calculated the capital and carbon costs of Irfan. The capital cost was slightly cheaper than business as usual (BAU), but the operating and user costs were significantly less – around half BAU. Water costs are 40% less, because of the reuse of water from the treatment plant and other water-saving initiatives, such as native plants, water-efficient fixtures and fittings, and district cooling.

The carbon cost of capital was approximately the same as BAU – this included construction of a light railway transit, which had a high carbon cost. There were carbon savings because less equipment was needed for cooling, but carbon costs were higher for glazing and extra thermal mass (it is expected most of the city will be built with traditional stone).

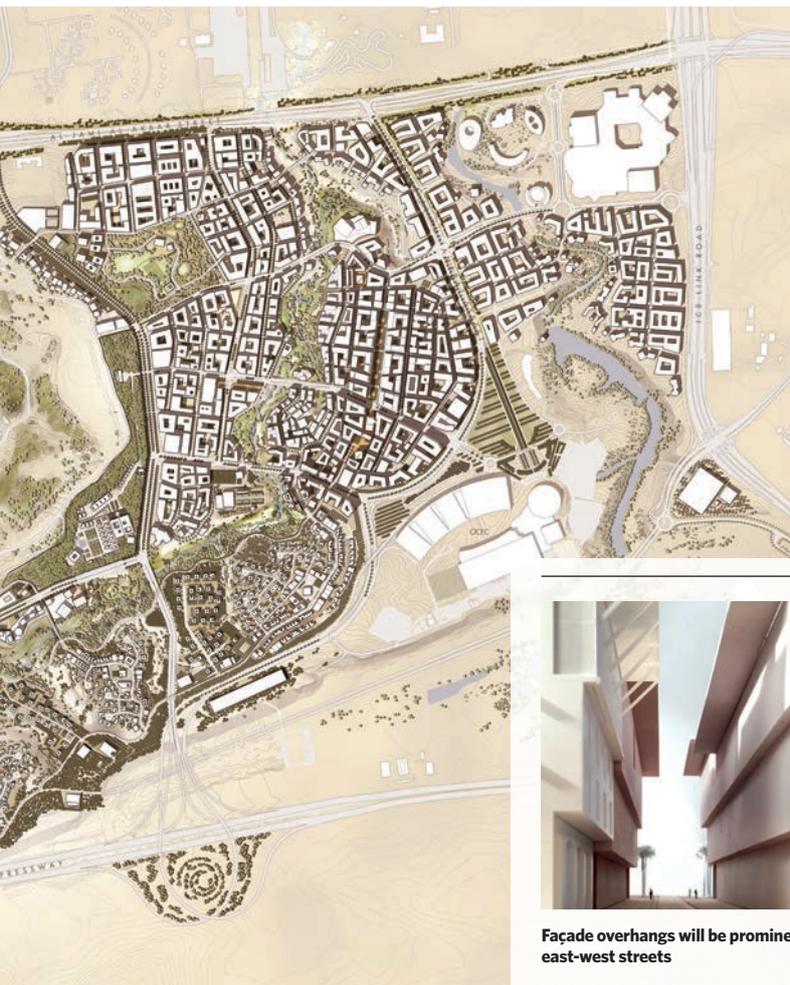
In operation and use, there is a drop of 42% in carbon cost. As operating/user costs are normally around 15 times higher than capital carbon costs, there is huge potential significantly to reduce carbon over time.

'We made early estimates about what we could achieve through passive design,' says Totten. 'It was a key focus.'

As a result, design codes stipulate that window-to-wall ratios must be no more than 20% – to reduce overheating – unless there is some form of mitigation against the resulting solar gain, such as shading, deep window reveals or solar-control glazing with low G-values. There is also a target for each block to generate 20% of energy from onsite renewables – primarily a combination of solar hot water and solar photovoltaics.

Thermal studies were carried out on blocks of buildings to determine their most efficient size and orientation. In the design guide, there are several block sizes to reflect different areas. For example, the souks – Arab marketplaces – have smaller, lower-rise buildings to reflect their historic character.

Wind and solar analyses were conducted on typical development blocks, to ensure there was enough shading and cross-wind to cool courtyards and buildings. For each block, whether residential or commercial, the developer will be given the appropriate design codes. 'The essence was to make the codes as user-friendly as possible. We put everything on two sides of a piece of paper,' says Ohnrich.



Shading options



Façade overhangs will be prominent on east-west streets



High-level and projecting cornices, used to shade streets and façades



Canopies and fins, incorporated into façades to shade windows

**“Attention, at the earliest stage, to building form, microclimate and transport infrastructure can vastly reduce energy loads” – Chris Twinn**

» This contains references to codes applicable to each particular block, such as cornices and colonnades. They are not fully prescriptive says Ohnrich. ‘As long as they comply, the design doesn’t have to match the next block,’ he adds. ‘The relationship will be coherent, but there is variation.’

**Energy infrastructure**

Metering is an important part of the design requirements of Madinat Al Irfan, and the aim is, eventually, for live operational data to be used by utilities firms to manage demand.

The data will also be used to ensure future infrastructure development is sized correctly ‘Sizing for peak demands is difficult and it is the utility providers’ prerogative to reject developments if they think the infrastructure is insufficient,’ says Ohnrich. ‘In the first phase, there may be larger pipes, but it’s embedded that – once data is available – developers use it to justify using smaller pipes in future.’

To give reassurance to utility companies, the masterplan has plots notionally dedicated to substations and space within utility corridors for large installations. ‘It’s difficult to know what the instantaneous peaks will be during, say, the Qatar World Cup,’ says Ohnrich, who adds that plots assigned to extra substations could be redeveloped once peaks are known.

**Governance**

To ensure the design codes are followed, there will be a system of verification and a proposed governance structure and planning process.

The masterplanning team, says Irfan, will be a blueprint for future developments in the Middle East and beyond. Energy has been subsidised in the resource-rich region, so energy efficiency has lost importance, says Totten. ‘By building correctly, the government can eradicate subsidies on energy and water, and still not increase people’s bills.’

Key to the savings is the return of traditional building styles, says Totten. ‘We are not imposing something on Oman. We’re reminding them why buildings were like this originally. Our calculations backed up the historic designs.’ **CJ**

**HALVING WATER USE**

A key requirement in the client’s brief was to cut water use by half. Annual average rainfall for Oman’s capital, Muscat, is only 100mm (compared with 584mm in London), so it was important for the masterplanners to consider how they could conserve every drop of water.

The visualisation on page 27 shows a flooded *wadi*, but – for the majority of the year – there is only a small water course. Average temperatures of 35°C in Muscat mean water features are kept to a minimum, because large expanses would evaporate. The only pools of water in the landscape are in areas shaded by bridges.

Narrow, deep waterways, designed to limit evaporation, are used to water the plantation terraces; these are inspired by the design of a 2,000-year-old Omani irrigation channel, known as *falaj*.

Arup site development engineer Richard Totten says they were fortunate to have an existing waste-treatment facility on site, as it meant there was a source of non-potable water that could be used for flushing, irrigation and some of the few water features. ‘It means there will be water in the *wadi* throughout the year,’ he adds.

Part of the water treatment will be carried out naturally when it irrigates the plantation terraces. ‘We use solar pumps to irrigate the landscape, and the nutrients are absorbed by plants and fractured limestone in the area. Pumps bring the water back to the surface, and you have a very clear body of water.’

Sites will be encouraged to remove waste water safely onsite, rather than relying on big surface pipes and pump stations – ‘unless they can prove it’s impossible, then they can tap into the city infrastructure,’ says Totten.



A narrow *falaj* waterway in Oman



Public spaces will be designed as places for people to meet

Perform » Reward » Celebrate

**“IT’S FANTASTIC THAT EVERYBODY GETS TOGETHER FROM DIFFERENT SECTORS AND THEY ALL CHEER THE WINNERS ON”**

David Clark, Sales Director (new build) at Vent-Axia  
2017 Building Performance Awards attendee



## HOST

Mark Watson, comedian,  
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This month: blockchain explained; big data in schools; circuit breakers; Nottingham's community energy battery; heat pumps

## CHAIN REACTION

Blockchain could disrupt the construction sector. CIBSE's Carl Collins explains how the technology can be used to bring the design and delivery teams together

The internet has had a long-standing problem – how do you trust the person or website you are doing business with? The levels of internet fraud and theft are well reported and, by some estimates, running to billions of pounds per year. It is too easy to pretend to be someone else – so you never really know who you are dealing with.

Fortunately, most people are able to spot the obvious frauds. It is rare that a real prince is moving his funds from somewhere exotic and needs your help. But there are far more sophisticated frauds, which get through with alarming regularity.

How can this be solved? A system – called blockchain – has been devised that does not allow you to pretend to be someone else.

It was devised by Satoshi Nakamoto (not their real name, ironically) to overcome this problem, offering what is known as a 'trustless network' – you don't need to have trust in the person you do business with because the network will do that for you.

The exchange of value using blockchain technology is carried out with 'crypto-currency'. Most people are aware of Bitcoin, a form of crypto-currency, though few really understand what it is and how it works.

### Distributed ledger

How does the blockchain work? The concept is remarkably simple. Consider a double entry book-keeping ledger, the income and outgoings have to match for the books to balance. Now, if everyone had a copy of that ledger and, if any one of them were different, the mismatching data would be rejected, so the books couldn't be cooked?

That is the heart of blockchain – all its

members have a synchronised copy of the 'ledger'. The synchronisation happens over the internet and the code checks everything matches.

The ledger has a series of blocks – the entries we would see in a traditional version – but these can be discrete quantities of data, not just financial incomings and outgoings.

They are connected by an encryption engine that uses the data within the block to create a 'key'. This key will only match the block immediately above and below, so its contents, once written, cannot be changed, or the chain of blocks will become corrupted and the system will reject the alteration.

### The block

Each block has a payload of information, which can be about anything – computer code that could contain written files, spreadsheets or parts of a construction model.

The block is written to the blockchain when proof of work or value has been established, which may be by applying processing power or by demonstrating that value is being exchanged.

The purpose of this demonstration of work is to make it difficult to write data to the blockchain if your interest is in gaining value from it for nothing, for example a fraudulent transaction.

### Relationship to fiat currency

Fiat currency is declared by a government to be legal tender and is not based on the value of the material used to create it. For example, five-



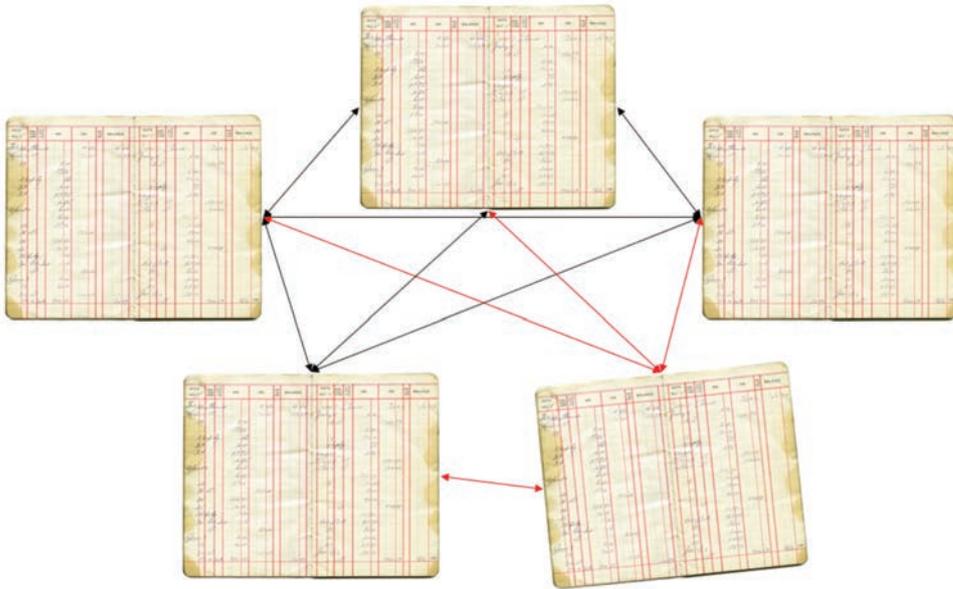


Figure 1: Block not synchronising with the blockchain

» pound notes are a token of value because they are not made of material that costs £5.

Crypto-currency is also an exchange of value, just using a different method – the blockchain. There are parallels that would imply we can exchange fiat with crypto and vice-versa. We can – and there are exchange markets for crypto-currency that translate the value to fiat currency.

The relative value of crypto to fiat currency is changing rapidly. The value of one Bitcoin is 48 times higher than it was two years ago. On 13 December, it was trading at £12,471.8, compared to £260.10 on the same day in 2015 (the original value of one Bitcoin was \$1). It should be noted, however, that exchange rates are prone to sudden fluctuations.

It is entirely feasible to exchange fiat for a crypto-currency transaction and back again.

**The aggregators**

Some stand-out recent start-up companies have been those that aggregate services and their users, charging a fee to put the user in touch with the best or nearest provider.

A good example is Uber, which connects private hire drivers with passengers needing a ride. Another is Airbnb, sourcing accommodation for people wanting short-term lets. These firms are successful because they are big names that can be referred back to in case of dispute.

