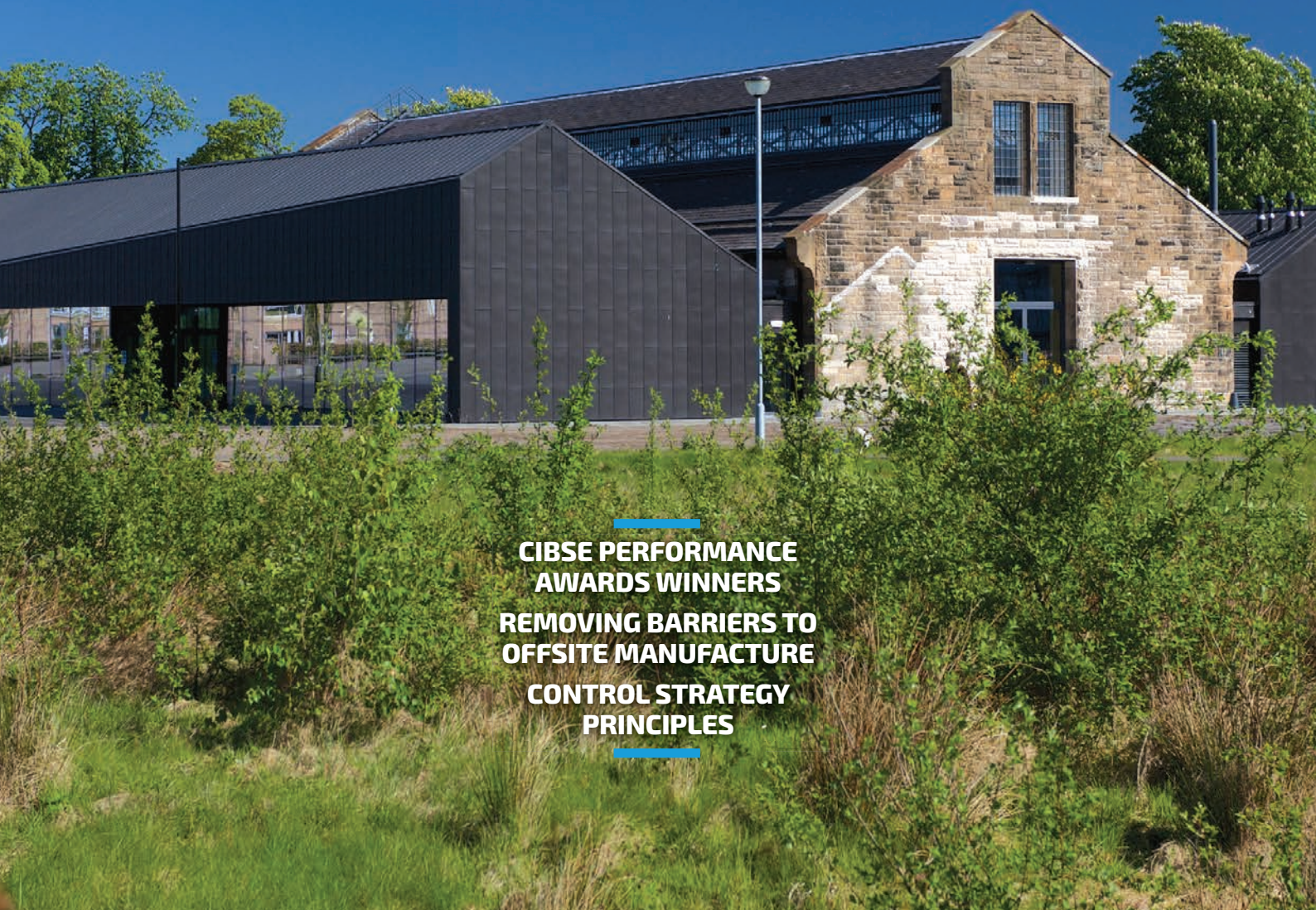
CIBSE JOURNAL

#Build2Perform

March 2020 www.cibsejournal.com

# HISTORY LESSONS

Historic Environment Scotland's conservation centre – The Engine Shed – crowned Building Performance Champion



CIBSE PERFORMANCE AWARDS WINNERS

REMOVING BARRIERS TO OFFSITE MANUFACTURE

CONTROL STRATEGY PRINCIPLES

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# Time to lead the way

When the CIBSE Building Performance Awards guest speaker, Yewande Akinola, challenged engineers to become campaigners for change, she reminded the audience of the critical role they have in driving society towards a more sustainable zero carbon future.

In a rallying speech at Grosvenor House London, she said engineers needed to show the 'clients, kids and the Gretas' that 'we've got this'.

It was encouraging to hear, from guests at my table at least, that clients were now starting to demand resilient buildings with a lasting green legacy. One said that clients had been moved to act by their children, who were asking them what they were doing about the rising sea levels and the loss of environmental habitat. And it wasn't just the performance of their buildings that they were worried about; they were also concerned about the amount of embodied carbon in product components. This was borne out by comments at *CIBSE Journal's* roundtable on offsite construction, with Landsec's Neil Pennell saying it was important manufacturers gave accurate information on embodied energy, in a standardised, comparable way (page 44).

The 2020 CIBSE Building Performance Champion – The Engine Shed – had the benefit of an engaged client that was keen to ensure sustainable targets were met throughout the lifetime of the project. Max Fordham worked closely with Historic Environment Scotland to create a range of targets in a 'sustainability matrix' covering energy management, thermal comfort, construction materials and waste. Crucially Max Fordham invited the estates team to review the matrix so the design team could understand how the operational measures would be implemented.

A two-year aftercare programme included a post-occupancy evaluation once the building opened. The value of such a survey quickly became apparent; it identified overheating caused by an erroneous BMS output that was overriding the manual ventilation inlets, shutting them down in the summer. Without an aftercare plan, this would have been difficult to spot.

Max Fordham, which also won Project of the Year – Public Use for the same project, put together a building user guide to help the operator understand how each control related to the building's services strategy (page 32). This is where, too often, building performance unravels. Hopefully, an aftercare strategy will become the norm in the years ahead – something that will be given a boost by RIBA's 2020 Plan of Work, which aims to encourage an 'in-use' approach to design and a 'light-touch' post-occupancy valuation at the end of handover.

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## CONTRIBUTORS

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**Joel Gustafsson**
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# CIBSE BUILDING PERFORMANCE AWARDS 2020

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### HIGHLY COMMENDED
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### PROJECT OF THE YEAR – RETROFIT
- Bartlett School of Architecture, 22 Gordon Street – BuroHappold Engineering

### PROJECT OF THE YEAR – RESIDENTIAL
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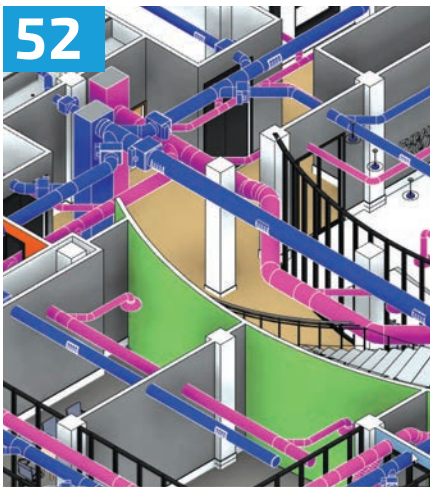





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## BRITISH ANTARCTIC SURVEY'S LATEST FACILITY BREAKS GROUND

Construction of the Discovery Building, a new operations facility for the British Antarctic Survey, started on site in January, at the Rothera Research Station. The project is being delivered by BAM, design consultants Sweco, and Hugh Broughton Architects, with Ramboll acting as technical advisers, with NORR architects and Turner & Townsend.

The two-storey, 4,500m² building's envelope will be formed with composite insulated metal panels and triple glazing to create an airtight and thermally-efficient enclosure. Rooflights will bring natural light into the centre of the building.

# Frustrated Dame Judith tells industry to 'get on with it'

**Scope of regulator would include all buildings assessed against a range of risk factors, said Dame Judith**

Dame Judith Hackitt has expressed frustration at how slowly the changes she demanded in her review of building and fire-safety regulations are being made, but said the industry should not be waiting to be told what to do and would be held accountable for its past failings.

She told a conference organised by technology firm NBS that the new building regulator would not be appointed until sometime next year, but said she hoped the regime would be operating 'in shadow form' before then.

Dame Judith added that it was 'folly' for the industry not to be taking responsibility now and 'putting right the sins of the past'.

She is chairing the transition board that will appoint the new regulator, who will be managed by the Health and Safety Executive. It follows the government's decision to accept all the 53 recommendations she made in her review.

The whole supply chain would be in the firing line, said Dame Judith, because product testing, marketing, labelling and approval processes were all 'flawed, unreliable and behind the times'. There will be serious penalties for those who fail to comply with the regulations, she added, saying it would be more than a 'rap on the knuckles' under the new system.

Dame Judith wants to see more data and performance accreditation, and the use of standardised systems, plus greater collaboration across the sector.

Dame Judith Hackitt

'This is a once-in-a-generation opportunity to leave the race to the bottom behind and change industry practice for good,' she told the NBS conference on 13 February, confirming that the scope of the regulator would move beyond the high-rise residential sector, with all buildings assessed against a range of risk factors.

The government had already broadened the scope last year, by proposing it cover buildings of more than 18m, compared with the 30m originally proposed.

'It is about the number and the vulnerability of the people who are exposed to risk – that is what this is all about,' said Dame Judith.

## 'Generational change' because of Hackitt Review

The building services sector is facing a period of unprecedented change as a result of the government's decision to accept all the recommendations in the Hackitt Review, according to CIBSE technical director Hywel Davies.

In his annual policy report to the CIBSE Patrons, Davies said the industry was facing 'once-in-a-generation – possibly two generations' upheaval, as it is forced to adapt to fresh legislation and a completely new competence framework.

According to Davies, there will be the most far-reaching reform of fire-safety legislation in half a century and a total resetting of building safety regulation. Membership of professional bodies alone will not be enough to satisfy the new competence rules being drawn up, he added.

'We have 27 million buildings in this country that will still be with us in 2050… and we will need to refurbish them all to meet new energy efficiency standards,' he told the Patrons meeting at the RAF Club in London. '2050 is only 9,000 days away – so that's 3,000 buildings a day.'

Patrons chair Nick Mead said this was a huge wake-up call for the industry, which would have to stop 'building and designing', but ensure all projects were properly planned, costed and designed before starting work on site.

## IN BRIEF

### Scotland ups pace on low carbon heat

New regulations are being developed to ensure all new homes in Scotland use renewable or low carbon heating systems from 2024. The rules will also be phased in for non-domestic buildings given consent to build from 2024, according to Scotland's Energy Minister, Paul Wheelhouse.

Scotland has pledged to reach 'net zero' emissions by 2045 and to reduce emissions by 75% by 2030.

'The pace of decarbonising Scotland's buildings has to increase significantly to achieve those aims, and emissions from our buildings will have to fall close to zero,' said Wheelhouse.

The Scottish government said it was also reviewing building regulations to improve the energy efficiency of new buildings.

### Refcom welcomes greater 'certainty'

An agreement between the EU and the UK to continue the mutual recognition of professional certification should put the refrigeration and air conditioning industry at ease, says the UK's primary F-Gas register, Refcom.

Months of protracted negotiations have produced 'clarity and certainty' for firms that operate in different parts of the EU, who feared their proof of competence would cease to be recognised after the UK formally withdrew from the EU at the end of January.

Refcom registration will continue to be accepted throughout the EU during the transition period – which will last until the end of this year – and probably beyond, as the UK and the EU thrash out a longer-term trading agreement.

### New refrigerants transforming market

Alternative refrigerant options are starting to reshape markets, claims a BSRIA report.

Sales of systems with capacities of up to 50kW rose to £11.5bn across Europe last year. While R410A was still the most commonly used refrigerant, R32 – with lower global warming potential – had increased its market share to around 37% of all split systems. That share is expected to reach 80% by 2023.

Last year, 80% of heat pumps sold in Europe were designed for R410A, with R134A units second.

# Three-quarters of new houses should not have been built

**Less affluent areas 10 times more likely to get poorest-quality designs, said UCL**

Most new housing developments in England are 'mediocre' or 'poor', according to a national audit by University College London (UCL).

The exercise, undertaken on behalf of charity CPRE and the Place Alliance, looked at 140 projects built since 2007. It concluded that 75% should not have been allowed to go ahead as designed, while one in five should have been refused planning permission because they did not comply with the National Planning Policy Framework (NPPF).

More than 50% should not have been given planning permission without significant improvements to their design, according to the study. UCL also found that less affluent communities were 10 times more likely to get the poorest-quality designs.

'Planning authorities are under pressure to deliver new homes and are prioritising numbers in the short term over the long-term negative impacts of bad design,' said Matthew Carmona, who led the research on behalf of UCL's Bartlett School of Design.

A report by the Building Better, Building Beautiful Commission said the government should create a fast-track planning system for well-designed schemes as part of a wide-ranging reform of the development process.

The commission, set up by former housing secretary James Brokenshire, recommended changes to the National Planning Policy Framework (NPPF) that would make it easier to turn down planning applications on design grounds.

It also attacked the 'permitted development' policy, which it said had led to hundreds of 'slum developments'.

One in five developments built since 2007 did not comply with the NPPF

# Offices waste energy worth £60m

UK businesses are wasting £60m on excessive energy bills every year, according to a new report by Green Alliance.

Offices in the City of London alone are losing £35m and the energy wasted by 3,300 offices in Manchester, Bristol, Leeds and Birmingham is worth £25m annually.

'We all work for or know businesses that waste energy – whether it's leaving lights on at night or wasting heat. It's hard to see why dealing with this problem isn't yet a priority for companies, in terms of cost savings, or for the government in reaching its carbon targets,' said the Green Alliance's senior policy analyst Caterina Brandmayr.

'Digital technology is an obvious and inexpensive way to track and control energy use, cutting business costs and carbon emissions. Cities will play a leading role in cutting emissions and would be a great place to start the UK's business energy efficiency revolution.'

The Green Alliance has also called for wider adoption of smart sensors and algorithms that can track and modulate energy use, as well as more investment in existing artificial Intelligence optimisation systems that could cut energy use in commercial buildings by 14%.


Robert Jenrick

# Minister urged to rethink 'inadequate' Part L plans

**New homes could be less energy efficient than those built to the 2013 regulations, say architects**

A group of architects has written to Robert Jenrick, Secretary of State for Housing, Communities and Local Government, urging him to step back from 'inadequate' energy efficiency standards proposed for the revised Building Regulations.

The Architects Climate Action Network wrote to the minister expressing its alarm at the apparent relaxing of energy efficiency levels being considered in the consultation on Parts L and F, as part of the Future Homes Standard.

If the changes are made, the architects say new homes would be less energy efficient than those built to the 2013 version of the regulations.

It called for the Fabric Energy Efficiency Standard (Fees) to be retained and upgraded – rather than scrapped, as is being proposed – to help reduce the energy use of all new homes to net zero from 2025.

Energy consumption reporting should also be easily understandable, it added, and claimed the use of carbon factors would be 'a step backwards' that would disguise poor fabric efficiency through 'over-reliance on a decarbonised grid'.

CIBSE responded to the consultations last month, in collaboration with organisations such as LETI, RIBA and UK-GBC. In its response, it said there was a need for improved fabric requirements, attention to whole-energy consumption and the in-use stage.

It said that proposed reduced fabric requirements and direct electric heating would have impacts on fuel-poverty and peak electricity demand. CIBSE also said local councils should be able to implement more onerous carbon-reduction requirements (page 28).

# Bill may 'downgrade' green policy

The government's planned Environment Bill is finally before parliament and includes new measures on clean air and biodiversity.

First drafted in late 2018, the bill had been expected to move to the committee stage last November, but was delayed by the General Election and Brexit.

It claims to go beyond EU standards in a number of areas and commits the UK to legally binding targets on air quality, including reducing the amount of fine particulate matter (PM 2.5) in the atmosphere and increasing the power of local authorities to address sources of pollution.

However, MP members of the Environmental Audit Committee (EAC) said the implementation of the bill without any changes from its draft form would lead to key national environmental policies adopted under the EU being 'severely downgraded'.

The bill includes the creation of an independent Office for Environmental Protection, which will act as a 'watchdog' on environmental policy and law. It will be able to take action against public authorities that fail to uphold environmental standards and will oversee efforts to reach net-zero emissions by 2050.

## Patrons celebrate diversity and collaboration

CIBSE Patrons marked its 40th anniversary with a reception on the viewing gallery of London's Tower Bridge.

Patrons' chair Nick Mead said the setting was appropriate because of the group's success in 'building bridges' between different parts of the industry.

'Collaboration has always been at the heart of what we do,' he told more than 100 members and guests. 'We have always remained true to our roots as a financial supporter of CIBSE and its vital projects – particularly around nurturing talent and the wide range of initiatives designed to attract, encourage and improve the recruitment, development, training and retention of young engineers.'

Guest speaker Jay Surti urged Patrons to keep encouraging greater diversity in engineering professions. The civil engineer turned lawyer pointed out that just 12% of Britain's engineers are women, at a time when the industry is suffering from an acute skills shortage.

'We need to address outdated perceptions about women in engineering and raise greater awareness of the opportunities for people from all backgrounds in this sector,' she said.

Lauding Patrons' role in encouraging collaboration, CIBSE chief executive Stephen Matthews said 'we only get better if we share our knowledge and work together'.

Patrons' annual House of Lords lunch, on 21 April, will be preceded by its first formal AGM, where a new committee will be elected. Lady Brown, vice-chair of the Committee on Climate Change, will host the lunch.

## ISO launches new standard

The international standards body, ISO, has launched a new standard for sustainability in buildings and civil engineering projects, to help owners, architects and engineers improve the long-term performance of built assets.

It said ISO 20887 can extend a building's life through effective adaptability that makes it suitable for another use, and by optimising its resources at the end of life through effective disassembly, reuse, recycling and disposal of materials. The result is reduced carbon emissions through optimal building use, lower costs through longer lifespan and better use of resources, and less waste going to landfill.

'This approach is what supports the circular economy, thus contributing to a more sustainable world,' said Philippe Osset, chair of the subcommittee that developed ISO 20887.

## £50M REGENERATION SCHEME COMPLETES IN LEICESTER

Property, construction and infrastructure consultancy Pick Everard has delivered the building services, civil and structural engineering – as well as sustainability and quantity surveying – to a £50m mixed-use development that is considered central to the regeneration of Leicester's Waterside area.

The firm worked with the main contractor, Morgan Sindall Construction, Charles Street Buildings Group (CSB), and Leicester City Council to deliver Great Central Square. The four-and-half-acre site includes two major new hotels operated by the Accor hospitality group.

## Local authorities need power to tackle IAQ

A report by leading health professionals has confirmed the link between polluted indoor air and the dramatic rise in asthma cases, and the severity of asthma attacks.

*Every breath we take: the lifelong impact of air pollution*, published by the Royal College of Paediatrics and Child Health (RCPCH) and the Royal College of Physicians, said children were suffering from impaired lung function and, potentially, reduced life expectancy because of poor indoor air quality (IAQ), which is also linked to a range of allergic conditions, including conjunctivitis, dermatitis and eczema.

According to the report, British children spend, on average, just 68 minutes a day outdoors, so the issue of IAQ should receive much more attention. 'Too many of our homes and schools are damp and poorly ventilated – this is adversely affecting the health of children,' said RCPCH paediatric respiratory consultant Jonathan Grigg.

He said local authorities should be given the power to make schools and other public buildings carry out urgent air quality improvements.

## Councils don't know their carbon footprint

Almost half of all local authorities in England do not know their carbon footprint, according to a freedom of information request by the trade body ECA. Of 214 local authorities, 93 (43%) said they did not measure all energy use linked to their built assets, and 47% do not have a plan for reducing it.