Blockchain removes the need for a trusted intermediary with its immutable history, making the aggregators superfluous. So, the first victims of blockchain may actually be some of the newest and most successful tech start-ups.

The distributed nature of the blockchain allows providers of, say, private hire vehicles,

to be found directly using a mobile phone, with all the history of that driver available for the passenger to see. In addition, the driver will have a private blockchain ‘key’ that will prove beyond doubt that they are who they say they are. There would be no need for an aggregation service taking money from you, the passenger, and a driver to put you in touch and provide the trust link. This should make the journey cheaper.

As Vitalik Buterin, of Ethereum Blockchain, says: ‘Whereas most technologies tend to automate workers on the periphery doing mental tasks, blockchains automate away the centre. Instead of putting the taxi driver out of a job, blockchain puts Uber out of a job and lets the taxi driver work with the customer directly.’

In 2014, Buterin founded Ethereum, a blockchain with the ability to create apps built in, so programs could be run, and contracts execute themselves.

The relevance to construction is that Internet of Things (IoT) devices – gadgets that talk directly to the internet – can also be members of the blockchain and part of the supply chain.

**“Each proven piece of effort will be paid automatically – so no payment chasing and no retentions, with all transactions held immutably in the blockchain”**

Let’s go briefly through a small worked example: I want to build a house and I’m going to use blockchain to bring my design and delivery teams together. I can create a crypto-currency on my blockchain and give keys to each participant as they join. Each proven piece of effort will then be automatically paid to them – so no invoicing, no payment chasing and no retentions, and with all the project transactions held immutably in the blockchain.

As my designer uploads the design, he or she gets paid for their effort. As I approve the design they get paid to carry it forward to the next stage. If I want to order a palette of bricks, I invite the supplier onto my blockchain, order my bricks and – when the delivery driver arrives onsite – a barcode is scanned by an IoT scanner, proving that these are the bricks and they are onsite, immediately releasing payment.

As the bricks are used to construct the walls of my house, laser scanners and/or cameras can check the progress and assess the quality of the job, so my brickie is paid before he gets to the pub!

At the end of the project, I have a complete history of who made which decision and when it was made. In effect, I have the perfect information model to operate my new home, a true asset information model.

This is just a simple sketch of how blockchain could disrupt the construction sector. I’m sure people are thinking up far better uses right now, and some will be working out the flaws in the system.

And there will be flaws – this is a new approach not only to technology, but transacting financially and contractual relationships, but it is very exciting.

**CARL COLLINS** is a digital engineering consultant at CIBSE

# KEY DIGITAL ENGINEERING PAPERS FROM BSER&T

Papers on mining big building operational data and smart cities have been published in the current *BSER&T*. We summarise them here

**M**assive amounts of operational data are collected and stored in modern buildings, offering rich information for investigation and assessment of actual performance. However, the gaps between building engineering and advanced 'big data' analytics mean this data is not being used effectively, according to Cheng Fan and Fu Xiao, in their paper *Mining big building operational data for improving building energy efficiency: A case study*.

Data mining is a promising technology for extracting previously unknown – yet potentially useful – insights from big data. This paper explores the potential application of advanced data-mining techniques for using big building operational data effectively.

A case study of mining the operational data of an educational building is also presented. The results show that the method can help building professionals identify operation patterns, detect deficiencies, and develop strategies for improving building energy efficiency.

Another paper published in the *BSER&T* journal is *Assessing energy performance of smart cities*, by Francesco Causone, Andrea Sangalli, Lorenzo Pagliano and Salvatore Carlucci.

The huge urbanisation process since the 1950s – which is projected to continue for the coming decades – is posing a crucial issue for the management of existing cities and the planning of future ones. Smart cities are often envisioned as ideal urban environments, where the different dimensions of a metropolis – such as the economy, education, energy, environment and finance – are managed in an effective way. To reach this objective, however, analysis tools are needed to create scenarios that will inform policy-makers' decisions.

Focusing on energy, this paper proposes an analysis method, based on exergy – energy that is available to be used – to support smart-city planning. It aims to help decision-makers assess the energy smartness of different scenarios, and to address urban energy policies. Possibilities and limitations of the method are discussed through its application to London, Milan and Lisbon. [C](#)

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# TRACKING PERFORMANCE



Educational facilities can benefit from big data, say Spie's **George Adams** and **Liam Rock**, who explain how remote monitoring and management at several schools reduced their carbon emissions by 18%

**T**he importance of data management has increased in recent times because of the significant value in creating information that can be used to improve performance. Consequently, data generation has expanded drastically and the term 'big data' has become a common concept in the built environment.

In this new era of data-based decision-making, we can look towards a more integrated approach to building performance. This includes: performance-based design; connectivity within design and build; the way a smart building operates; the needs of the workplace; digital technology; the platform for integration; system integration; continuous measurement of performance; and analysis of data and decision-making.

Big data seeks to offer a solution based on databases and data analysis; it is not just about storage and availability. The objective is to analyse the data to make sense of it, and leverage the value that can come from it by joining up different data sets to form a broader understanding of building performance.

## Overall objective and vision

In truth, the data we can abstract from buildings isn't really so big – most of it is very manageable, if structured in an organised way. This means measuring things, auditing, carrying out technical reviews, behavioural change and applying a collaborative approach to reducing energy waste, while not diminishing occupants' comfort. The maintenance activities and life-cycle status of the systems and fabrics must also be incorporated into the overall plan of action.

Focusing on the delivery of the construction of educational facilities – especially in the field of building energy efficiency – collecting big data, using different kinds of measurement and



analysis, can help improve the process of creating more efficient facilities in the future.

## Performance and energy in schools

We must be realistic about the way buildings perform and the cause of the performance gaps. The first step is to identify simple metrics for monitoring performance, and comparing to benchmarks and data from a range of buildings.

For schools, we use the carbon-per-pupil metric. This is because schools can vary widely in their levels of carbon emissions as a result of their size, use, management, system selections and building shapes and fabrics. They can also vary in performance because of their age, size, style and technologies. CO<sub>2</sub> per pupil in primary schools can range from 180kg to about 500kg per annum, and in secondary schools from around 400kg to 900kg per annum.

Interestingly, older schools can perform at much lower levels of CO<sub>2</sub> and energy than some newer facilities. This is because some modern services such as mechanical ventilation can use more energy during their operation.

The key to any energy strategy is to assess the capability of the building and its technical systems to achieve the performance targets





that have been set. This includes the training and competency of the onsite team that maintains and operates the systems.

In some facilities, how control systems work – and how control parameters can be maximised while safeguarding comfort conditions for the occupants – isn't always well understood. Also, responsibility for control-system maintenance is often subcontracted out, which can lead to a lack of single-point ownership.

Control sensors can be out of calibration – or even obsolete – as these elements can be overlooked in the planned preventative maintenance (PPM) scheduling. This can cause systems to operate ineffectively, waste energy and cause disruption.

The operation of facilities can be complex. Energy consumption can increase outside of school hours – for example, during additional functions at weekends and in the evenings. So targets for the facilities need to be structured accordingly.

Occupant behaviour in relation to energy use can also be part of the 'big data' picture, when occupancy levels, use of areas, and the management of doors, windows and lights are considered. It is essential to make staff more aware of these important features, as well as to implement an energy-communications plan.

We have established a key principle of improving the management of energy in schools, which requires the integration of engineering and controls expertise into the monitoring/management activities around energy and the building management system (BMS).

### Remote monitoring and management

A remote monitoring and management capability that operates on a number of facilities is the best way to improve energy performance.

## "Improving the management of energy in schools requires the integration of engineering and controls expertise into the monitoring/management activities around energy and the BMS"

This is in place in more than 20 secondary schools in the north of England, with the remote monitoring operated from our head office in London. Most of the schools are new-build, with only two extensively refurbished.

The remote-management facility was developed to bring specialist expertise within the business in contact with the day-to-day delivery of contractual requirements. It serves key elements around building performance and energy.

Various contractual requirements mean the facilities must be operated efficiently. For example, energy and water has to be managed within benchmarks established during the first two years of operation. We are also required to maintain specific environmental conditions within different room types. Classrooms, games halls and gyms, and circulation spaces have to be managed to tight criteria, with financial penalties for failures.

A building energy management system (BEMS) was installed at each school and connected – via stand-alone networks – to head-end management stations at the local office. Once this was complete, the team in London began to review basic settings around time clocks, temperature requirements and settings, and put in place a number of management protocols to control how – and when – changes to the system could be made. Access to the system was restricted, and training given to regular users to maintain good operational order.

Once this early phase was completed, the team began to make use of the advanced features of the system to log and report on hundreds of individual data points. A detailed set of logs was initiated within each controller – including boiler flow and return, calorifier and space temperatures – and elements such as valve position and pump activity were recorded. Control signals being sent by the system were also tracked, to allow for the monitoring of equipment responses to instructions sent.

### Making big data work

This capability generated large volumes of data that – to be meaningful – had to be processed, analysed and acted upon.

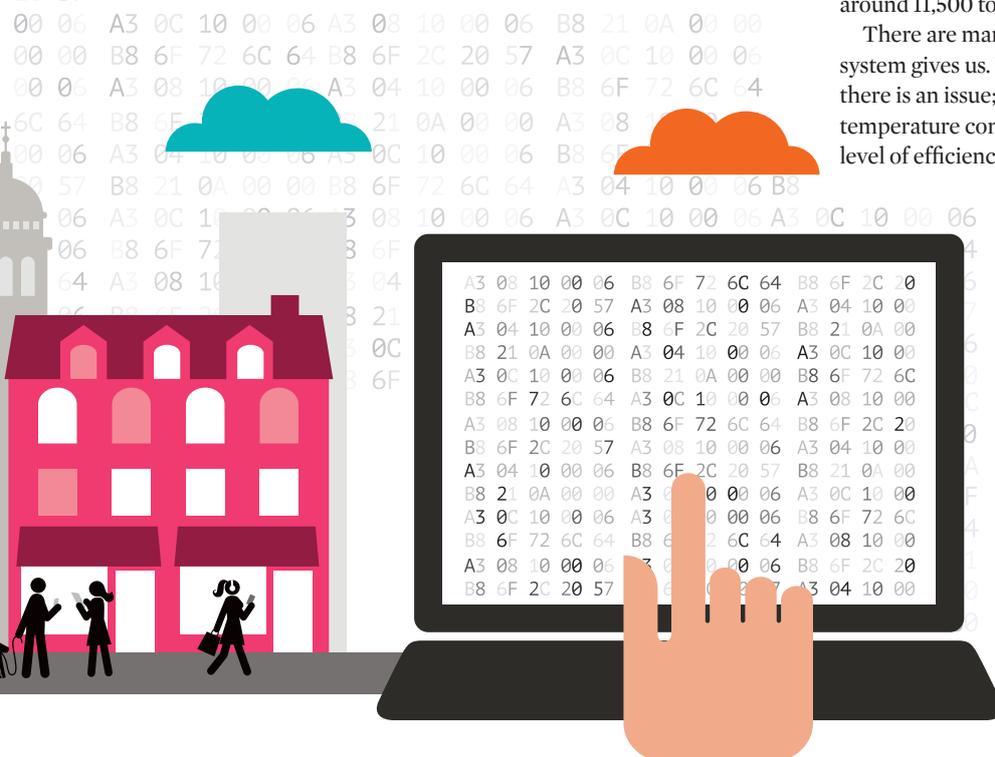
We developed, and continue to develop, data-mining tools to turn this big data into useful information. Such tools, and the active system monitoring, have allowed us to support total carbon reductions of around 11,500 tonnes of CO<sub>2</sub> over five years.

There are many advantages to the operational capability this system gives us. We can: very quickly identify and alert the team if there is an issue; reduce the risk of a compliance failure on a space temperature condition; and ensure we are operating the facilities at a level of efficiency that is well inside our benchmarked conditions.

As a result of using this data, carbon emissions associated with energy consumption have fallen from 603 tonnes per pupil in the first year, post-benchmarking, to 497 tonnes per pupil today. This is a reduction of around 18% in five years and, with the data revealing ever more opportunities, we expect emissions to continue to fall.

We are working towards greater integration between systems, maintenance, energy use and expert diagnoses, to achieve performance excellence. A greater vision could be to establish a predictive model, which can assimilate total building operations and adjust systems to achieve the best possible performance automatically.

**GEORGE ADAMS** is UK engineering director and **LIAM ROCK** is energy manager at Spie UK



# STAYING IN CONTROL

A power-management function built into a circuit breaker can help building operators avoid penalty charges for exceeding the peak consumption agreed in energy contracts, says ABB's Atif Saleri

**A**t the start of April, a new regulation will allow utility companies to charge a penalty rate when their commercial customers draw more power than expected.

DCP 161 – an amendment to the Distribution Connection Use of System Agreement (DCUSA) – is being introduced to offset the costs that distribution network operators (DNOs) incur when their customers routinely draw more power than agreed.

Growing peak-energy consumption represents a significant cost to DNOs, as they must invest in improving their infrastructure – for example, by upgrading high-value equipment, such as industrial switchgear and transformers. Although customers pay a fee for their grid connection, it only covers consumption up to an agreed limit, which reflects the grid's power capacity.

Until now, excess consumption has been charged at the same price as standard consumption. However, Ofgem decided this was equivalent to a discount on energy for those who routinely exceed their theoretical peak demand.