Even so, 166 councils (78%) said they were planning to be net zero by 2050 and 49 (23%) claimed they would be carbon neutral by 2030.

# Smart ambient heat network planned for Islington

**GreenSCIES to harness waste heat from Tube in 5th-generation system**

Plans for smart energy grids based on low temperature heat networks have been revealed.

A network in Islington, North London, will provide heat and power for 33,000 residents and 70 local businesses, and be connected to charging points for electric vehicles.

The Green Smart Community Integrated Energy System (GreenSCIES) is a partnership between London South Bank University, Islington Council and Transport for London.

It works by sharing heat and cooling between buildings using a low temperature (5th-generation) heat network, in conjunction with heat pumps that raise or reduce the temperature according to buildings' requirements.

The system will take secondary waste heat from the London Underground and other facilities, such as offices and data centres.

It will be connected to the electricity network and use artificial intelligence to draw low-cost electricity from renewables and thermal stores when electricity prices are high.

Director of the GreenSCIES consortium Graeme Maidment said: 'GreenSCIES provides a brilliant opportunity to deliver low carbon energy in urban areas.

'We did some comprehensive modelling in Islington and are predicting an 84% reduction in energy use compared to gas, Grid electricity and conventional fuel vehicles.'

GreenSCIES is also working with the Birmingham West Midlands Combined Authority (BWMCA) on a potential site. 'What we're trying to do is develop schemes that are generic and replicable in any urban setting,' said Maidment.

GreenSCIES partner Phil Jones said: 'It will become a template for high-energy density areas, particularly where there is a good balance of heating and cooling.'

GreenSCIES is one of 10 local smart energy projects awarded £21m of funding last month by UK Research and Innovation.

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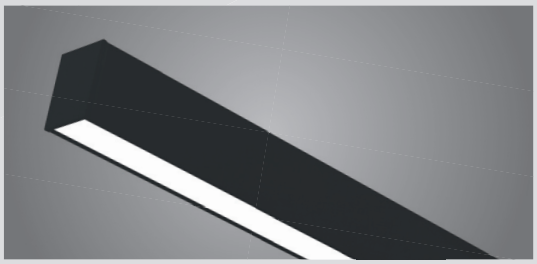

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# CAMPAIGNERS FOR CHANGE

Outstanding projects, products and companies driving best practice in the industry were celebrated at the 13th CIBSE Building Performance Awards, as **Liza Young** reports

Max Fordham and BuroHappold Engineering were the standout winners at the CIBSE Building Performance Awards at Grosvenor House hotel in London last month.

As well as scooping the Project of the Year – Residential award for the Agar Grove Estate regeneration, Max Fordham won Project of the Year – Public Use for The Engine Shed, Scotland's building conservation centre.

The consultancy was also crowned Building Performance Champion for The Engine Shed (see our feature on page 32). The judges, chaired by CIBSE technical director Hywel Davies, recognised Max Fordham for its extremely thorough attention to detail and commitment to a two-year aftercare period. They were impressed by the project's rounded approach to sustainability – taking in material, energy and human aspects – and the long-term view of the development.

As well as winning the Project of the Year – Retrofit category for Bartlett School of Architecture, 22 Gordon Street, BuroHappold Engineering picked up the trophy for Building Performance Consultancy (over 300 employees).

BuroHappold Engineering associate Tom Hopton was crowned Building Performance Engineer of the Year. Having worked at the consultancy since 2015, Hopton has been the lead engineer for many award-winning projects with innovative design at their core – from the UK's first large-scale horse-manure biomass system to the restoration of a 900-year-old building into a modern training campus.

On the evening of the awards, hosted by magician Ben Hanlin, guest speaker Yewande Akinola, of Laing O'Rourke, talked about the power of engineers to the 680-strong audience. As engineers, she said, we have the power to 'shape a better world and improve the quality of our environment'.

'Whether it's buildings or the built environment in the Far East – or in this country or in the Middle East – we are literally shaping the future of our world, and technology is paving the way for this. We are the game changers,' Akinola added.

However, she believes engineers need to become campaigners for the changes we need to see, and show 'the clients, the kids and the Gretas that we've got this'. She added: 'We need to shape the future of our buildings and environment by combining creativity and engineering, to get to a place where we can say to children: we have done our very best.'

Akinola also stressed the importance of diverse teams that 'reflect the societies that we serve' to make these changes.

'We live in incredible times,' she said, 'and engineers are at the heart of it. I am hopeful for the future – and I hope you are inspired to step into the light and change towards creating and shaping that sustainable, exciting, creative world that we all deserve, and our children deserve.' CJ »

## Building Performance Champion

**Winner: The Engine Shed – Max Fordham**

The Engine Shed is Scotland's new building conservation centre, and is housed in a redundant Ministry of Defence train shed with new-build wings. Judges said Max Fordham showed extremely thorough attention to detail and a commitment to a two-year aftercare period, and that the building's sustainability matrix, soft landings, building user guide and quarterly reporting were exemplar.

Sponsored by Baxi Heating

The Engine Shed

## » Building Performance Consultancy
### (up to 50 employees)

**Winner: Noel Lawler Green Energy Solutions (NLGES)**

The Ireland-based consultancy worked with a biomass boiler specialist to convert heat from poultry droppings to electricity, with excess heat used to warm the hen houses. This resulted in reduced energy consumption, better bird welfare, less pollution, and an improved business case for farmers. The judges were also impressed by NLGES's inclusion of biophilic elements in its head office in Kilkenny, and by its investment in staff training.

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## Building Performance Consultancy
### (51–300 employees)

**Winner: Elementa Consulting**

Elementa collaborates internally through open-office brainstorming sessions and presentations, and externally through workshops, BIM planning sessions, and technical discussions with non-technical people. The judges felt that the consultant's Performance Hour soft landings workshop showed its 'clear commitment to client betterment'. They said Elementa showed R&D in challenging areas, including post-occupancy evaluation, building performance, corporate social responsibility, and wellbeing. It also shared a commitment to reducing energy use.

Sponsored by: Imtech

## Building Performance Consultancy
### (over 300 employees)

**Winner: BuroHappold Engineering**

BuroHappold shares its expertise as a delivery partner for the Design for Performance (DfP) initiative, while its global Building Performance Group holds regular events to share best practice internally. Its 'Hackademy' also prepares engineers to make best use of the data generated by BIM technologies. An example of BuroHappold's post-occupancy evaluation work is the partnership with Newcastle University Urban Sciences Building, where open-access and real-time data from the BMS has been embedded into the BIM model, used as a 'living lab' for research and FM.

Sponsored by: ABB


## Collaboration

**Winner: ESFA School Building Framework Project – Bowmer + Kirkland/Integrated Environmental Solutions**

The main contractor and building performance analysis consultant worked with a BMS controls subcontractor to tackle the performance gap. They refined the way data was collected and transmitted from several ESFA schools, to achieve more granular operational insights. The team used this to create energy profiles, which could be fed back into the IES Virtual Environment building simulation software. By integrating iSCAN, this collaboration brought real-world data into the existing model for cross-comparison and validation that the buildings did operate as intended.

Sponsored by: Lochinvar

## Learning and Development

**Winner: HVAC Centre of Excellence – Air Conditioning and Mechanical Contractors' Association and Holmesglen**

The Australia-based centre – created through a partnership with Holmesglen, and with input and support from HVAC businesses and the Government of Victoria – was established to address the shortage in mechanical services plumbing professionals. It is the first HVAC training centre to offer applied learning, and brings together industry, education and government. Using simulation and replication of entire systems found in today's buildings, the centre upskills existing technicians and trains tomorrow's mechanical services professionals using the latest technologies.



Past president Peter Wong accepted the award on behalf of Yale-NUS College

## Facilities Management

**Winner: Yale-NUS College**

The 14-strong Infrastructure, Safety and Security Office – supported by outsourcing partners – is responsible for facilities management at the Singapore-based college, which has about 1,200 staff and students. QR codes have been placed around the campus so security officers on patrol can report defects using a GPS tracking system. In the past two years, the college has reduced the average defect turnaround time from 5.57 days to 0.73 days. The college also monitors energy consumption via a suite of meters across the campus, and educates students and staff about thermal comfort in a shared zone.

Sponsored by: Gratte Brothers

»

## » Product or Innovation – Thermal Comfort

**Winner: Hysopt HVAC Design and Optimisation Software**

Hysopt's winning HVAC Design and Optimisation Software accomplishes the feat of optimising cooling and heating systems design to deliver energy savings. The judges appreciated that the product is scalable, has wide application, and can link to thermal modelling tools. On average, Hysopt's software unlocks a yearly energy saving of 30-40%, with an investment payback of between one and five years. Very often, minimal adjustments give savings of up to 15-20% without requiring capital expenditure.


## Product or Innovation – Wellbeing

**Winner: arbn well – arbnco**

Arbn well is the first high-density indoor environmental quality sensing service dedicated to health and wellbeing, for use in new and old offices, homes, hospitals, schools and universities. A network of sensors measures temperature, relative humidity, $CO_2$, total volatile organic compounds, particulate matter and light levels, and communicate over a private network using an improved version of LoRa. Real-time information is provided to building managers, and reports are generated automatically to identify long-term issues and trends in the building performance.

**Sponsored by: Tamlite Lighting**

## Project of the Year – Retrofit

**Winner: Bartlett School of Architecture, 22 Gordon Street – BuroHappold Engineering**

The judges were impressed with the pre- and post-occupancy evaluation (POE) of the £22m refurbishment of University College London's 22 Gordon Street. This helped BuroHappold achieve a 60% reduction in energy use per $m^2$ – despite the usable floor area of the building increasing by more than 40% and greater environmental control being provided.

The building's Display Energy Certificate rating improved from G to D, and Building Use Studies showed that staff and students were most satisfied with the design of the building.


## Project of the Year – Public Use

**Winner: The Engine Shed, Scotland's Building Conservation Centre – Max Fordham**

Scotland's new building conservation centre is housed in a redundant Ministry of Defence train shed with new-build wings. Traditional skills and natural, low carbon materials, such as stone and reclaimed timber, were used in the construction, while passive design measures, including natural daylighting and natural ventilation, help provide a healthy, comfortable environment. The post-occupancy evaluation at the end of year one showed that high comfort levels had been achieved in practice as well as design, and these were improved by monitoring temperature and $CO_2$ levels in the aftercare period.

## Project of the Year – Commercial/Industrial

**Winner: Institute of Physics – Aecom**

Aecom's accessible Institute of Physics integrates several cutting-edge systems, including a geothermal closed-loop borehole, plus oversized free cooling ventilation combined with adaptive internal setpoints. Set in a conservation area on the edge of London's 'Knowledge Quarter', the building features 'chimneys' that replicate Victorian stacks, to take in fresh air at a high level and discharge it up through a central atrium. The building's thermal mass mitigates peak temperatures and sets adaptive comfort criteria during peak summer conditions.

**Sponsored by: Hattersley**



"We need to shape the future of our buildings and environment by combining creativity and engineering, to get to a place where we can say to children: we have done our very best"
– Yewande Akinola

## » Project of the Year – International

**Winner: Mason Bros, Auckland, New Zealand – Mott MacDonald**

Mason Bros – a 1920s former warehouse beginning its second life as a key part of Auckland's Wynyard Quarter Innovation Precinct – incorporates passive design features, including: exposed thermal mass; natural ventilation; large south-light glazing; and a balanced window-to-wall ratio to maximise daylight while minimising fabric heat gains. The building's carbon emissions are 9.5 $kgCO_2/m^2$, and it benefited from an 18-month tuning and commissioning programme after practical completion.

Sponsored by: CIBSE Patrons



## Building Performance Engineer of the Year

**Winner: Tom Hopton, associate, BuroHappold Engineering**

Hopton has worked in the building services industry for 14 years – and with BuroHappold since 2015 – and is a fellow of CIBSE. He has been the lead engineer for many award-winning projects with innovative design at their core – from the UK's first large-scale horse-manure biomass system to the restoration of a 900-year-old building into a modern training campus. He leads the sustainability team's efforts to share and exchange knowledge among more than 500 engineers in 17 offices across 10 countries.

Sponsored by: Ideal Commercial Boilers

## Project of the Year – Residential

**Winner: Agar Grove Estate Regeneration: Phase 1A – Max Fordham**

The £11.5m first phase of Camden's largest community investment project comprises 38 social-rented homes, and more than 90% of the estate residents were engaged in commenting on the proposals. The M&E design brief focused on reducing residents' fuel bills, cutting carbon, and minimising maintenance requirements. A logical extension of this approach was the Passivhaus (PH) standard, using fabric-first design to reduce heat losses and to model building performance more accurately.

Sponsored by: Titon Hardware

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# Technical Symposium heads to Glasgow for 10th anniversary

**University of Strathclyde to host event featuring more than 80 presentations**

The 10th annual CIBSE Technical Symposium is to be held jointly with ASHRAE at the University of Strathclyde, Glasgow, on 16-17 April. While some papers and presentations are still going through the review process, it promises to be the largest technical symposium to date, with more than 80 presentations over the two days.

These include case studies, opinion and research papers, and the popular fast-track session, where poster presenters highlight the key points of their work in a five-minute presentation to a plenary of delegates before lunch on day one.

Other planned sessions include: real-world sustainable development; digital techniques to optimise built environments; enhanced school energy performance and wellbeing; grid decarbonisation; heat networks; electrical energy storage for low-impact buildings; controls design and implementation; fire safety and smoke control; applying BIM; design tools for lighting; and tall and mega-tall buildings.

There will also be an exclusive presentation on the soon-to-be published CIBSE TM61, which aims to improve the understanding and implementation of realistic building performance predictions.

The evening reception on Thursday will take place at Glasgow City Chambers, a short walk from the university. Not only will delegates be able to enjoy the architectural splendour of the building, but also appreciate some traditional Scottish fare.

On Friday, at 8am, there is a free walking tour of the University of Strathclyde District Energy Centre, hosted by the university's assistant director Roddy Yarr. Places are limited, so be sure to sign up at registration.

The technical symposium is deliberately kept as a small event, with delegate registrations limited to around 200 people. This is so attendees can discuss current industry issues in a relatively intimate and friendly setting, and get to know and exchange ideas with the presidents, officers and CIBSE and ASHRAE staff.

- For details, visit **cibse.org/symposium** and search **#CIBSEsymposium** on Twitter

**A range of papers will be given at the University of Strathclyde**

## Take a step towards professional membership

If you are looking to apply for professional membership this year, join our next application workshop on 31 March.

CIBSE interviewers John Forster and Caroline Cattini will be running the interactive workshop, and will offer guidance on how to submit a successful application for 1 August. They will also share top tips on preparing for the interview.

This level of support from CIBSE interviewers cannot be accessed anywhere else. You will also receive a review of your draft report and a follow-up call with a CIBSE interviewer.

One workshop attendee said the experience had been 'helpful and gave a lot of ideas about how to address some of the competencies I'd been struggling with'.

- To book your place, visit **www.cibse.org/workshop**

# SLL begins its search for 2020 Young Lighter of the Year

**SLL Young Lighter 2019, Anna Wawrzynia, accepting her trophy for her entry *A light booster metro car for the commuting workforce*, with SLL president-elect Bob Bohannon (right) and comedian Hal Cruttenden**

Entries for the Society of Light and Lighting (SLL) Young Lighter 2020 are now being accepted.

The award is open to anyone with an interest in light and lighting, and the winner will be crowned SLL Young Lighter 2020 and receive £1,000.

Entries can be based on any light-related topic, from design, art installation, conservation, research or innovation.

The Young Lighter of the Year competition is a high-profile opportunity to help younger lighting professionals in the early stages of their career. Over the years, it has attracted some incredible projects and created notable winners, making it an invaluable platform to explore and discuss ideas relating to light.

The initial entry stage requires a short PowerPoint submission outlining the entry, with those shortlisted being asked to submit a short video expanding their ideas. Finalists will be selected from this second stage, and invited to deliver a 15-minute presentation at LuxLive in November.

- The deadline for entries is 8 May. For full details and to enter, visit **bit.ly/CJMar20SLLYoung**


# TM40 offers wider view of wellbeing

**TM40 features latest research on building comfort and productivity**

The built environment's role in public health, wellbeing, comfort and cognitive performance is attracting increased awareness, and has prompted the revision of CIBSE TM40: *Health and wellbeing in building services* (originally published in 2006).

TM40 will be launched this month, although the executive summary has been available since November.

The new edition includes the latest research linking building factors to comfort and wellbeing.

'Health and wellbeing' is extremely broad in scope, ranging from acute health impacts, through comfort and performance, to fulfilment, joy and happiness.

The revised TM40 is mostly focused on the middle ground and on providing best-practice advice on the design, construction and operation of buildings to support health, comfort and wellbeing.

The environmental parameters covered in 2006 – namely, air, humidity, thermal comfort, light, acoustics, electromagnetic fields and water – are in the new edition. There is a broader range of contexts, however, including new-build, non-domestic environments, homes, refurbishments, and some considerations of external spaces and site layout.

Important updates include the health effects of pollutants from indoor and outdoor sources, the non-visual effects of light, and the potential impact of electromagnetic fields from power lines or wireless technologies. It includes recommended performance criteria – for instance, daylight levels and pollutant levels in water.

Guidance is also given on design, construction and operation, and an overview of monitoring approaches is provided, to allow building performance assessments.

- For more information, and to download TM40, visit **cibse.org/TM40**

## Questions announced for CIBSE ANZ awards

CIBSE Australia and New Zealand region is challenging entrants to its Student, Graduate and Young Engineers awards to demonstrate their understanding of the issues facing the industry, to be in with a chance of winning AUS$1,000.

Graduates (with up to two years' industry experience) and young engineers (three to seven years' experience) are asked: Given your own work experience and field of expertise, what changes need to occur in planning the built environment today to help achieve a desirable, high-performing, sustainable built environment one decade on?

Student of the Year entrants must answer: Using your current interest in the built environment and review of global trends, what changes need to occur in planning the built environment today to help achieve a desirable, high-performing, sustainable built environment one decade on?

The closing date is 28 May, and the winners will be announced at the ANZ Annual Function and Awards in Sydney in July. For full details and to enter, visit **bit.ly/CJMar20ANZYoung**

## Research to benefit from a Heap of money

Applications are being invited for the Society of Light and Lighting (SLL) Jean Heap Research Bursary.

Open to anyone with an interest in light and lighting, the bursary makes available up to £4,000 for a specific piece of study or research designed to benefit SLL members and industry.

Karen van Creveld won the 2019 bursary for her research proposal on measuring real daylight exposure afforded by architectural environments, and the implications for wellbeing.