Rather than passing on the cost of the required network upgrades to all consumers, DCP 161 will ensure it is met by those who use additional capacity. From 1 April 2018 – depending on region and voltage level – customers will be charged as much as three times the standard rate if they exceed their peak consumption over half-hour periods.

The smart thing for energy managers to do is negotiate a new peak energy with their DNO, or take steps to improve energy efficiency and create fail-safe systems to limit consumption in a way that is invisible to building occupants.

The latter option will avoid the new penalty charges, but will also help building owners improve their energy performance.

In addition, it will negate the need to upgrade or oversize the power distribution panels inside the building.

## Intelligent load control

Automatic control of a building's loads, based on its demand, can moderate the demand for energy. For example, heating, ventilation and air conditioning (HVAC) systems will draw more energy on a cold winter's day, resulting in peaks in consumption and, potentially, penalty charges.

By prioritising loads and temporarily cutting the power to non-essential loads, an operator can limit the power consumption so that it never exceeds a maximum level. They can limit the power to HVAC services, for instance, putting the building operator in control of consumption. The traditional way to achieve this is to install dedicated

load-control devices. As the number of loads grows, so does the complexity of the electrical installation to manage each load – and the investment required.

However, it is now possible to adopt a smart power-management tool, which works by switching off non-essential equipment and only switching it back on when acceptable power levels are reached. It requires a combination of accurate metering, smart software and switchgear control technology.

To meet the growing demand to limit energy consumption, power-control functions have been integrated by manufacturers into specialist circuit breakers over the last five



Four circuit-breaker units have been installed to control power from four feed-in transformers. They perform as general low-voltage circuit breakers, and one has power-management software embedded into the electronic trip unit. This is already used for overcurrent protection, so no complex control systems or dedicated software is needed.

It takes account of the energy consumption through all four circuit breakers to decide which load to disconnect and when. Remote control is via a dedicated communication system over a single ethernet cable to the downstream device. It uses accurate metering in the circuit breaker devices, plus ethernet communication and switching modules. **CJ**

**■ ATIF SALERI** is market development manager at ABB Ability

years. This reflects the trend towards ever-greater energy efficiency and that some systems – such as those on ships – have an absolute limit in available power that can lead to blackouts if exceeded.

The power-management tool inside the circuit breaker has an algorithm that monitors power use over time and determines the average. When consumption approaches the maximum, the software compares consumption with a prioritised load list and takes low-priority loads offline automatically.

Up to 15 loads and/or generators can be controlled through a single circuit breaker. Implementation and operation are straightforward because the power controller makes use of the in-built metering and control in the circuit breaker. This eliminates the need to create programming for external programmable logic controllers (PLCs).

#### Four-step decision-making

A four-step programme in the power-controller algorithm – measurement, synchronisation, evaluation and load management – keeps power below the maximum level.

The first step is to measure the total power flow through the circuit breaker. It then divides the day into time intervals and calculates average power over each period. In the case of DCP 161, the building operator can synchronise these intervals with Ofgem's half-hourly billing periods.

During the evaluation step, the algorithm takes decisions – either to maintain the existing loads, decrease or increase them.

The final step is to decide which loads to disconnect or reconnect according to a set of rules that consider: load priority; each load's 'respect time' – a minimum time that a load must remain connected or disconnected to avoid damage; and whether loads have become available again once their respect time is over.

#### Limiting power consumption in Bergamo

ABB is using the power-controller feature at its SACE manufacturing facility in Bergamo, Italy. The circuit breaker controls HVAC loads with a combined capacity of 400kW and limits consumption, to save energy and reduce utility bills by up to €11,000 per year.



"By prioritising loads and temporarily cutting the power to non-essential loads, an operator can limit the power consumption so it never exceeds a maximum level"





# BATTERY PACKS A PUNCH

Europe's largest community energy battery installation at the Trent Basin housing development in Nottingham will be a demonstrator project for the UK. **Andy Pearson** explains the concept and the challenges behind it

**I**t's not been a straightforward project – it has been much more difficult than we first anticipated for numerous reasons, which has been valuable learning for future schemes,' says Professor Mark Gillott, chair of Sustainable Building Design at the University of Nottingham's department of architecture and built environment.

He's talking about what is currently Europe's largest community energy battery installation at the Trent Basin housing development in Nottingham. The university is one of a number of organisations involved in the project with the intent to establish a model for low-carbon community energy schemes across the UK. 'We should have been on site months ago and, instead, we finally started on site on 4 December with installation of the energy infrastructure,' he says.

The development of more than 500 homes on the banks of the River Trent is being built in five phases by Blueprint, a developer specialising in the construction of sustainable homes.

Blueprint has been working with Gillott's university team for a number of years to improve the sustainability of its projects.

'Initially, I wanted to install photovoltaic panels (PVs) on this scheme but, now that the feed-in tariffs have reduced, I couldn't make the numbers work,' says Nick Ebbs, CEO at Blueprint. 'So when the possibility of using communal energy storage came up in our discussions, we thought this could be a way to make PV work.'

Together, they decided to trial battery technology on a commercial basis as part of a community energy scheme at Trent Basin.

The project is funded through matched industrial investment, the Energy Research Accelerator and Innovate UK. It is being coordinated through a consortium of experts within the Innovate UK Sustainable Community Energy Networks project (ProjectSCENE), including the University of Nottingham, AT Kearney, SmartKlub, Urbed, Blueprint, Siemens, Solar Ready, Stickyworld and Loughborough University.

'Although the technology is established, I wouldn't have committed to this project without the grant because there isn't a proven demonstrator and the business models don't yet exist,' says Ebbs.

'In fact, our pitch to Innovate UK was for this to be that community energy demonstrator. We said we'd either demonstrate how you can do it, or why you cannot do it, and, in so doing, we'd show the government what needs to



**560**  
Homes

The number of homes at Trent Basin when all phases have been completed

be done to make community energy happen.'

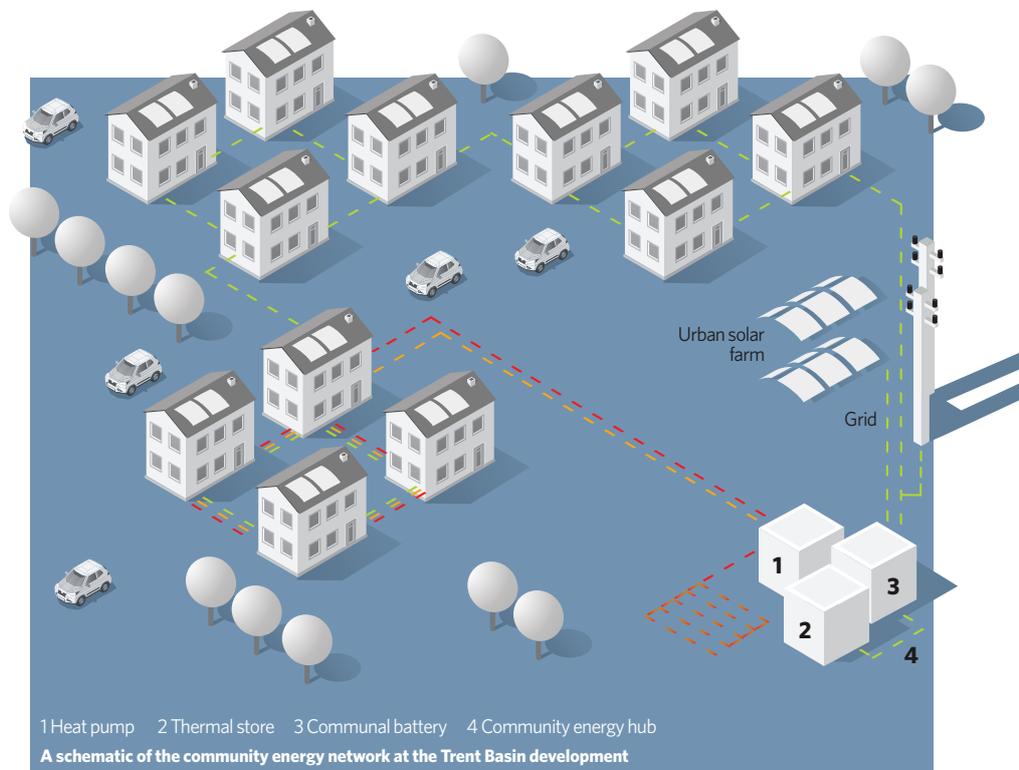
The project concept is to be pragmatic – so new developments can more easily approach carbon neutrality while earning revenues to repay the capital cost of the scheme and reduce residents' energy bills. Phase 1 generates electricity on site through PVs installed on the roofs of the dwellings or from the urban solar farm. This generated power is then fed, via private wires, to the battery, connected to the grid. Phase 2 will see the incorporation of a heat pump network and thermal store, also powered by the PV and battery. Revenues will be earned from grid and heat sales. Residents are free to choose their own electricity supplier. This setup allows price arbitrage to be used consistently with the carbon mix of the grid, for example importing at night and exporting at some points of the day.

The battery will also be used to supply or absorb power from the national grid under a frequency response-type contract. 'The frequency response contract is potentially a significant revenue driver that will help pay for this kit,' says Ebbs.

The plan is to have the community energy network run by an Energy Services Company (ESCO), the model for which is being established by SmartKlub.

Construction of the first 50 homes under phase 1 of the project was already under way, without the rooftop PVs, before the funding was in place and the energy infrastructure had been developed. However, to ensure the scheme could accommodate the community energy solution later, the developer installed the private wire infrastructure.

Because the energy scheme started after the



## “The frequency response contract is potentially a significant revenue driver to help pay for this kit”

detailed planning permission had been granted for phase 1, the roofs are not aligned for optimum PV use. However, the energy team – working in collaboration with Blueprint's architects – have influenced the roofscape for phases 2, 3 and beyond, to ensure the designs promote efficient PV deployment. Not only did the teams consider the orientation of the PV scheme, but also the buildability elements, ensuring the roof designs offer appropriate mechanical fixings – installed with the roof, not retro-fit – and that the homes are able to accommodate the cable infrastructure without adaptation. It is also expected the 'integrated systems' – for example PV and thermal – will be installed using the same scaffolding access equipment as the developer, further reducing cost and timescales. PV systems will be retrofitted to the phase 1 homes where appropriate. The differential in PV yield versus cost between phase 1,2 and 3 will enable the energy analysts to understand the correlation between a fully integrated new build and a retrofit scheme, allowing the final report to advise on the costs of both.

In this community approach there are challenges, which the team is currently working through. For example, individuals will have a PV panel owned by the ESCo on the roof of their home. New roof lease agreements needed to be drafted to ensure that the ESCo could operate and maintain the PV installation, and that both the home owner and the potential mortgage lenders were satisfied their own interests had been accommodated and maintained.

To operate the community energy scheme as a commercially viable entity, it relies on a minimum amount of PV being used for generation. However, there are currently very few new roofs on which to install the new PV as the homes are being built. Interestingly, the scheme includes what Gillott refers to as a 'meanwhile-use urban solar farm'.

This solar farm (200kWp) has temporary planning permission for three years and is an innovative answer to this dilemma. Effectively, it is a temporary solar farm built on land that will be developed later in the project, which enables the scheme to generate a substantial quantity of



» clean renewable electricity from day one. ‘The idea is that as the developer builds on the land, the PVs on it are uplifted onto the houses that now occupy the site, so that the panels get reused,’ says Gillott.

Power generated by the PVs can be stored in a giant 2.1MWh battery, sized to be future-proof.

‘This will be a 560-home development when all phases have been completed; the battery will serve all these houses and more,’ says Gillott. ‘We’ve done a lot of work on modelling to optimise the size of the systems and batteries for different loads and demands from the community, combined with different scales of generation, to come up with a sweet-spot for the battery size based on the rate of return on investment,’ he says.

Mark Brown, representing Solar Ready, explains: ‘The primary governor for the type of battery, its chemistry and capacity, is the way you are going to use the battery and the number of cycles – from fully charged to discharged – it will be expected to complete over its lifetime,’ he says.