The deadline is 27 March. For details, visit: **bit.ly/SLLJeanHeap2020**

# New members, fellows and associates

## FELLOWS

**Wendt, Anna**
London, United Kingdom

## MEMBER

**Duggan, James Joseph**
Paulstown, Ireland

**Atyab, Mohamed**
Dubai, United Arab Emirates

**Pais, Sujay**
Dubai, United Arab Emirates

**Herrick, George**
London, United Kingdom

**Gonzalez Garza, Carlos Fernando**
Oxford, United Kingdom

**Davies, Warren**
London, United Kingdom

**Hillan, Anthony**
London, United Kingdom

**Boulton, Ross**
Bath, United Kingdom

**Skeen, Peter**
Redhead, Australia

**Humpage, Carl**
Lichfield, United Kingdom

**McCarthy, Aaron**
Belfast, United Kingdom

**Honey, David**
London, United Kingdom

**Williamson, Sean**
St Leonards, Australia

**Wong, Hon Chiu Raymond**
Tseung Kwan O, Hong Kong

**Morris, Stuart**
Bournemouth, United Kingdom

**Rees, Paul Timothy**
Caerleon, United Kingdom

**Voss, Mark Adam**
Wolverhampton, United Kingdom

**Hughes, Gary**
Bromsgrove, United Kingdom

**Williams, Paul Steven**
Weston-Super-Mare, United Kingdom

**Tranter, David**
London, United Kingdom

**Allen, Richard**
Dundee, United Kingdom

**Patheyjohns, Nicholas**
Wolverhampton, United Kingdom

**Turvey, David**
Preston, United Kingdom

**Broadbent, Peter**
Solihull, United Kingdom

**Ledger, James**
London, United Kingdom

**White, Imogen Judith**
Bath, United Kingdom

**Gosling, David Lawrence**
Colchester, United Kingdom

**Jansen, Christopher**
St Albans, United Kingdom

**Taylor, Martin**
Oxford, United Kingdom

**Protonotarios, Ioannis**
London, United Kingdom

**Aivaliotis, Theodoros**
Edinburgh, United Kingdom

**Anastasiou, Chrysanthi**
London, United Kingdom

**Chan, Ching Yan**
Shau Kei Wan, Hong Kong

**Ho, Hong Ki**
Shatin, Hong Kong

**Wong, Hing Fong**
Kowloon, Hong Kong

**Cheung, Ka Man**
Fanling, Hong Kong

**Chow, Wai Nang Francis**
KLN, Hong Kong

**Collard, Charles Anthony**
Epsom, United Kingdom

**Chan, Chun Kit**
Tinshuiwai, Hong Kong

**Watmon Oloya, Anthony**
Wallington, United Kingdom

**Tsvyatkov, Tihomir**
St Albans, United Kingdom

**Julien, Patrick Brian**
Croydon, United Kingdom

**Clark, Graeme**
Milngavie, United Kingdom

**Trowles, Nicholas**
Bath, United Kingdom

**Lindup, Riki**
Bliston, United Kingdom

**Tang, Hin Nam**
Tsuen Wan, Hong Kong

**Szilagyi, Csaba**
London, United Kingdom

**Choi, Sui Ping**
Kwun Tong, Hong Kong

**Ho, Pik Ling**
Kowloon, Hong Kong

**Leung, Chi Ho Paul**
Tseung Kwan O, Hong Kong

**Chan, Kai Chong**
Lai Chi Kok, Hong Kong

**Jeffers, David**
Sallynoggin, Ireland

**Shiell, Helen Louise**
Freemans Bay, New Zealand

**Wong, Man Kwong Victor**
Tsuen Wan, Hong Kong

**Esteves, Igor Alfonso**
Harrow, United Kingdom

**Barrington, Nathan James**
London, United Kingdom

**Madni, Shahbaz**
Southall, United Kingdom

**Milonidis, Konstantinos**
Cambridge, United Kingdom

**Castelo Becerra, Marta**
London, United Kingdom

**Poon, Hao Chi Cynthia**
Shatin, Hong Kong

**Thomas, Nicholas**
Cheadle, United Kingdom

**Kahraman, Gizem**
London, United Kingdom

**Kianbakhsh, Pejman**
Kettering, United Kingdom

**Li, Pui Yee**
Yuen Long, Hong Kong

**Sung, Man Fan**
Kowloon, Hong Kong

**Poon, Wai Lam**
New Territories, Hong Kong

**Wong, Ka Chun**
Yuen Long, Hong Kong

**Downie, Chris**
Newtownards, United Kingdom

**Lally, Joseph Anthony**
Sale, United Kingdom

**Gallagher, Conor**
Belfast, United Kingdom

**Marshall, Robert Ewan**
Nottingham, United Kingdom

**Miszkiewicz, Adrian**
Polegate, United Kingdom

**Costello, Emmett Laurence**
London, United Kingdom

**Van der Sterren, Wilhelmus Henricus**
Peterborough, United Kingdom

**Calabro, Emanuele**
London, United Kingdom

**Mahmood, Omar**
London, United Kingdom

**Williams, Tom**
London, United Kingdom

**Loh, Yee Lyn**
Manchester, United Kingdom

**Allard, Neil**
London, United Kingdom

**Chow, Kevin Chi Tsun**
Diamond Hill, Hong Kong

**Waldron, Paul Kenneth**
Reading, United Kingdom

**Cheung, Ping Hang**
Tai Wai,Hong Kong

**Tse, Kwok Kan**
Shatin, Hong Kong

**Warwick, Anna**
Epsom, United Kingdom

**Suen, Wing Yee**
Sham Shui Po, Hong Kong

**Lai, Tsz Kin**
Tai Wai, Hong Kong

**Stosic, Andrea**
Newcastle upon Tyne, United Kingdom

**Cheng, Ka Wing**
Tuen Mun, Hong Kong

**Prince, Craig Adrian**
Sydney, Australia

**Leung, Tsz Pang**
Yuen Long, Hong Kong

**Tam, Lok Hong**
TKO, Hong Kong

**Fan, Yuen Yee**
Ma On Shan, Hong Kong

**Lo, Hon Kit**
Kwai Hing, Hong Kong

**Chong, Pui Man**
NT, Hong Kong

**Wong, Tak Fai**
NT, Hong Kong

**Au Yeung, Chun Tong**
Wong Tai Sin, Hong Kong

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**Salisbury, Elin**
Cardiff, United Kingdom

**Coulter, David**
Glasgow, United Kingdom

**Middleton, Stuart**
York, United Kingdom

**Webb, Andrew James**
Bath, United Kingdom

**Taylor, Stuart**
Wolverhampton, United Kingdom

**Taylor, Andrew**
Burton-on-Trent, United Kingdom

**Sayer, Christian Martin**
Powys, United Kingdom

**Ballinger, Isabelle**
Bristol, United Kingdom

**Dreossi, Victor Mario**
Manchester, United Kingdom

**Yeung, King Yee**
Tsz Wan Shan, Hong Kong

**Sapina Grau, Antoni Joan**
London, United Kingdom

**Chan, Man Yu**
Kowloon, Hong Kong

**Tse, Kwok Yuen**
Tsing Yi, Hong Kong

**Davis, Nicholas**
London, United Kingdom

**Mercer, Matthew**
Reading, United Kingdom

**Hall, Erica Jamea**
Wokingham, United Kingdom

**Doda, Anri**
Sutton, United Kingdom

**Hill, Chris**
London, United Kingdom

**Diaz, Danilo**
Grays, United Kingdom

**Fairbairn, Jonathan**
Longfield, United Kingdom

**Hakim, Sajed**
Stanmore, United Kingdom

**Zhang, Yifan**
London, United Kingdom

**Salem, Ahmed**
Wolverhampton, United Kingdom

**Mohamed Abdien Babiker, Roaa**
Maidenhead, United Kingdom

**Wong, Chi Hang**
Kwai Chung, Hong Kong

**Choi, Tin Chi**
Tuen Mun, Hong Kong

**Li, Ka Hin**
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**Lam, Wing Yin**
New Territories, Hong Kong

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**Mone, Vincenzo**
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**Kimber, Louis**
Bristol, United Kingdom

**Petken, Teddy**
London, United Kingdom

**Noble, Henry Hunt**
Hessle, United Kingdom

**Treacy, Jack**
Cambridge, United Kingdom

**Sharp, Hector**
London, United Kingdom

**Schaefer, Vera**
Cambridge, United Kingdom

**Coombe, Neil**
Exeter, United Kingdom

**Mahmood, Musab**
Crawley, United Kingdom

**Waters, Samuel**
Solihull, United Kingdom

**Critchell, Thomas**
Romford, United Kingdom

**Sayers, Owen David**
Epsom, United Kingdom

**Manners, Cavan**
Leeds, United Kingdom

**Titcombe, Ben**
Southampton, United Kingdom

**Heitmann, Zak**
Birmingham, United Kingdom

**Frost, Hannah**
Sheffield, United Kingdom

**Mills, Matthew**
Worcester Park, United Kingdom

**Hetherington, Michael**
Wakefield, United Kingdom

**Roberts,Paul David**
Clevedon, United Kingdom

**Jacob, Tarik Alexander**
Leeds, United Kingdom

**Middlemiss, Alexandra**
Cardiff, United Kingdom

**Sandy, Afiya**
Chaguanas, Trinidad and Tobago

**Cockerill, Adam**
Manchester, United Kingdom

**Victor, Michael**
London, United Kingdom

**Sore, Barney**
London, United Kingdom

**Ritchie, James**
Swanley, United Kingdom

# FEEDBACK

## An engineer encourages the industry to sell itself; and a reader responds to an article about professionals post-Brexit

### Will the next generation solve climate change?

As we read more about the increased pressure on Earth's climate from our contribution to harmful emissions, building services engineers find ourselves in a quandary. When it would appear so many wish to help, why are so few coming into an industry that can contribute so much to helping mitigate the impacts of our existence?

As engineers, we are working towards – and, indeed, are set to play an even greater part in – tackling the challenges of reducing our reliance on energy sources that result in increased carbon emissions. This is especially the case given that the world's buildings consume just over one-third of the world's energy requirements.

Yet, as an industry, we massively undersell ourselves at a time when we should be more relevant than ever. When going into schools to speak to students about a potential future in engineering, there is active engagement and understanding during discussions about structural, aeronautical and chemical engineering. The same cannot be said of building services engineering, however, with the typical response being: 'What's that?'

This is further demonstrated by the closing down of multiple building services engineering courses at universities throughout the country. This is devastating when there are massive shortages in suitable graduates coming through to replace an ageing workforce.

True, we cannot wait for the next generation to solve the climate crisis – but we need them to carry on with the work we start. As such, I would urge as many building services engineers as possible to volunteer at their local school – whether that be primary, secondary or sixth form. Spread the word about what we do, and the difference we can make as we move into an uncertain future, for us as an industry and as a species.

So the question remains: climate crisis, who will solve it – the next generation?