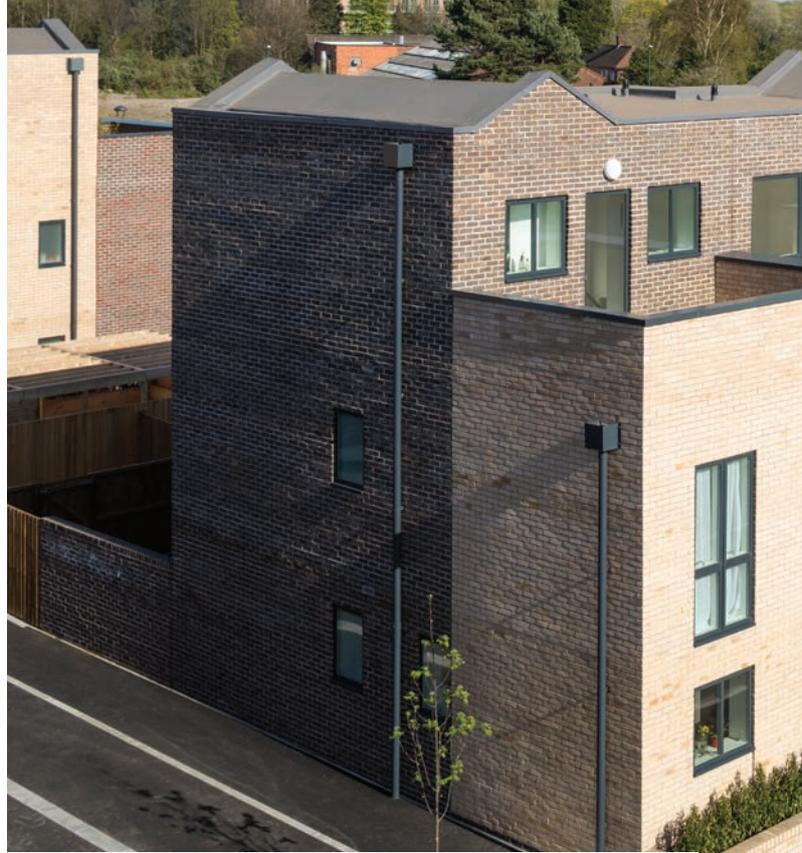
‘If you buy a battery designed for 6,000 cycles for a scheme with an energy model, which shows it will complete one full cycle per day, then you will have 6,000 days’ use from the battery before it has degraded in line with the manufacturer’s predictions. This might only be 40% of its capacity when new,’ he adds. ‘However, if you’re going to exercise the battery for frequency response, you might want to cycle only 30 times a year, in which case, you will get many more years’ use out of the battery.’

The algorithms to be deployed by the University of Nottingham will seek to understand the correlation between energy storage and its efficiency given the potential loss of performance over time/use. This will be quite an undertaking, considering other potential influencers that will be introduced with the thermal store implementation.



**50%**

Percentage of time the battery is available for community use



**“One goal we had at the outset was for developers to move away from the default position of a wall-hung, gas-fired, condensing boiler” – Mark Gillott**

The 2.1MWh capacity battery storage system is manufactured by Tesla and is of lithium ion chemistry. To ensure it is operated safely and within the manufacturer’s warranted use, it has been supplied complete with its own battery management system.

The scheme has a 500kW inverter, used to turn DC into 3ph AC for use on the grid circuits. This relatively low ratio ensures the battery store will not be ‘stressed’ under normal use, further increasing life expectancy of the asset. The community energy system has a standard 1MW connection to the local DNO substation which, in addition to the output, also has to accommodate the potential 300 kWp exported from the PV installation.

‘We’ve signed a deal via an aggregator so that, if the national grid demands a frequency response provision from the battery, we can supply 500kW of power,’ says Brown. ‘This ensures that the community energy scheme is able to attract revenue to sustain the operational costs while also providing community energy benefits, cementing its commercial viability.’

Despite the 2.1MWh capacity, the battery’s 500kW inverter means it has a maximum output of 500kW at any one time, offering four hours’ discharge at maximum output. This is because the development only has a 1MW connection to the grid which, in addition to the battery output, also has to accommodate the 300 kWp exported from the PV installation to the grid.

‘We’ve signed a deal so that if the national grid demands a frequency response provision from the battery, we can supply 500kW for up to half an hour at a time, twice in any 24-hour period,’ says Brown. ‘Because we’ve got four hours of potential supply, 50% of the battery is available for community use,’ he adds.

The battery is housed in the project’s energy centre along with a new sub-station and ring main unit – an expensive addition the team had not anticipated at the outset. ‘When we set out on the project, we

The capacity battery storage system is manufactured by Tesla





assumed we'd connect to the low voltage, 415V, three-phase side of the grid,' says Brown. 'However, when the application went to Western Power Distribution, because of the power requirements and the 1MW connection we wanted, we were required to connect to the high voltage 11kV side of the network, meaning the budget had to stretch to buying the new associated electrical infrastructure.' These elements offer valuable learning and will be included in the final published reports.

In addition to storing electricity, the scheme will also have a thermal store, constructed under the later phases of the project. It will connect to ground source heat pumps powered from the battery.

The interplay between heat and power is crucial, enabling the bigger issue of how to decarbonise heat by removing the need for gas combustion to be addressed. 'One goal we had at the outset was for developers to move away from the default position of a wall-hung, gas-fired, condensing boiler,' says Gillott.

The battery is set to go live on 1 June as a commercial entity, once all the trials for grid compliance are complete.

Ebbs has already embraced the solution. 'By doing it at a communal

level, you can drive very significant efficiencies by having one big battery, rather than lots of individual ones, and you can also aggregate demand and supply to make more efficient use of the supply that is being generated across the community,' he says.

'We've now incorporated electric car charging and are looking at battery powered bikes because, through the battery, we can make electricity available for charging relatively cheaply and, in the future, we might even be able to use car batteries as part of the storage process because, for 95% of the time, cars go nowhere,' he adds. 'It is coming together really interestingly as a holistic solution fit for purpose in the 21st century'.

■ For more on the project, and to find out the dates of project open days, visit [www.projectscene.uk](http://www.projectscene.uk)

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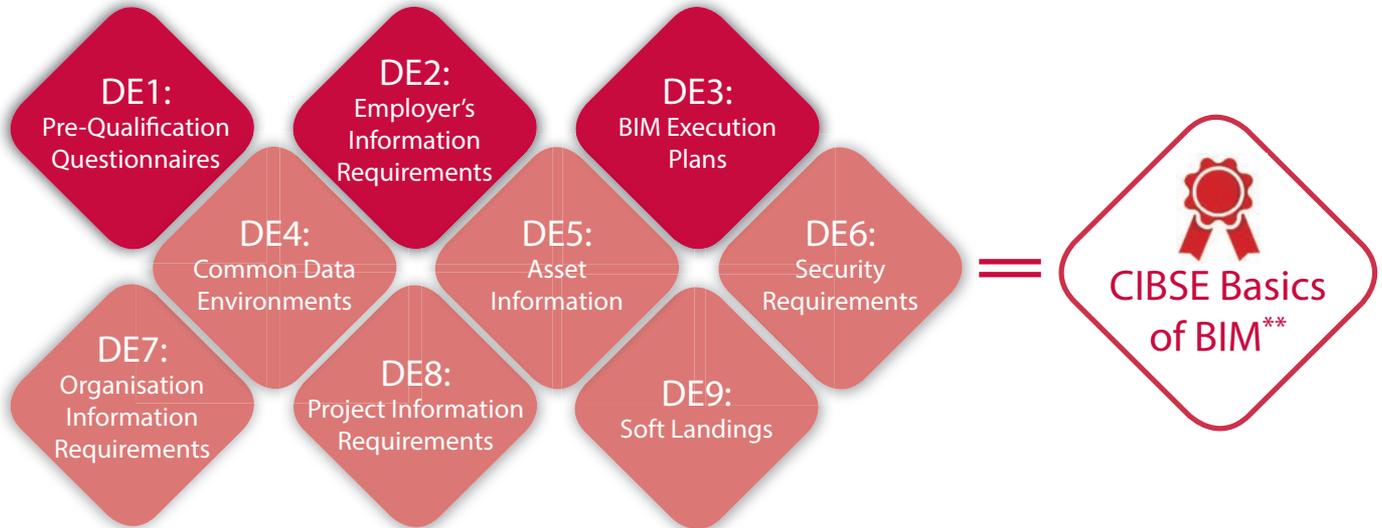


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# HOME TRUTHS

Accurately predicting domestic electrical heat pump performance is vital if the UK is to encourage their adoption. But the EU's Ecodesign regulations do not account for vital criteria. A better method is needed, says BRE Group's **Will Griffiths**

**I**n its efforts to reduce CO<sub>2</sub> emissions, the UK government has encouraged the adoption of electrical heat pumps for space and hot-water heating in all building types. Unfortunately, the country's experience of domestic electrical heat pumps has been mixed, with field trials demonstrating poorer performance than anticipated. Despite subsidies, this dissatisfaction is compounded by the relatively low cost of natural gas and the high cost of a heat-pump installation.

The European Union (EU), via Ecodesign directive 2009/125/EC, has sought to enhance the efficiency of energy-consuming products sold within it, with minimum standards and energy labels as key features.

## MISSING CRITERIA

The regulations miss the following criteria essential for accurately determining heat pump performance as part of a domestic heating system:

- Plant size ratio (PSR) - design heat pump output divided by design heat load; Ecodesign assumes 1
- Backup heating (effectively ignored)
- Hot-water load estimate for actual dwelling - hot water is ignored within the SCOP calculation
- Operating hours - the SCOP calculation ignores the effect of intermittent heating, which is prevalent in the UK
- Design flow temperature - only two options: 35°C or 55°C
- Hot-water cylinder characteristics - the SCOP calculation ignores hot-water operation
- Minimum modulation rate - some inverter heat pumps can modulate minimum heat output to a lower level than others, avoiding on/off cycling
- Weather compensation - the SCOP calculation assumes weather-compensation control is always present and active
- UK weather - the SCOP calculation uses European average weather data, which is less accurate for UK purposes



This directive has had considerable success in improving the efficiency of a wide range of products.

The EU Ecodesign regulations No 811/2013 and 812/2013 - which came into force in November 2015 - apply to electrical heat pumps and give a seasonal coefficient of performance (SCOP) estimate for space heating. Separate hot-water efficiency estimate is also given when a hot-water cylinder is sold as part of the heat pump package.

There is a problem with the Ecodesign regulations, though, because they estimate space and/or hot-water efficiency as a product, not as part of a dwelling heating system. They also assess space and hot water heating services independently, when they affect each other.

While the test data requirements are comprehensive (EN14825 test and calculation standard used to estimate space-heating efficiency, and EN16147 test standard used to estimate hot-water heating efficiency), the regulations miss essential criteria for accurately determining heat >>

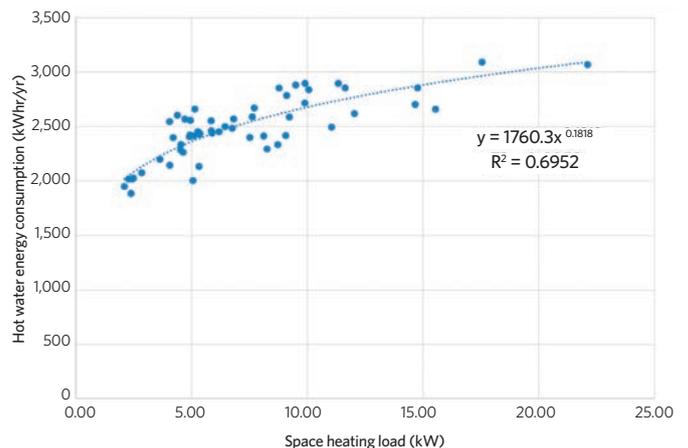


Figure 1: Hot-water energy consumption v space-heating load

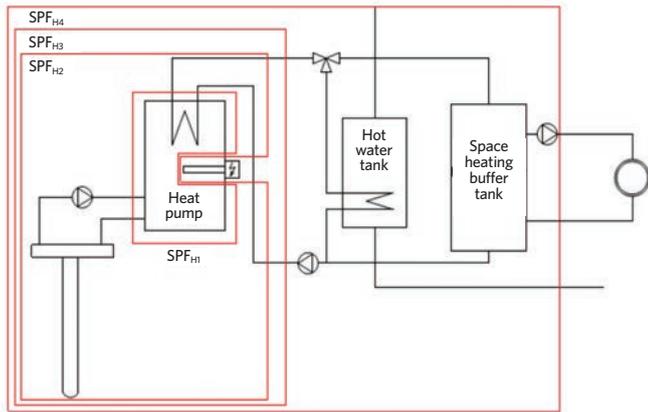


Figure 2: SEPEMO system boundaries to determine heat pump annual performance<sup>6</sup>

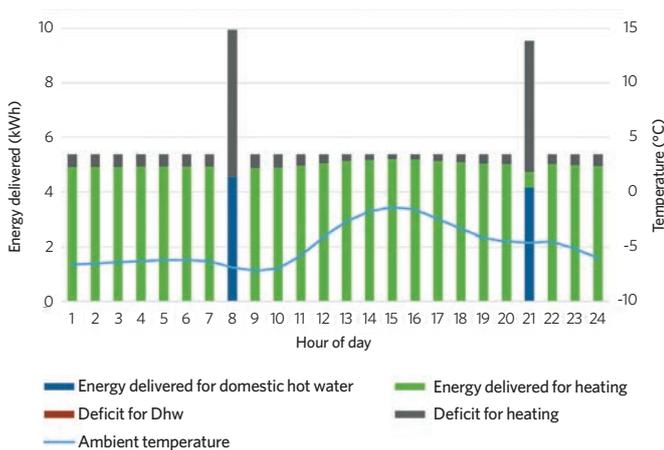


Figure 3: Example heat pump - energy delivered on the coldest day of the year (24-hour heating), with PSR = 0.8

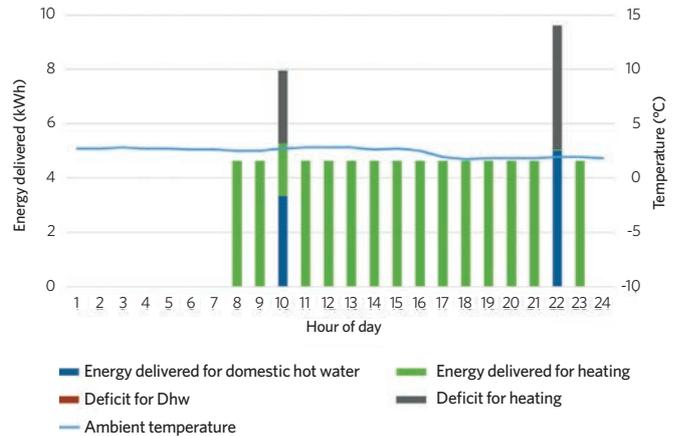


Figure 4: Example heat pump - energy delivered on the coldest day of the year on which 16-hour heating is supported, with PSR = 0.8

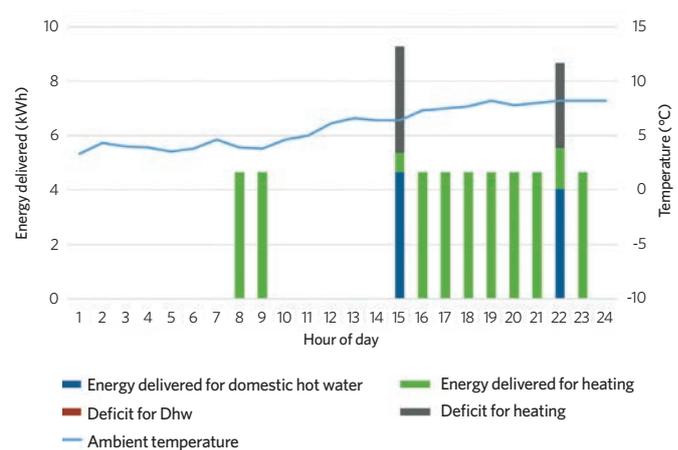


Figure 5: Example heat pump - energy delivered on the coldest day of the year on which 11-hour heating is supported, with PSR = 0.8

» pump performance in UK homes. See panel, 'Missing criteria'.