***Ryan Beagan***
***Principal mechanical engineer, Hulley & Kirkwood***

### Raising awareness post-Brexit

I just wanted to say thank you for the inclusion of Dorte Rich Jørgensen's article ('Be open and supportive in post-Brexit Britain') in the February issue. You don't hear these types of stories that often, and I don't think there is as much awareness as there should be about the Settled Status scheme and what's happening to non-British EU nationals (such as myself) in this country.

***Julia Maul***
***Marketing communications executive, Hamworthy Heating & ACV UK***

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# Restoring our reputation

Collaboration holds the key to the Hackitt culture, says CIBSE Patrons chair **Nick Mead**

At his annual policy briefing for Patrons members, CIBSE technical director Hywel Davies said our sector was facing a 'once in a generation… maybe even two generations' period of upheaval. The government is poised to bring about a seismic change to our regulatory environment, including the most far-reaching reform of fire safety legislation in half a century and a total resetting of building safety regulation. So, why is this happening?

Sadly, the basic reason is that the construction industry's reputation is in tatters – and all the specialist sectors associated with it are suffering from reputational fallout. The review, set up in the wake of the Grenfell Tower disaster, uncovered ignorance and a 'culture of indifference', which its chair, Dame Judith Hackitt, is determined to address. The government has accepted all her recommendations and has the comfortable parliamentary majority to speed through a raft of new rules that will turn our industry on its head – including a Building Safety Bill that will be enforced by a new and powerful regulator.

Dame Judith was, frankly, horrified by the 'broken system' that characterises construction projects in this country. She was damning about our industry and its failure to take responsibility for its end product and the impact it has on people's lives. She also does not believe it can be left to the industry to reform itself – so we must brace for an avalanche of new legislation.

Part of her vision involves a series of approval 'gateways', with project teams having to demonstrate safety and compliance at key stages in the design and delivery process. Manufacturers will also be subject to a more demanding specification and testing regime, including having to demonstrate how their products perform when installed as part of a wider system.

These have the potential to change fundamentally how we go about our daily business – and it is one of the great benefits of being a CIBSE Patron that we hear about such things early, and can sit down together to examine the implications.

We believe the collaborative culture within our group is an example of how we can progress together. Our membership reflects the whole supply chain and it is only through collaboration that the new culture will develop. We can discuss the technical details, and the opportunities for modern methods of construction and digital systems to underpin the new regulatory system, but this is going to be all about how we treat each other as supply chain partners; how we ensure we always remember our ultimate customer – the building user – because they are the only people who can restore our reputation.

# Emergency response?

**With increasing concern about the pace and scale of climate change, there are growing calls for radical changes to the energy efficiency requirements of building regulations. Hywel Davies considers the challenges of seeking deeper and faster emissions reductions**

There is a widespread view that the changing climate demands more urgent action than ever, with many local authorities declaring 'climate emergencies'. Many observers are calling for deep and radical cuts in the energy use and carbon emissions of buildings to start almost immediately, and the Committee on Climate Change is increasingly concerned about the slow rate of change.

In England, a major consultation on the future direction of energy efficiency requirements for new homes closed recently, and further consultation on proposals for new non-domestic buildings and refurbishment of existing buildings is awaited. Government's response to parliamentary calls for regulations to address overheating is also keenly awaited.

This all seems obvious. The relationship between carbon dioxide concentrations in the atmosphere and global temperatures have been known since the work of Swedish chemist Svante Arrhenius in the late 19th century. His calculation of the warming effect of higher $CO_2$ levels is remarkably close to the observed data collected from the late 1950s onwards.

Increased average temperatures and more frequent extreme weather events are occurring around the globe. It seems so simple to seek immediate and drastic improvements to the energy efficiency standards for new buildings. But, in reality, it is a more complex problem.

Carbon emissions from buildings are not the only concern for building regulators right now. Since the Grenfell Tower disaster, which claimed 72 lives and changed many more forever, it has become clear that far too many buildings in England are inappropriately clad, and that those buildings do not comply with Requirement B4 of the Building Regulations, which addresses external fire spread.

Tenants and leaseholders are living in buildings that do not provide acceptable levels of fire safety, while some freeholders wrangle over what they can, legally, be required to do.

"A fundamental duty of government is to ensure the homes we build are safe, and that residents feel safe in them"

Many of those who have leases find they cannot sell their property because of concerns about the external façade construction and the inability to either mortgage or insure the dwelling.

These people consider that the fire safety of those buildings is much more of an emergency than anything else right now. Putting an end to the lethargy, inaction or sheer evasion of responsibility of those wrangling building owners – and making these buildings safe to occupy – is, understandably, the top priority for building regulations ministers right now. This is reflected by the commitments in the Queen's Speech to a Fire Safety Bill and a Building Safety Bill. The former will clarify legal responsibilities for the external walls of multi-occupied residential buildings under the Fire Safety Order.

Meanwhile, at least one leading housebuilder is urgently assessing its recently completed homes for their compliance with aspects of the regulations. A growing body of evidence over the past two decades shows

The industry must address quality concerns over new homes

**DR HYWEL DAVIES** is technical director at CIBSE **www.cibse.org**

that many homes do not deliver the levels of energy efficiency expected from their design. Current levels of compliance of new homes leaves significant scope for improvement.

Dame Judith Hackitt's report provided numerous examples of the failings of the construction sector, and the evidence published by the public inquiry, as well as the Phase 1 report, make it clear that we not only have a performance gap, but also a quality gap in our sector.

She identified significant concerns around enforcement and compliance, issues that some have been flagging up for many years. Those quality concerns are also known to plague the energy performance of buildings in use.

The industry must address quality concerns with new homes, and deliver buildings that really meet the fire-safety requirements and all other parts of the regulations. There is an urgent need to improve those buildings known to need fire-safety improvements. These tasks are far from trivial.

This is the backdrop to the most recent consultation on changes to Part L of the building regulations. It gave options for more stringent emissions reductions, as well as a plan for developing a 'Future Homes Standard' to come into effect from 2025.

While changes to the fabric energy efficiency standard are unwelcome – and the proposed timeline to write the Future Homes Standard inadequate for delivering a robust, tested standard for use by 2025 – they do seek to improve standards further and remove current loopholes allowing developers to build to the 2010 requirements in 2020.

The idea that we can just add a further challenging set of energy efficiency targets to come into force this year does not reflect what is possible. The industry does not have the capacity to deliver this, and the regulatory system simply cannot deliver all these objectives at once.

A fundamental duty of government in a developed country is to ensure the homes we build are safe, and that residents feel safe in them. Nobody will want to live in a zero-emissions home if they don't feel safe there.

We must make significant cuts in emissions from buildings, and quickly. This needs major changes to the way we design and build our homes, and the energy efficiency standards to which we build.

This is why we need to maintain safe, energy efficient fabric standards in 2020 and start to develop the energy efficiency standards for 2025 now – not next year. There is no more time to waste.

# Get the house in order

After the submission of the Part L and Future Homes Standard response, CIBSE's **Julie Godefroy** outlines the next steps for housing policy

CIBSE's response to the Part L and Future Homes Standard is in. It was supported by a huge level of interest among members, and done in collaboration with organisations including the London Energy Transformation Initiative (LETI), RIBA, the Royal Town Planning Institute (RTPI), the Chartered Institute of Environmental Health (CIEH), and the UK Green Building Council (UK-GBC). This showed an impressive level of consensus on key aspects:

- The need for more ambition, improved fabric requirements, and attention to whole-energy consumption and the in-use stage
- Allowing leadership from local authorities to implement more onerous carbon-reduction requirements, subject to local viability testing
- The need to produce the Future Homes Standard as soon as possible, to allow early adopters, and help develop expertise and supply chains. This must include not only energy and carbon aspects, but also – hand in hand – Part F proposals to ensure good indoor air quality at improved airtightness levels
- Concerns about peak electricity demand and fuel-poverty impacts, which could result from reduced fabric performance and direct electric heating.

"A further consultation would probably need to happen to implement the sort of changes CIBSE has been recommending"

## Next steps

The Ministry of Housing, Communities and Local Government (MHCLG) will produce a summary analysis of the responses – when is not yet known. It is currently not expected to make all submissions available, although it is possible that interested parties will submit a Freedom of Information request. After this, MHCLG will either publish the final Part L and Part F 2020 versions or – if changes that were not in the original consultation are proposed – a further consultation. The latter would probably need to happen to implement the sort of changes CIBSE has been recommending.

We are expecting a consultation soon on the Part L elements for non-domestic and existing buildings, and (from BEIS) on operational ratings for non-domestic buildings (for example, Display Energy Certificates, DECs). Get in touch at **technical@cibse.org** if you are interested in being involved – and, in particular, if you have data on in-use performance, and thoughts on changes to the National Calculation Methodology to relate more closely to in-use energy consumption.

You can also support CIBSE's efforts by signing the **Building Performance Network statement on operational performance**, and committing to monitor and disclose the energy performance of the buildings you occupy (for example, through a voluntary DEC).

**DR JULIE GODEFROY** is technical manager at CIBSE

## Beyond individual buildings

CIBSE has recently responded to the Committee on Climate Change's call for evidence for the UK 6th carbon budget and Welsh target.

We are also preparing recommendations on planning and climate change to welcome our 11th housing minister in 10 years, including:

- **Change the narrative:** buildings, neighbourhoods and cities that are low carbon and incorporate green infrastructure are not a sign of nanny state, 'banning' or restricting people's rights. They are places where people like to live and can deliver numerous environmental, health and wellbeing benefits.
- Review the system of **incentives and requirements** to truly encourage and reward schemes that offer long-term environmental and health benefits. Improve the transparency of viability assessments, starting with the very term 'viability', as the system actually allows much higher profits than the word implies.
- **Allow and encourage climate leadership** from local authorities and applicants, as highlighted in our response to the Part L and Future Homes consultation.
- **Provide adequate local authority resources** to implement building regulations and planning policies.
- **Develop planning guidelines** on topics where the planning system is central, including:
  - Climate adaptation, including overheating risk
  - The transition to electric vehicles and, increasingly, all-electric buildings, including consideration of the transport system and local infrastructure – for example, charging points, large-scale storage
  - Low carbon and climate-adapted retrofit for heritage buildings and conservation areas. This should be done in collaboration with heritage bodies, the Institute of Historic Building Conservation (IHBC), and CIBSE, among others, to maintain the quality and integrity of our built heritage.
- **Review permitted development rights (PDRs):** they are causing serious health and safety concerns (see *CIBSE Journal*, October 2019), cannot take account of public transport and local amenities, and are a missed opportunity to apply higher carbon and sustainability standards.
- **Review the approach to fracking and onshore wind turbines:** it is not consistent with the UK's net-zero carbon target to allow fracking and encourage continued investment in fossil fuels, while imposing a moratorium on onshore wind turbines in England. To build acceptance from local populations and spread the benefits of onshore wind schemes, planning should require genuine community engagement and encourage community energy schemes.