If reasonable confidence in performance estimates – namely the annual efficiency – cannot be guaranteed, then the long-term uptake of heat pumps also cannot be assured. This problem is particularly acute, given the commercial competitiveness of condensing boilers and the low price of natural gas.

Since 2010, the calculation methodology for energy rating of UK dwellings – SAP – has incorporated heat pump performance data. This was achieved via the Product Characteristics Database (PCDB) using EN14511:2007 test data at defined conditions and a modified version of the calculation method EN15316-4-2:2008 – a bin method.

Ecodesign regulations require all heat pumps to be tested in accordance with EN14825, so SAP's previous test-data requirements have become obsolete. The SCOP is also unsuitable because SAP requires annual efficiency for the heat-generator system, not the product alone. Nevertheless, the heat pump product test conditions and data arising from the EN14825 standard are highly useful, so a revised SAP heat pump

calculation method – incorporating EN14825 test data – was needed.

A significant element of the revised method, developed by BRE, was an annual, combined, space- and hot-water heating duty cycle, incorporating hourly heat load and temperature assumptions for a typical UK domestic system. It includes hot-water draw-off times based on a scaled version of EN16147 Profile M, with energy requirements derived from field trials.<sup>1,2</sup> The combined duty cycle is used to estimate annual efficiency using UK average (Leeds) weather conditions. The method is based on EN15316-4-2:2017 and uses EN14825 test data.

### Method

The SAP<sup>3</sup> heat pump calculation implements EN15316-4-2's<sup>4</sup> hourly time-step approach because of the issues discussed above, but with considerable customisation and specification of UK dwelling variables. The calculation method is entitled 'Calculation Method: CALCM:01 – SAP Revised Heat Pump Performance Method'.<sup>5</sup>

The method performs coefficient of performance (COP) calculations for each hour, or fraction of it, depending on: the heating service being delivered (space or hot water); the required flow (sink) temperature; and the source (air or ground) temperature. The annual efficiency estimate is calculated by dividing total energy outputs by total energy inputs.

Hot water is a significant proportion of domestic energy use; the average consumption of UK homes – based on 2.4 occupants and 80 litres of hot water at 55°C – is about 4kWh per day. But this figure, based on Energy Saving Trust data, varies between homes.

The basis of the heat pump calculation method is that average hot-water energy demands must be met before space-heating demands,

with any deficits satisfied by backup direct-electric heating. A standardised schedule for hot-water consumption, based on EN16147 Profile M, is used, with energy consumption adjusted according to the assumed dwelling heat loss (see Figure 1). Values were determined using English Housing Survey data.

For the purposes of SAP – and, arguably, any reliable system-comparison metric – the system boundaries used within this calculation method are identical to the SEPEMO SPF H4 definition (Figure 2). This incorporates all electrical-energy consumption from the space and hot-water system, which includes circulation pumps and backup heating.

### Example calculation results

The ability to interrogate hourly calculation-method results, using the developed calculation engine, is a useful facility that could be employed for many purposes.

Figures 3, 4 and 5 display example results for the same heat pump – with a PSR of 0.8 – where the operating hours vary from 24 hours a day for the coldest day of the year, to 16 and 11 hours on the coldest days that can be supported by these reduced operating hours. The design-flow temperature for the heat emitter system was 55°C. The heat pump in this example must operate for longer to satisfy the standardised SAP heating profile requirement. These figures show that:

- Where a hot-water demand exists, some or all of the space-heating demand on these days must be satisfied by direct-electric heating;
- Operating hot-water heating at times of peak space-heating demand is not optimal. This may not occur in some or many installations in practice, but it is still commonplace;
- The heat pump is able to deliver a larger amount of energy during hours when the ambient (source) temperature is higher (Figure 5).

### Calculation method validation

To determine if the calculation method gives a reasonably accurate estimate of a heat pump system's annual efficiency, it was validated. This included reviewing data, supplied by University College London (UCL), which analysed data from the Renewable Heat Premium Payment (RHPP) metering programme for the government, comprising 700 heat pump installations.

While measurement uncertainty exists – and no design heat-load

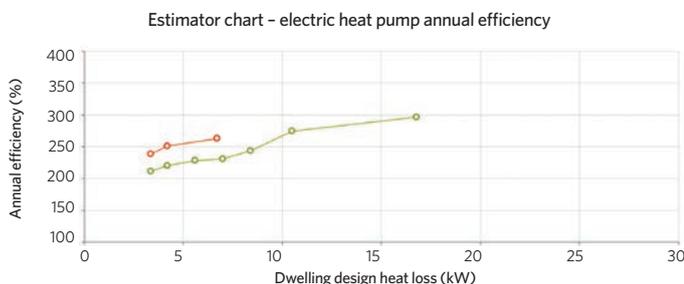


Figure 6: Different heat pumps

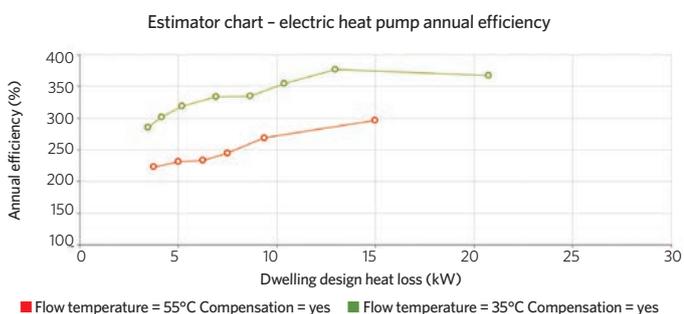


Figure 7: Same heat pump, different design-flow temperature

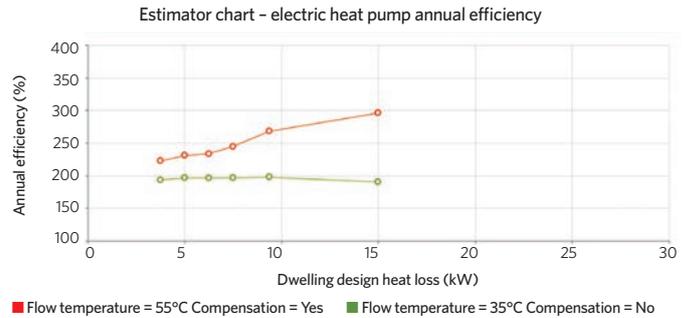


Figure 8: Same heat pump, weather compensation on or off

## “The regulations miss essential criteria for accurately determining heat pump performance in UK homes”

information for RHPP installation sites is available – the calculation method gives reasonable agreement with measured results, and with earlier studies. It is also clear that Ecodesign SCOP values appear to over-predict performance.

### Heat pump performance estimator website

For SAP purposes, heat pump annual efficiency values are calculated by the revised method and held within the PCDB. This has data records for each heat pump submitted by manufacturers and processed by BRE.

To encourage use of the wide range of annual efficiency estimates held in the PCDB, BRE developed [www.bre.co.uk/heatpumpefficiency](http://www.bre.co.uk/heatpumpefficiency).

Figures 6-8 show the website's ability to display the effect of product selection, design-flow temperature and weather compensation on annual efficiency. The x-axis is presented in terms of the dwelling heat loss (kW) and relates to the PSR. [CJ](#)

■ **WILL GRIFFITHS** is head of NCM technology recognition at the BRE Group

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### Acknowledgements

The Department for Business, Energy and Industrial Strategy funded the development of the heat pump calculation method as part of BRE's contract to maintain and develop the National Calculation Methodology (NCM) for energy rating of dwellings (SAP). UCL supplied unpublished data to BRE for the purpose of validating calculation method results.

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## Employing the Internet of Things for smarter buildings

This module offers an introduction to the Internet of Things, and explores various protocols and applications relevant to building services engineering

Some estimate there are already approximately 20 billion devices connected to the Internet of Things<sup>1</sup> (IoT) – and this staggering number is predicted to double by 2022. By comparison, the population of the world is just 7.6 billion. Although a large proportion of these devices are unlikely to affect the world of the building services engineer directly, there are ever more opportunities to use the IoT to enable both traditional – and novel – applications for measuring, supervising and controlling the built environment. And it is the IoT that delivers the connected devices and data streams that underpin the rollout of ‘smart cities’.

This CPD will give an introduction to the IoT, and explore some aspects of protocols and applications relevant to building services engineering.

### The Internet of Things

Just as the adjective ‘smart’ has been appended by marketers to many seemingly mundane systems, so the phrase ‘Internet of Things’ has become increasingly commonplace in the lexicon of building systems. But, despite the possible hype, there are some great system applications emerging that merit serious consideration, and which can rightfully adopt the monikers of being ‘smart’ and ‘internet-connected’.

As discussed in the recent paper by Ted Saarikko<sup>2</sup>, the wider business benefit of the IoT in creating value can be a complicated – as well as an interconnected – process, involving multiple parties and perspectives. But, as he observes, ‘the potential payoff is significant, as a connected product can provide valuable information regarding location, status and use – insights that, in turn, can be used to enhance efficiency in logistics, efficacy in service and maintenance, and innovation in new product development’.

In practical terms, the IoT is a vast network of internet-connected devices that are able to collect and exchange data using embedded sensors that are, in

some cases, able to directly modify their local environment. Advances in technology are driving the development of smaller, cheaper, less power-hungry ‘sensors’, with embedded autonomous computing and communication abilities, and onboard memory. The increasing availability of such widely distributed sensors at the ‘field level’ has coincided with the boom in ‘cloud’ storage. These work together with the massive computing resources now available to implement novel control methods, as well as opening up the potential of truly useful artificial intelligence (AI) in the operation of building systems. The recent paper from M Rinker,<sup>3</sup> based on reviews undertaken up until 2016, indicates that the application of AI in building energy use prediction benefits significantly from the application of ‘ensemble prediction methods’ – those that effectively integrate multiple methods to improve output accuracy of the forecast. The ready availability of reliably collected data is essential to the successful implementation of such AI-driven energy assessment methods. Similarly, the impact of the potentially ‘ubiquitous’ sensor can provide continuous



» feedback from the built environment. This can enable continuous condition-based monitoring – for example by ‘listening’ to a fan coil – and allow user experience, through personal feedback devices, as input into the decision-making for design<sup>4</sup> and operational strategies.

There are many technologies being employed to make the connection between devices, sometimes referred to as ‘endpoints’, in a building – such as occupancy detectors, temperature sensors, cameras, or microphones – and the wider network, through some form of network gateway.

Wireless networks are increasingly replacing the requirement for physical connections in many building services applications. The communication with these field-level devices is known as the ‘physical layer’, in terms of network topologies. Articles by Anna Gerber<sup>5</sup> and Brian Ray<sup>6</sup> present and discuss the principal variants that currently provide the physical layer – their descriptions are abstracted and augmented below:

**Low-power wide area network (LPWAN)** is a category of technologies designed for low-power, long-range wireless communication, so are ideal for use within large-scale deployments of low-power IoT devices such as wireless sensors.

**Cellular (telephone) LPWAN NB-IoT and Long Term Evolution – category MI (LTE-M)** standards are aimed at providing low-power, low-cost IoT communication options via existing cellular networks. Narrow-band IoT (NB-IoT) is the newest of these standards and is focused on long-range

communication between a large number of devices – although it is not yet practically available with many telecoms providers.

**Bluetooth Low Energy (BLE)** is a lower-power version of the widely used Bluetooth 2.4 GHz wireless communication protocol. It is designed for short-range (<100 metres) communication, typically in a star configuration, with a single primary device that controls several secondary devices. BLE also allows mesh connections so that each node in the system acts as both a wireless data source and a repeater – information from a single sensor node jumps from node to node until the transmission reaches the gateway. It is best suited to devices that transmit low volumes of data in bursts, as the devices are designed to sleep to save power when they are not transmitting data. Battery life can extend to months or even years.

**ZigBee and Z-Wave.** ZigBee has a similar range to BLE, of up to 100 metres, and has a slightly slower data-transfer rate than BLE. ZigBee is a mesh network protocol that was designed for building and home-automation applications. A closely related technology is Z-Wave, which is also based on IEEE standard 802.15.4 for low-rate wireless personal area networks. Z-Wave was also designed for home automation, and has recently been released as a public domain specification. Z-Wave’s interoperability layer ensures that devices can share information and so work together. ZigBee and Z-Wave are, by their very nature, short- to medium-range, and Ray<sup>6</sup> reports a HVAC controls application where additional node ‘thermostats’ were needed in a building, solely to ensure that the ZigBee mesh connections consistently worked.

**Radio Frequency Identification (RFID)** tags store identifiers and data, and are attached to devices for one-way reading by an RFID reader. The typical range of a passive (battery free) RFID is less than one metre, while for active (higher frequency) RFIDs (with power source) it can be hundreds of metres. Active tags periodically broadcast their ID, while assisted passive tags become active when the RFID reader is present.

**Near Field Communication (NFC)** is closely related to RFID, but allows two-way short-range communication and was developed primarily to enable secure mobile payments. It is used for very short-range communication (up to 10cm), such as holding an NFC-enabled phone or tag next to a card reader. NFC is also useful for smart labels in asset tracking.

**Dash7** is an open-source communication protocol that uses active RFID, and it is designed for use within industrial IoT applications for secure long-range communication. Signals can penetrate building fabric, so it is particularly suitable for building applications, and this can contribute to a low implementation cost.

Figure 1: A VRF system employing wired and wireless mesh networks to provide optimal operation (Source: Based on Panasonic illustration<sup>14</sup>)

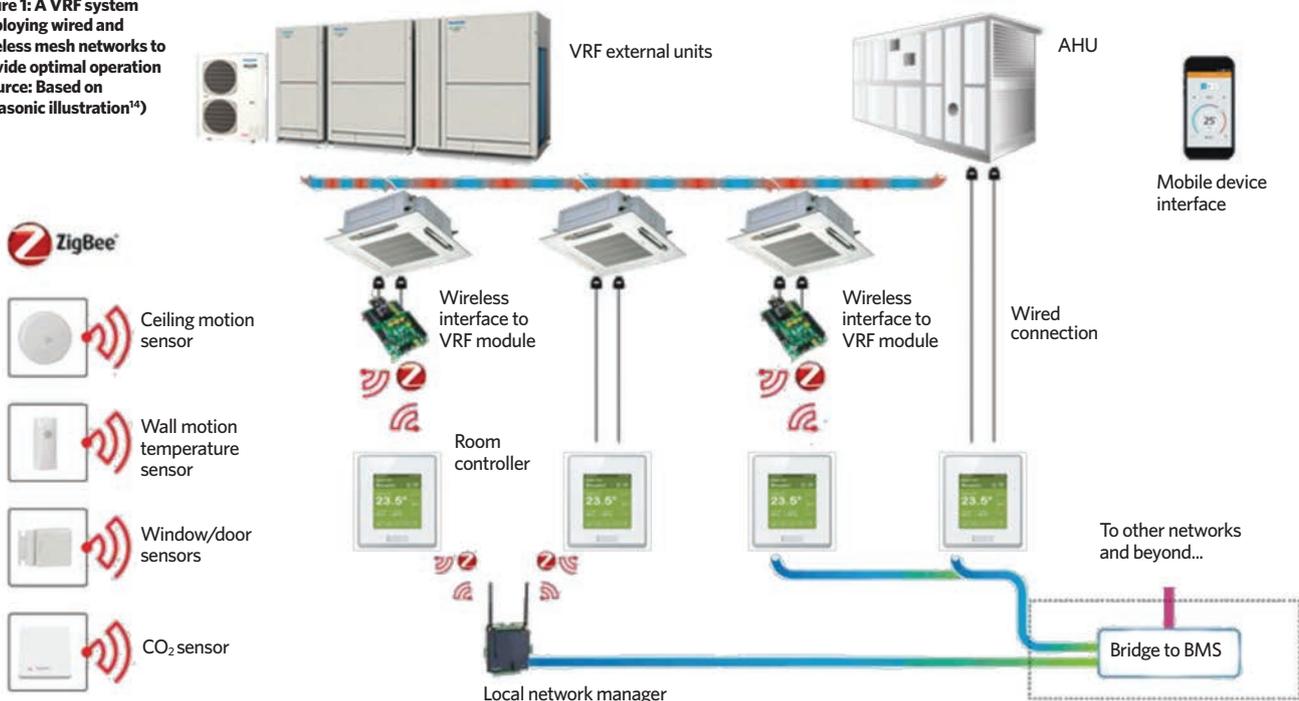




Figure 2: The web interface allows secure interaction from practically any internet-connected browser software (Source: Panasonic<sup>13</sup>)

Wi-Fi is standard wireless networking, based on several IEEE 802.11 specifications. 802.11n offers the highest data throughput, but at the cost of high power consumption, so IoT devices might only use 802.11b or g for power-conservation reasons. As longer-range and lower-power solutions become more widely available, it is likely that Wi-Fi will be superseded by lower power alternatives.

**IoT security**

The global access that IoT offers to building systems introduces new security risks and challenges to the devices themselves, their operating systems and – importantly – the systems to which they are connected. This was identified by Gartner<sup>7</sup> as the No 1 IoT consideration for 2017 and 2018, where security technologies will be required to: protect IoT devices and platforms from information attacks (such as hacking and phishing) and physical tampering; encrypt their communications; and address new challenges such as impersonating ‘things’ or ‘denial of sleep’ attacks that drain batteries. The Gartner report highlights that threats will continue to emerge as hackers find new ways to attack devices and protocols, so ‘things’ that have long lives may need updatable hardware and software to adapt during their lifespan.

The scope of the threat is wide – and increasing – but is feasibly controllable, as with any building system, with proper supervision and maintenance. However, the risks are significant. Compared with traditional physical building systems, it is rather more challenging to be able to identify weaknesses in connected electronic devices, and it requires vigilant attention to the current status of connected components, as well as appropriate emerging technologies. This may include vulnerabilities across the whole connected system that have, for example, recently emerged in anything from the sensors<sup>8,9</sup>, through to the smartphones<sup>10</sup> and computers<sup>11</sup> that are used as human interfaces – as well as weaknesses in HVAC system security, allowing inappropriate access to interconnected systems.<sup>12</sup> The paper by F A Alaba<sup>13</sup> provides a far more extensive account of security risks practically posed by the IoT.

There would appear to be a role for a maintained operational building information model (BIM) that, as part of the building operation and maintenance – and beyond the building’s design and construction phase – keeps up-to-date security audits of connected devices, patches and user alerts, through linking to OEM databases.

**An application of a smart control regime to a variable refrigerant flow (VRF) system**

A smart controller was applied in the variable refrigerant flow (VRF) system, as shown in Figure 1, to enable users to manage and monitor their indoor environment. This smart controller can interface with web-enabled devices, including web browsers, via a building management system (BMS), as illustrated in Figure 2, and smartphones, such as shown in Figure 3. Users are able to adjust the temperature in multiple zones and view the current, and historical, room conditions. This enables users to prevent such things as conditioning unoccupied zones, and can allow the simple resetting of set-point temperatures if the use of the zone is changed.

The smart system can draw on information from occupancy sensing – using passive infrared (PIR) sensors and/or door sensors – and indoor air quality (IAQ, normally using CO<sub>2</sub> and/or VOC sensors), together with humidity and temperature sensors. This enables the room to be operated at different conditions depending on rules that define its use. The management gateway can connect to the wider BMS – which could bridge to protocols such as Modbus, LonWorks and BACnet. This allows the system to draw on inputs, such as external conditions and potentially energy tariffing information. And by linking through the wider network to, for example, separate room-booking systems – or, potentially, by reacting to data from RFID tags in digital room keys or those held by facilities staff – system operation can be automatically adjusted.

Building operators can access a detailed breakdown of the system’s energy consumption on a daily, weekly, monthly or annual basis. This can help end users compare space use with energy consumption and allow adjustment of the system – for example, to prevent unnecessary operation during dormant periods.

Remote access, through the internet, enables specialist installers to offer ongoing maintenance contracts. Maintenance teams can be engaged in preventative monitoring and adjustment that keeps the air conditioning system operating at its optimum level. By anticipating needs, the likelihood of a system breakdown is minimised, and the useful system life can be extended. Response time is reduced for the rectification of faults and implementing changes, so contributing to improved end user satisfaction.

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■ Turn to page 50 for references.



Figure 3: A smartphone offers an interface into the smart control system, allowing both monitoring and set-up (Source: Panasonic<sup>13</sup>)

# » Module 121

January 2018

**1. What is stated as the estimated approximate number of devices currently connected to the Internet of Things, calculated in relation to the global population?**

- A Two for every five people
- B One per person
- C Five for every two people
- D 7.6 per person
- E 10 per person

**2. What does Rinker suggest as being beneficial for AI prediction of building energy use?**

- A Embedded autonomous computing
- B Ensemble prediction methods
- C Enhanced efficiency in logistics
- D Continuous occupant feedback
- E Novel control methods

**3. Which of these is specifically noted as a one-way communications protocol?**

- A BLE
- B LTE-M
- C NFC
- D RFID
- E ZigBee

**4. Which of these is not mentioned as a potential security vulnerability for the Internet of Things?**

- A Denial-of-sleep attacks
- B Impersonating 'things'
- C Information attacks
- D Physical tampering
- E Unavailability of good IoT housekeeping processes

**5. Which of these is not likely to be a principal benefit of a smart control system?**

- A Ability to view current and historical room conditions
- B Remote set-point adjustment
- C Effective system operation in the event of a power failure
- D Opportunity for preventative monitoring
- E Smartphone interface

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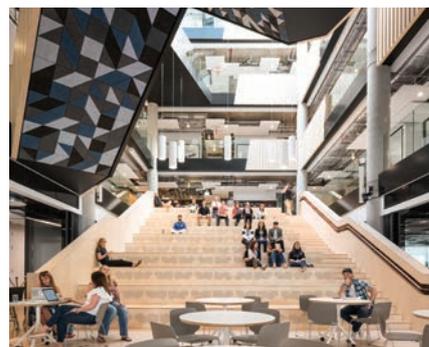
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■ Call 01483 531213 or visit [www.wieland.co.uk](http://www.wieland.co.uk)



## Gripple strikes again with system to speed up and ease services installation >

Gripple, creator of an increasing range of building services suspension systems, has done it again with Fast Trak.

The prefabricated trapeze bracket 'hits the spot' for flexible and safe installation of electrical containment, ductwork, pipework and other mechanical services.

Up to six times faster to install than traditional methods - including threaded rod and channel - Fast Trak offers tool-free adjustment, and is ideal when ceiling space is less than 800mm.

■ Call 0114 2288 623 or email [m.kimberley@gripple.com](mailto:m.kimberley@gripple.com)



## < Noel Lally rejoins Hamworthy as area sales manager

After seven years' service, Hamworthy Heating is saying farewell to retiring Robert Kirk, sales manager for Oxford, Milton Keynes and parts of the Home Counties. In turn, the team welcomes a familiar face - Noel Lally - as his replacement.

Lally, who started as a gas apprentice at North Thames in 1980, has more than 37 years of experience in the industry. He previously worked for Hamworthy from 1996 to 2001, as a field sales engineer.

■ Visit [www.hamworthy-heating.com](http://www.hamworthy-heating.com)



## < Next generation of Gripple's wire suspension solutions has greater SWL

Gripple has developed a complete wire suspension solution for the installation - in all applications - of HVAC, mechanical and plumbing services, offering increased speed, higher load performance and easier adjustment.

The UniGrip replaces the Trapeze and Trapeze Plus products, but combines their functionality and best features, and adds to them. With three models, UniGrip boasts an increased load-rating performance up to 33%, each with a greater safe working load (SWL) of 5:1.

■ Call 0114 2288 713, email [g.bills@gripple.com](mailto:g.bills@gripple.com) or visit [www.gripple.com](http://www.gripple.com)

## > RIW provides waterproofing expertise for Winchester House

A 19-storey residential development, which forms part of the redevelopment of Bracknell town centre, has been supplied with waterproofing systems by RIW, for the construction of the extensive basement and podium areas.

Developed on the former site of 3M's offices, which have been demolished, Winchester House contains 311 apartments, as well as shops and a gym. Comer Homes, which led the project, won Best Luxury Home Developer at the Home Builder Awards 2017.

RIW was involved from the pre-contract phase and worked closely with lead consultant Pure Structures to specify and detail the waterproofing system. Comer Homes is installing the RIW systems, including more than 3,000m<sup>2</sup> of Structureseal, which is being used behind the basement retaining walls and under the reinforced concrete slabs.