# Why heat pumps can help and hydrogen can't

With the rapid decarbonising of electricity, Max Fordham's **Joel Gustafsson** says industry and government should encourage the uptake of heat pumps rather than be lulled into a false sense of security by hydrogen

The energy used to heat buildings is responsible for around 20% of the UKs carbon emissions.[1] As a nation, we have committed to net-zero carbon by 2050, and providing all heat for buildings from low carbon sources is a key component of the strategy.[2] This should be both alarming and empowering to building services engineers. The decisions we make *now*, and the technologies we implement, will be operational for most, if not all, of the next 30 years.

The world is currently 1°C above pre-industrial levels – Australia is on fire, Cape Town is running out of water and Cambridge hit 38.7°C in summer 2019. Another 0.5°C will exacerbate all of these impacts and many more, and this is the current 'best case'. We cannot ignore the urgency. This means we need to get on with deploying the technologies that are available to us now and not wait for technological answers that are many decades away. It will be too late.

"Electricity is decarbonising, the grid has spare capacity, and we know how to turn it into heat with an efficiency of 300-400%"

## How far away is hydrogen?

It is impossible to mention low carbon heat without discussing hydrogen. The replacement of methane in our gas network with hydrogen seems instinctively simple. However, we can't allow ourselves to be lulled into a false sense of security; the technical and economic barriers that stand between us and a functioning hydrogen economy are almost as high now as they have been for the past 20 years.

First, green hydrogen is made by electrolysis of water, using renewable electricity, in hydrolysers and subsequent compression into a network; around 35% of the energy is lost to this process.[3]

Second, the energy density of hydrogen per unit volume is one third that of methane. If we are to use it as a direct replacement, we will need three times more storage and distribution capacity than we currently have for methane.

Lastly, burning it is inefficient. Hydrogen burns hotter than methane and the thermal losses within the boiler will increase such that current levels of combustion of efficiency are unlikely.[4] In total, we lose around 50% of the electricity we put in using hydrogen in this way.

## An immediate opportunity

Using hydrogen for heat is not a means to reduce the $CO_2$ emissions of the UK in the 2020s.[5] So, what can we do? The answer lies in the proliferation of UK renewables. In the past five years, the carbon intensity of grid electricity has decreased by 60%. Coal-fired power stations have been decommissioned, and the cost of offshore wind has decreased. Both of these things happened much faster than predicted and the trends are accelerating.[6] Meanwhile, the increased efficiency of electrical appliances has reduced peak loads from 61.7GW in 2002 to 50GW in 2018.

Electricity is decarbonising rapidly, the grid has spare capacity, and we know how to turn it into heat with an efficiency of 300-400%.[7] Electric heat pumps are completely orthodox in Scandinavia, France and many other countries. Yet, in the UK, we put their widespread deployment in the same bracket as burning hydrogen in boilers – something that is at least 30 years away.

The hydrogen solution is often proposed by those wishing to gain efficiencies by making use of existing 'infrastructure' – a completely sensible aim. Heat pumps can provide this when applied to existing heat networks to make excellent use of the physical installations put in place to enable combined heat and power (CHP). We should note that CHP is currently a technology that burns gas to displace low carbon electricity; the net result is that its heat-carbon intensity is 130% that of a gas boiler and 330% more than an electric heat pump[8].

## Retrofit heat pumps

Retrofit of CHP with heat pumps is possible, and can have an immediate impact. Two stages of vapour compression take heat from air at temperatures as low as -15°C and raise it to 70°C; with water, we can efficiently go to 90°C.[9] The refrigerants, either ammonia or a combination of butane and propane, have a near-zero global warming potential. Further, the buffer vessels that have been installed to accommodate the low turndown of CHP engines can be deployed to store heat from heat pumps, shift demand,

**JOEL GUSTAFSSON**, partner, principal engineer and member of MF: Net Zero

and reduce pressure on electricity grids. This is working now in mainland Europe. There are technical hurdles, of course – acoustics, cold plumes, and poor performance of existing heat networks – but these can be overcome. The installations in colder climates show this and will be followed by more in the UK.

Housing served by heat networks is uncommon: approximately 500,000 customers for 20 million buildings. Low-density houses and bungalows are about 90% of the buildings requiring a standalone solution. This sector is significantly easier – efficient, mature heat-pump solutions exist. There are multiple retrofit options from different manufacturers to replace gas boilers.

Consider a 100m² semi-detached house with solid walls, double glazing and 'some' loft insulation. The peak heat loss will be ~60W/m², or 6kW. Running a heat pump to supply this heat requires 2kW – less than a kettle and only 14% of the capacity of the 63A supply. Most heat used by dwellings is supplied to low-density, owner-occupied buildings[10] for which the electrical infrastructure was designed for night-storage heaters. The local infrastructure (low-voltage cables, 11kV cables, transformers) has spare capacity. We can transfer the heating load to electricity now and don't need to wait for hydrogen.

Of course, eventually, this requires an increase in electricity capacity. High-voltage direct current (HVDC) is an established means of transporting large quantities of electricity over long distances with low losses. We have HVDC connections to France, Belgium and the Netherlands; a cable connecting us to Norway will be live in 2021.[11] We can transport electricity large distances,[12] but this is experimental and inefficient for hydrogen.[13]

As engineers, we rely on a pragmatic scepticism to filter out real innovation from wishful thinking and spin. We need to stop being distracted by hydrogen and get on with delivering the solutions of this decade.

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6 Updated energy and emissions projections: 2018 **bit.ly/CJMar20JG2**

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8 Jan 2020 average carbon intensity of 209 $gCO_2$/kWh used. CHP with 40% thermal efficiency and 40% electrical efficiency.

9 Large-scale district heating, Drammen, Norway, WWF Scotland 2016.

10 *English housing survey, headline report 2017-18*, MCLG.

11 North Sea Link website, accessed February 2020 **northsealink.com**

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13 Japan launches first liquid hydrogen carrier ship **bit.ly/CJMar20JG6**

# HISTORIC SUCCESS

The Engine Shed in Scotland was named Building Performance Champion because sustainability was embedded at every stage of the project, from the briefing workshop to building aftercare. **Andy Pearson** speaks to Max Fordham about the design process behind the exemplar scheme

'This project's success comes from its use of a sustainability matrix,' says Matt Thomas, principal engineer at Max Fordham. He is talking about The Engine Shed, Historic Environment Scotland's (HES's) new facility in Stirling. Here, Max Fordham's sustainability matrix was fundamental to establishing the project's sustainability targets, and critical to ensuring measures were implemented as the project progressed from concept, through design and installation, to handover and aftercare.

The project's success in attaining – and, in some cases, exceeding – its sustainability objectives was one of the reasons for its success at this year's CIBSE Building Performance Awards, where it won Project of the Year – Public Use, and Building Performance Champion. The judges described the scheme's approach to sustainability as 'exemplar'.

The Engine Shed was built in the 19th century to accommodate steam engines at the Forthside military ordnance depot, Stirling. After the demise of steam, the shed was used by the Ministry of Defence as a truck-repair workshop until the site was abandoned in 1976. The building remained empty until it was selected by HES as the new home for its conservation, outreach and science teams.

HES wanted a facility in which to create a visitor attraction, and a space where the public could learn about, – and engage with – traditional buildings, and the skills and materials required to build, conserve and maintain them.

Its plan was to use The Engine Shed as the centrepiece of the new facility by extending its floor plan with two new sheds – one on its eastern flank and another on the west. The west shed would accommodate a reception desk, seminar rooms, offices and toilets, while the east shed would house a studio, equipment room, laboratory, kitchen, offices and the plantroom. A freestanding lecture theatre was also planned for the original part of the building.

There were a number of sustainability initiatives that HES wanted to address with the restoration and extension of the facility, and it appointed Max Fordham as sustainability consultant for the project.

To understand what was important to HES, a brief-setting workshop was hosted for the client, building users and key members of the design team. This enabled the consultancy to establish the key sustainability ambitions so that it could produce an initial sustainability matrix (see panel, 'The sustainability matrix').