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



### ✓ Pola pioneer

Pola, from Future Designs, is a recessed downlighter, offering powerful illumination in a 380mm luminaire size. It is available in various lumen outputs and colour temperatures, and has a spring design for simple installation.

Pola offers energy efficient lighting with carbon reduction to all environments, including office space, accent and perimeter lighting, and reception, breakout, amenity and circulation spaces. It also has homogeneous light and a highly efficient reflector. Other features include a RAL colour to suit tool-free installation, emergency conversions, and links with lighting-control systems and Power over Ethernet. The Pola also has Part L and Enhanced Capital Allowance, low and easy maintenance, long life of 50,000 hours and a Zhaga replaceable LED module.

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



### ✓ Rittal's new laser-machining centre to revolutionise control panel production at firm

Runcorn and Ewloe-based electrical engineering firm LCA Controls has switched its control panel operations from manual production to laser-machining. The move is expected to transform its productivity and efficiency.

LCA Controls, which is under new ownership, has invested in a Rittal Perforex LC 3015 3D laser-machining centre – a system that will revolutionise construction of its stainless steel panels by automating processes previously done by hand.

With its integrated 3D-modelling and computer-aided design (CAD) capabilities, the Perforex LC 3015 can be programmed to manage measuring and machining to an extremely high degree of accuracy. It will allow higher volume orders and enable rapid turnaround of bulk orders, including next-day delivery.

■ Visit [www.rittal.co.uk](http://www.rittal.co.uk) or [www.friedhelm-loh-group.com](http://www.friedhelm-loh-group.com), or follow @rittal\_ltd on Twitter



### Cottesloe School puts Herald boilers at heart of its energy plans

The Cottesloe School, in Leighton Buzzard, has more than 1,000 secondary-age students, and has gone through a number of expansions and upgrades in recent years.

Business manager Nicola Hulland is determined to improve the E rating that the school received on its 2012 Energy Performance Certificate. As a result, five new Herald floor-standing condensing boilers, supplied by manufacturer Lochinvar, were installed last year, to improve comfort conditions for students and staff, and help manage energy use.

Lochinvar's condensing Herald boilers are available in eight models, offering outputs from 41kW to 221kW. Each model features a 316L stainless steel heat exchanger – which improves resistance to corrosion – and is supported by a 10-year warranty.

They also offer very low NO<sub>x</sub> emissions of 39mg/kWh, qualifying them for the maximum three Breaam points available.

■ Visit [www.lochinvar.ltd.uk](http://www.lochinvar.ltd.uk)



### ✓ Impressive results for Evinox ModuSat under BESA HIU testing

Evinox's ModuSat XR heat interface unit (HIU) has achieved impressive results after being tested to the British Engineering Services Association (BESA) UK standard for HIUs.

Launched in late 2016, the BESA UK standard for HIUs was introduced to help designers and specifiers evaluate the performance of a particular unit on their network. It aims to provide HIU benchmarking, similar – in many ways – to the well-known SEDBUK scheme for domestic boilers.

Currently, only a handful of manufacturers have published results for the HIU test regime, with Evinox one of the first to undertake the process.

With an overall volume weighted average return temperature (VWART) of just 33.4°C, impressively low domestic hot-water return temperatures, and the ability to deliver flexible keep-warm operation, the BESA test results offer a clear, independently verified confirmation that the Evinox ModuSat XR range delivers outstanding heating and hot-water performance for modern heat networks.

Mike Shaw, commercial director at Evinox Energy, said: 'We believe independent testing is a vital step forward for the communal and district heating industry and – as one of the UK's most established HIU manufacturers – we were determined to be involved from the early stages.'

'Our latest ModuSat XR and XR-ECO models have been developed with the new standard in mind, and we're confident that this regime from BESA will lead to more efficient heat networks being designed and delivered.'

The BESA standard is currently optional for HIU manufacturers; however, Evinox believes this will be a mandatory requirement in the near future, and asks designers and specifiers to start insisting on the use of BESA-tested units for their heat network projects going forward.

■ Call 01372 722277 or visit [www.evinoxenergy.co.uk](http://www.evinoxenergy.co.uk)



### ◀ New Dunham-Bush appointment to focus on trench and perimeter heating

Dunham-Bush has appointed David Taylor as regional sales manager for its heating division. Primarily, he will be responsible for developing sales of trench and perimeter heating systems.

Taylor brings a wealth of experience in this field, having spent more than 21 years at Jaga Heating, most recently as a major projects manager.

He is particularly pleased to be working for a UK manufacturer renowned for delivering high-quality unitary and bespoke heating solutions.

■ Email [info@dunham-bush.co.uk](mailto:info@dunham-bush.co.uk)

## New production lines will enhance Kingspan portfolio ▼

Kingspan Insulation is investing €17m (£15m) in two state-of-the-art, low-waste production lines at its facilities in Derbyshire and North Yorkshire, enhancing its portfolio of construction and mechanical engineering insulation products.

The prototype Continuous Process Line 3 (CPL3) – which is expected to go live at Kingspan Industrial Insulation’s site in Glossop in August 2018 – is the latest evolution in the firm’s Queen’s Award-winning CPL technology.

■ Call 01544 387 384, email [info@kingspaninsulation.co.uk](mailto:info@kingspaninsulation.co.uk) or visit [www.kingspaninsulation.co.uk](http://www.kingspaninsulation.co.uk)



## Rinnai delivers business-specific hot-water systems ▼

Rinnai UK is spearheading a new concept for economic and efficient hot-water delivery, which brings all the components of a system together in one bespoke, designed pack for businesses.

System thinking has led Rinnai to the point where it can offer a service to design and deliver a complete hot-water system in one, easy-to-install, fully specified and energy efficient ‘pack’. This is delivered direct to site, and meets all the demands of the client in one seamless operation.

Associate director Chris Goggin says specifiers and designers of commercial and domestic projects can consult with Rinnai engineers and be assured they will have the right system for the job when they need it.

A total solution – including water heaters, flues, scale protection, unvented cylinders, valves, prefabrication racks, advanced BMS controls, and water-sampling equipment – can be specified, designed and delivered by Rinnai.

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



## Mikrofill at Goodyers End Primary School, Warwickshire ▼

Three Mikrofill Ethos stainless steel condensing boilers have been installed at Goodyers End Primary School in Warwickshire.

Established in 1996, the primary school decided to replace its low pressure hot water (LPHW) heating plant. The boilers and ancillaries were removed, and replaced with new Mikrofill equipment by contractor Dodd Group. These included three Ethos 90kW condensing boilers, each with an integral shunt pump giving a total modulation of 30 > 1 (270 > 9kW).

Supplied with free-standing support frames, Mikrovent 750 low loss header and air/dirt separator, and a cascade header sensor, the new boilers supply variable temperature (VT) circuits around the lower school area. The new LPHW installation was complemented by a Mikrofill 400 precommissioned pressurisation package. The upper school’s hot water supply was further enhanced by the installation of an Extreme 500-litre loading cylinder. The Extreme plate heat exchanger operates at a  $\Delta t$  of 30°C, optimising condensing boiler efficiency.

■ Call 03452 606020 or visit [www.mikrofill.com](http://www.mikrofill.com)



## KoolDuct still performing swimmingly at leisure centre after 15 years ▼

The Gloucester Leisure Centre – now renamed GL1 and managed by Aspire Sports and Cultural Trust – features four swimming pools, a gym, and spa areas. It has a top-quality specification, which includes the use of Kingspan’s KoolDuct preinsulated ductwork system.

A total of 9,000m<sup>2</sup> of the system was installed in 2002, to fabricate ductwork in a variety of sizes, from 1,800 x 1,200mm to 200 x 100mm, connecting to eight air handling units.

■ Call 01544 387 384, email [info@kingspaninsulation.co.uk](mailto:info@kingspaninsulation.co.uk) or visit [www.kingspaninsulation.co.uk](http://www.kingspaninsulation.co.uk)



## Underfloor air conditioning upgrade for Avaya fit-out ▶

AET Flexible Space, underfloor air conditioning systems provider, has completed commissioning new equipment installed in the refurbished office buildings at the Cathedral Hill Campus, Guildford, for occupier Avaya. The plenum under the building’s raised access floor is split into ventilation zones. Each zone is supplied with conditioned air, fed into the plenum by zonal downflow units, and supplied into the workspace via fan terminal units (Fantile), with adjustable controls.

■ Call +44 (0)1342 310400, email [lucy@flexiblespace.com](mailto:lucy@flexiblespace.com) or visit [www.flexiblespace.com](http://www.flexiblespace.com)

## Grundfos graduates with honours ▶

The University of Edinburgh admitted its first students in 1583, making it the sixth oldest English-speaking university in the world.

The McEwan Hall is the university’s venue for graduations, examinations and concerts. Dating back to 1897, it was in need of a refurbishment that would improve access, and repair and upgrade the building services. Grundfos Pumps worked in partnership with Buro Happold and Arthur McKay Building Services to deliver a new M&E solution. This included Grundfos energy-efficient circulators, which will support all the heating, cooling and hot-water demands.

Completion of this £35m upgrade means the hall will continue to play its role in the life of the university for many years to come – but, with added flexibility, it will also be used for an even wider range of events and activities.

■ Call 01525 850000 or visit [www.grundfos.co.uk](http://www.grundfos.co.uk)



## Luceco LED lighting > refurbishment at the University of Chester

Luceco has supplied a cost-effective, energy-saving LED lighting solution for three major buildings at the University of Chester's Parkgate Road Campus. The lighting design brief was to reduce the energy consumption of the Best, Westminster and Chritchley buildings, with a payback of within five years.

A selection of fittings - including more than 750 LuxPanel luminaires - were installed. Easy to fit, with no maintenance requirements and no visible frame when placed in the ceiling grid, high-efficiency LuxPanels have the additional benefit of 13% extra visible light, compared with other LED panel luminaires.

More than 200 circular LuxPanels were fitted, mainly in circulation areas and toilet areas. Featuring slim-framed panels, circular LuxPanels offer luminous uniformity and can be supplied as standard with emergency packs or with dimmable remote drivers in 240, 180, 150 and 120mm sizes.

Other luminaires installed in transit areas include the Atlas Bulkhead, an alternative to traditional 28- and 38-watt 2D compact fluorescent fittings. Selected Atlas luminaires were fitted with an integral microwave sensor to further reduce energy consumption.

Replacement lighting for the sports hall required compliance with Sport England guidelines, and LuxBay luminaires from Luceco were selected. LED LuxBay is environmentally friendly, with no warm-up time to produce 100% light output. Variants include 100, 150 and 200 watts, with either a wide or narrow clear lens, offering more than 50,000 hours of operational life.

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



## ^ Ideal Commercial announces free commissioning offer

Ideal Commercial Boilers is pleased to announce the launch of its free commissioning offer. All Evomax, Imax Xtra, Imax Xtra EL and Evomod boilers, installed after 1 January 2018, will be eligible for the offer, worth up to £233 per boiler.

The introduction of the offer is a first for the UK commercial boiler market. A new online commissioning booking process will also make the free commissioning offer easy for customers to claim.

■ Call 0844 543 6060, email [commercial@idealboilers.com](mailto:commercial@idealboilers.com) or visit <http://www.idealcommercialboilers.com>

## < New Trox PWX fan-coil range redefines energy efficiency and acoustic performance

Trox has announced the launch of a major new fan-coil range - the Trox PWX series. This brings to market a 25% to 35% energy efficiency improvement over alternative models, with outstanding acoustic performance and BACnet-enabled integrated controls packages as standard.

The new products have undergone thorough in-house testing - using Trox's test chamber, which is constructed to comply with ASHRAE 79, BS1397 and Eurovent 6/3) - and have been subject to extensive corroboration of results at an independent test facility.

Specifiers can input exact performance criteria for an extremely wide range of thermal and acoustic scenarios, instead of using less reliable 'anticipated' or 'expected' data. The Trox PWX range is therefore able to speed up the specification of projects significantly, reduce levels of risk, streamline installation and commissioning, and provide valuable environmental and cost benefits. While units have the same dimensions - 270mm deep - to meet market requirements, they feature new inlet attenuators, inlet plenums and discharge attenuators, capable of achieving outstanding performance across a wide range of applications.

■ Call 01842 754545 or visit [www.troxuk.co.uk](http://www.troxuk.co.uk)



# > DIRECTORY Your guide to building services suppliers

Tel: 020 7880 6217 Email: [callum.nagle@redactive.co.uk](mailto:callum.nagle@redactive.co.uk)

### Air Handling



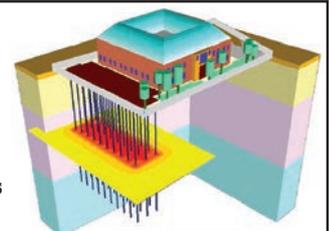
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### Fire Design Engineers

**Kent, Surrey, Cambs. £30 - £50k + benefits**

A fast paced, highly successful, employee focused consultancy are looking for experienced people to deliver fire engineered solutions. Knowledge of UK legislation for design from brief to operation is essential as is an understanding of producing fire strategies. These are great opportunities to join an ambitious company with inspirational people working with blue chip clients on complex projects. Ref: 4736

### Lead Mechanical Engineer

**Central London, £42 - £47p/h**

This represents a great opportunity for a Lead Mechanical Engineer to join a front runner within the mission critical sector, an innovative company, looking for inventive and intelligent engineers that can solve complex problems. The requirement is for a Lead Mechanical with demonstrable UK consultancy experience and mission critical project exposure specifically Data Centres. Ref: 4607

### Head of Building Services

**Cambridgeshire, £60 - £80k + benefits**

An established multi-disciplinary consultancy are seeking to increase their offering by developing an MEP division in their Cambridge office. They are seeking an experienced senior manager with a successful background of design, project delivery, commercial and business development. You will be working with end clients, stakeholders and alike whilst hiring, and managing a team of engineers at all levels. Ref: 4730

### Electrical Engineer

**London, £40p/h**

I have a requirement for a contract electrical engineer to work on a long-term contract in London. You will provide designs from conception through to completion on high end commercial projects. The work is predominantly low voltage, lighting, electrical power distribution and alarm system designs. Similar experience is essential. Immediate start. Ref: 4748

### Principal Mechanical Engineer

**North London, To £60k + benefits**

An exciting opportunity reporting directly to one of four partners within a rapidly developing consultancy, established 30 years ago has arisen. Working closely with clients and leading a team you will deliver some of London's biggest projects. Must be driven and ambitious as my client actively encourages quick progression. Excellent salary and benefits. Ref: 4727

### CAD/Revit

**North London, To £38k + benefits**

An exciting opportunity for an MEP CAD/Revit Technician (3-4years experience) as arisen within a rapidly developing consultancy, established 30 years ago. You will work closely with clients while servicing several M&E teams on multiple projects with values of up to £200 million. Must be driven and ambitious as my client actively encourages quick progression. Excellent salary and benefits. Ref: 4739

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





## Group dynamic

The new CIBSE HVAC Special Interest Group will consider every stage of the design, installation and operation of heating and cooling systems. Operational director Phil Draper is keen to ensure the supply chain understands the consequences of poorly set up services

The CIBSE heating ventilation and air conditioning (HVAC) Special Interest Group was launched at Build2Perform in November. The aim of the group is to share knowledge across the building services sector to improve the performance of buildings.

The group will be focusing on the HVAC supply chain from design through to operation. Among the speakers at the launch was property specialist Phil Draper, who said that many buildings' HVAC systems were not optimised for performance at handover.

'The big problem we have in the industry is having to put non-completed buildings right without upsetting the client,' he says. 'There's no money to do this, as you don't have a budget to improve the building for another five years.'

He said that in-house staff did not always have the competence to fix issues, such as inaccurate meter readings, often found in new buildings.

Draper also said that engagement with the end user was crucial to ensure HVAC was optimised. He recalled making large savings by timing systems to turn off at 6pm rather than the default of 7pm, after speaking to the occupant and finding out that no-one worked that late.

The first event for the HVAC Special Interest Group will be at Hoare Lea on 24 January.

### Q Why are you involved in the HVAC Special Interest Group?

A As soon as I was invited to join the group, it instantly appealed to my desire to try to improve the HVAC system in our buildings across the UK. The chance to work with CIBSE and the other committee members, who have a vast experience of building services, was a key reason why I got involved. I want to work with people with a shared passion in wanting to improve. It will be a great path to walk down.

### Q What needs to happen to improve performance?

A One of my strengths is in using the data that metering and BMS can give us. I feel that how this information is used and fed back into designs, on both new and existing buildings, is how the performance of the HVAC equipment will

improve. I have already used this data to achieve savings of more than 70% in base building energy, so I know it's possible. The designs and operations are based on the extremes in temperatures and occupancy, but systems often don't work at these extremes. How we set up and operate the HVAC systems during regular hours is how the performance can be improved.

### Q Does the industry need more engineers operating buildings or more staff training?

A The industry needs more engineers to identify and advise on how to operate buildings, and then to train the operatives of the building in how to implement and maintain it. Building services and HVAC systems are wide and varied, so training shouldn't just be in a classroom, but onsite and with the manufactures and installers.

### Q Is smart building technology an opportunity or will it overcomplicate building operation?

A Smart buildings and associated technologies are a great opportunity to identify ways of improving performance and engaging with occupiers and clients by changing operation to suit the building needs, which could be different to how it was designed. The technology – if installed correctly and displayed in a suitable format – can be the best new tool in the engineer's toolbox. It can monitor the HVAC systems in real time to identify both good and poor performance and, ideally, feed the information to the right operative.

### Q Will mandatory HVAC monitoring help improve performance?

A Any monitoring of system, if done correctly will improve performance, as people don't know what they don't know. It's these reviews of performance that should be used to identify the inefficiency and – more importantly – what should be done to improve the operation. Things like air conditioning inspections shouldn't be seen as just compliance documents, but a chance to make a system operate better. Although, the inspection and its outputs will only be as good as the person inspecting it and the data they have available to them at the time of inspection.

■ **PHIL DRAPER** is operational director at Cavendish Engineers

## NATIONAL EVENTS AND CONFERENCES

### Society of Light and Lighting: Light Bites

25 January, Birmingham  
22 February, Bristol

The 2017-18 SLL Lighting Knowledge Series, Light Bites, continues in Birmingham in January, before moving on to Bristol in February. The day includes peer-reviewed, bitesize presentations focusing on four key areas: design, build, specify and future. Speakers will include: Lee Thomas and Nick Van Tromp, from Fagerhult; Steve Shackleton, from Zumtobel Group; Helen Loomes, from Trilux; and Roger Sexton, from Xicato. The series will continue through to June 2018.  
[www.cibse.org/sll](http://www.cibse.org/sll)

### CIBSE Building Performance Awards

6 February, London

The winners of the 14 categories for the 2018 CIBSE Building Performance Awards will be unveiled. Join host Mark Watson to celebrate excellence and achievements in building performance, and to network with more than 700 guests from across the built-environment sector.  
[www.cibse.org/bpa](http://www.cibse.org/bpa)

## CIBSE TRAINING

For details, visit [www.cibse.org/training](http://www.cibse.org/training) or call 020 8772 3640

### Practical controls for HVAC systems

12 January, London

### Low carbon consultant building design and EPC

16-17 January, London

### Practical project management

18 January, London

### IET wiring regulations (17th Edition)

19 January, London

### Mechanical services explained

23-25 January, Birmingham

### Electrical services explained

23-25 January, London

### Fundamentals of digital engineering

24 January, Birmingham

### Power system harmonics

25 January, London

### Fire risk assessment to PAS 79

26 January, London

### Low carbon consultant building operations and DEC

30 January - 1 February, London

### Lighting: legislation and energy efficiency

2 February, London

### Complying with ESOS: The ISO 50001 standard explained

2 February, London

### Mechanical services explained

6-8 February, Manchester

### Fire detection and alarm systems for buildings

6 February, London

### Energy efficiency building regulations: Part L

6 February, Birmingham

### Fire sprinkler systems: design

7 February, London

### ESOS - Energy savings opportunity scheme

8 February, Manchester

### Introduction to combined heat and power (CHP)

9 February, London

### Building services one-day overview

9 February, London

## CIBSE GROUPS, SOCIETIES AND REGIONS

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

### North East: Heat pumps and decarbonising of heat

9 January, Newcastle upon Tyne

With speaker Dr Chris Underwood, of Northumbria University.

### CIBSE closing date surgery

11 January, London

Applicants for the 1 February closing date can book a 20-minute slot with a CIBSE interviewer to discuss the draft engineering practice report and interview process.

### SoPHE: Using CHP with prioritised DHW systems

17 January, Manchester

A talk by Jason Fretwell, of AO Smith.

### Southern and SLL: Non-visual responses to light and health and wellbeing

23 January, Eastleigh

Professor Debra Skene, section head of chronobiology at the University of Surrey, and president of the European Biological Rhythms Society, will discuss studies conducted by her and her team into light's influence on human chronobiology, circadian rhythms and pineal melatonin.

### Scotland: Soft landings in practice

23 January, Edinburgh

After an overview of the soft-landings process, the talk

will look at the performance gap from the perspective of balancing architectural and M&E strategies.

### East Midlands: Cyber security for building systems

23 January, Ashby-de-la-Zouch

Evening CPD event to raise awareness of the risks involved - and good practice to be adopted - with IT systems, to minimise issues.

### South West: Water treatment in commercial heating systems

24 January, Bristol

Russ Walliss will focus on best-practice water treatment system of 'clean, protect, maintain', complemented by various case studies that offer real-world examples of the problems and cost associated with them.

### Daylight group: Daylight in major projects

24 January, London

With speaker Jürgen Koch, of 4 Green Architecture, looking at two award-winning projects, and Laura Philips, of Buro Happold, discussing the realities of delivering daylight projects on site.

### North West: Annual celebration dinner

26 January, Manchester

Relaunching the annual dinner at the Midlands Hotel, in Manchester, to coincide with the region's 90th anniversary, with guest speaker Eddie 'The Eagle' Edwards.

### ANZ: Fire stopping of services penetrations

31 January, Brisbane, Australia

What you need to know for a compliant installation.

### Scotland: Membership briefing

31 January, Glasgow

Briefing with focus on Associate and Member grade applications, and registration with the Engineering Council.

### East Anglia: Fan curves in details

1 February, Cambridge

CPD event with overview of fan curves, including an introduction to fan-curve software.

### SoPHE: Blue roofs

6 February, London

A talk by ABG.

## HIGHLIGHT



Comedian Mark Watson will host the awards on 6 February

## CIBSE Scotland Conference: Opportunities for growth in the building engineering sector

20 March, Glasgow

CIBSE Scotland is to host a one-day conference at the University of Strathclyde to explore opportunities for growth of the building engineering sector in the region. CIBSE President Peter Y Wong will deliver the opening address, before talks from speakers including: Ann Allen, executive director of estates and commercial services, University of Glasgow; Chris Stark, director of energy and climate change, Scottish government; Zeb Ahmed, deputy managing director, Bouygues Energies & Services Contracting; Tamsin Tweddell, senior partner, Max Fordham; and Ant Wilson MBE, director, Aecom.

Toby Jeavons, associate partner at Rogers Stirk Harbour & Partners will offer an architect's perspective and Alistair Murray, UK leader of Arup Fire, will talk about issues concerning fire safety and protection in buildings. For more information and to book, visit [www.cibse.org/scotlandconference](http://www.cibse.org/scotlandconference)



Technology Innovation Centre, University of Strathclyde

# GREEN INFRASTRUCTURE DESIGN CHALLENGE

## CALL FOR ENTRIES

Closing date: 19 February 2018

Announcement & exhibition: 06 March 2018

CIBSE & UKCIP warmly invite you to take part in the third annual GI design challenge!

Supported by ecobuild, this challenge provides an opportunity to showcase what constitutes a healthy, productive and sustainable urban environment both now and as the climate changes. From a building performance perspective as well as the improvement of surrounding public spaces, the challenge will highlight the role of building-level green infrastructure such as green roofs, internal or external living walls, indoor farms and gardens, and collections of plants.

The objectives of this challenge are to:

- showcase opportunities to improve the liveability of our cities through GI
- demonstrate how GI can make an area an attractive place to work
- demonstrate how GI can contribute to improved health and wellbeing
- improve energy efficiency and climatic resilience

Find out more from:

[www.arcc-network.org.uk/gi-challenge](http://www.arcc-network.org.uk/gi-challenge)

# CMR

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CMR Controls manufactures low air pressure and air volume measurement sensors and control systems for standard air conditioning, clean rooms, sterile laboratories, containment facilities, and fume cupboard extract systems.

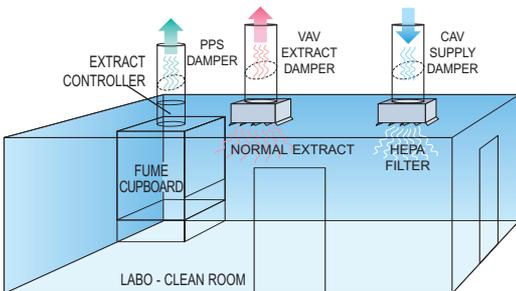


### DPM PRESSURE SENSOR

Panel Mount Pressure or Velocity Transducers with remote alarms, analogue and digital interfaces. Traceable calibration certificates supplied as standard.

### AIR MANAGEMENT SYSTEM

A complete turn-key system to control room pressure to +/-1Pa. Fume cupboard face velocity to 0.5m/s at high speed and provide constant air changes into the labo - clean room.



### PRECISION COMPONENTS FOR VENTILATION AND PROCESS CONTROL

## CMR CONTROLS

A Division of C. M. RICHTER (EUROPE) LTD

22 Repton Court, Repton Close,  
Basildon, Essex SS13 1LN. GB  
Website: <http://www.cmr.co.uk>

Tel: +44 (0)1268 287222  
Fax: +44 (0)1268 287099  
E-mail: [sales@cmr.co.uk](mailto:sales@cmr.co.uk)



### DPC CONTROLLER

Fast and accurate controls to drive high speed dampers or invertors. Full PID stand alone controls with BMS interface.

### CAV AND VAV DAMPERS

Accurate air flow measurement with the unique CMR Venturi built into the airtight shut-off damper to control room pressure or constant volume.

Metal Damper



### PPS EXTRACT DAMPER

Poly-propelene control and shut off valve incorporating the CMR Venturi Nozzle. This is essential when dealing with corrosive extract air especially from fume cupboard systems.

PPS Damper