## THE SUSTAINABILITY MATRIX

**The matrix included topics such as: energy management, thermal comfort, construction materials, waste, management and education, and provided indicative sustainability targets for these.**

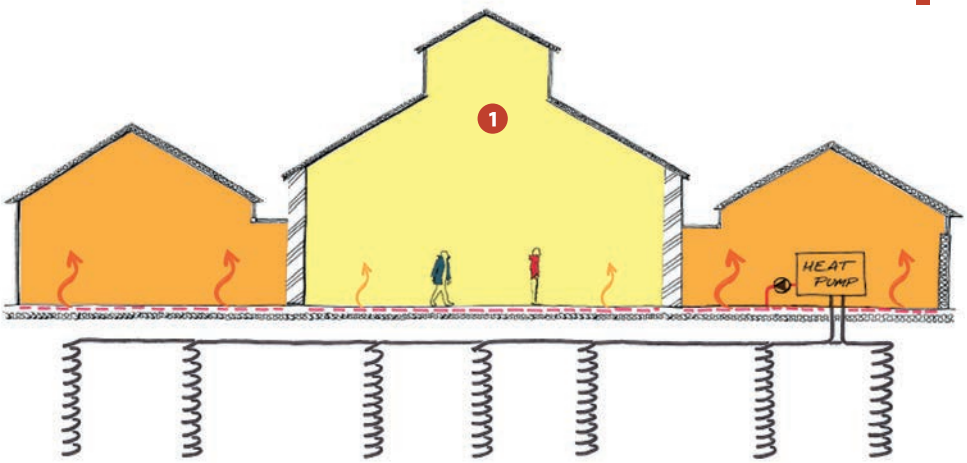
**Max Fordham followed up an initial workshop with a more detailed one, involving the design team, at which the project's sustainability targets were set. It invited HES's estates and sustainability teams to review the matrix to enable the design team to understand how operational measures would be implemented.**

**'The matrix was HES saying "we want to be sustainable and this is what sustainability means to us",' explains Thomas. 'It is deliverable, measurable and not an aspiration that will get squeezed out as the project progresses.' In addition, because the design and construction teams were procured directly by HES, the client retained close control of the design's sustainability aspects.**

**The matrix underpins all design, procurement, specification and construction decisions. 'It formed part of the M&E services design brief, and meant we had visibility at the start of the design of what HES wanted to achieve with the building,' says Thomas.**

## PROJECT TEAM

**Owner/client, project manager and quantity surveyor:** Historic Environment Scotland
**Building services, sustainability, soft landings and acoustics consultant, and lighting designer:** Max Fordham
**Architect:** Reiach and Hall, and Historic Environment Scotland
**Main contractor:** ESH Construction
**M&E contractor:** Parker Technical Services
**Structural engineer:** David Narro Associates




**1 The main shed is designed to be cooler than the other spaces. As visitors are likely to be wearing outdoor clothes when they arrive, they should still be comfortable. Fleeces are available to help keep everyone warm, and staff are encouraged to wear one if they're cold. This should help to save energy. HES must manage expectations from occupants; groups in shirtsleeves cannot break out from seminar rooms to the main shed and expect the same temperature.**

The prime target that had to be addressed by the building services design was to create an energy efficient, low carbon building through improved fabric performance, passive design strategies and efficient environmental solutions.

In line with the project's sustainability aspirations, the building uses a fabric-first approach to help minimise operational energy use. Both new wings were designed with high levels of fabric insulation, while the shed's existing roof had high-performance Aerogel insulation added, to improve its thermal performance without adding significantly to its weight. Internal insulation was also used on the gable end walls, which were not built against.

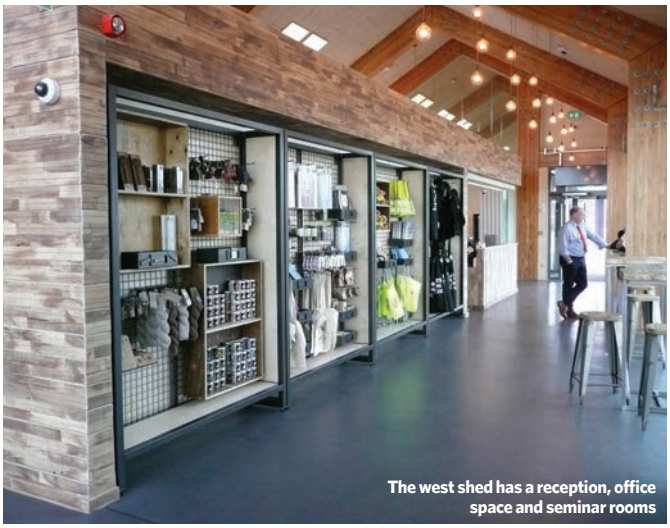
Despite this fabric-first approach, however, airtightness was not controlled completely. An aspirational target of $3.5m^3 \cdot h^{-1} \cdot m^{-2}$@50Pa had been set at the project's outset. Retaining the historic fenestration and roof structure in the main shed precluded this, however, and the whole-building target was relaxed. The employers' requirements did not include for airtightness testing, as it was not part of the building warrant. As a result, the airtightness of the new-build wings and building as a whole has not been quantified.

**The original engine shed, flanked by two new-build east and west wings**

The building is partly naturally ventilated. In the existing shed, the natural ventilation system is based on fresh air entering through windows in the gable end and exiting predominantly through openings in the clerestory glazing that runs along both sides of the roof ridge. Known as 'hoppers', these are fixed inward-sloped panes of glass with a hinged and weighted lid. The lid is opened and closed using a system of ropes and pulleys, which are still in place.

When The Engine Shed was first built, the hoppers would have been opened manually, but now they are operated using a wall-mounted actuator. They operate automatically to provide an exhaust air path for the lecture theatre, with a manual override to ventilate the main space.

In the offices and seminar rooms in the east and west extensions, fresh air enters the spaces through ventilation panels independent of fixed glazing. Vitiated air can also be exhausted through roof lights. In the west shed, this was an issue because the roof lights close completely when it rains – and the BMS-linked dampers were also closing, which meant the offices got stuffy, particularly on days when it is warm and wet. Mechanical ventilation in the form of MVHR units is used to ventilate the laboratory and digital studio, with airflow rates controlled on $CO_2$ levels. These spaces also incorporate fan coil units (FCUs) for cooling. »



**The west shed has a reception, office space and seminar rooms**

» The lecture theatre is also mechanically ventilated using an air handling unit (AHU). Because the theatre is a freestanding box in the centre of the concrete floor of the main shed, fresh air is delivered to the unit through underfloor ductwork. The recirculated air is warmed or cooled by the AHU and delivered to the space through grilles positioned beneath the raked seating.

'There is a return air path from the main shed back to the single-pass AHU,' says Thomas. Vitiated air simply rises up and out of the room and into the main shed through acoustically treated openings in the theatre's roof.

The lecture theatre is the only space in the building to have warm-air heating; the remainder of the spaces are heated by an underfloor system. 'We did option appraisals on the energy source to heat the building and there was a definite rationale for going for underfloor heating,' says Thomas. 'The system strengthened the argument to use heat pumps and it satisfied the requirement for internal architectural cleanness.'

A ground source heat pump (GSHP) is used. Heat is supplied by three, 180m-deep boreholes located outside the footprint of the building (see panel, 'Ground up approach', on page 36).

The building opened in July 2017, and the sustainability matrix included detailed energy management measures to help ensure the completed building performs in line with the designer's intention. Measures include the requirement


**Overview of the building's spaces and environmental strategy**

**Environmental strategy**

- Natural ventilation. Underfloor heating and cooling
- Mechanical supply and extract ventilation. Underfloor heating and cooling
- Mechanical ventilation with heating and cooling. Air supplied from raked seating. No underfloor heating
- Mechanical ventilation via grilles at high level and natural ventilation openings. Underfloor heating. Cooling provided by individual fan coil units
- Natural ventilation via wall panel, plus underfloor heating and cooling
- Natural ventilation via wall panel, plus underfloor heating. Cooling provided by individual fan coil units
- Cooling via fan unit located within space
- Underfloor heating manifold

The main shed was built in the 19th century to accommodate steam engines

for detailed commissioning and seasonal commissioning, fine-tuning, training, and in-use energy monitoring.

The in-use performance of the building was addressed using a soft landings-type approach and two years of aftercare. As a consequence, following practical completion, Max Fordham organised monthly aftercare meetings involving the main contractor, subcontractors and controls specialists, as well as walk-arounds with the building users.

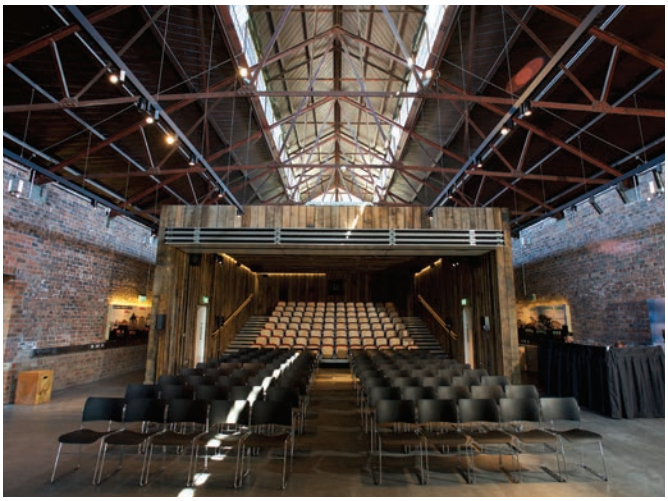
Quarterly aftercare reports were produced detailing systems and energy performance, with recommendations for further actions. Measures taken in response to the aftercare have had an impact: reports show a reduction in energy use in the second year. For example, year-two gas consumption is 30% lower than year one, mainly because the boilers had to run for long periods when defects took the GSHP offline. Reduced heating setpoints, modifications to the BMS and correct GSHP operation have all contributed to this reduction. However, the reports show that gas consumption is still slightly higher than had been predicted – although there are twice as many full-time staff in the building as the design brief, and the target for first-year visitor numbers was hit within three months.

Electricity use has also reduced from year one to year two, mostly as a result of lighting control and plant control improvements. In addition, the GSHP's performance shows an average COP of 5.2, which exceeds the manufacturer's quoted COP of 4.

A post-occupancy evaluation (POE) was conducted one year after the building had opened, to give feedback on how well the building was operating and the extent to which it meets the needs of users. According to the document: 'The evaluation was carried out on 11 July 2018, a very hot day during an extended heatwave.'

Positive findings from the POE include: good acoustics and effective natural ventilation in the east and main sheds; on the downside, overheating and humidity was found to be a problem in the west shed. In fact, overheating in the west shed has been such an issue that HES has resorted to using a temporary air conditioning unit.

Air quality and humidity were also found to be an issue, with many occupants finding the space too dry in winter and too humid in summer. It was discovered that an erroneous BMS output was overriding the manual ventilation inlets, shutting them down in high summer and opening them up to over-ventilate the space in winter. This was readily rectified once highlighted. »



The freestanding lecture theatre in the main shed is mechanically ventilated with an AHU

» Lighting was also found to be on unnecessarily in many spaces. For example, users did not realise that pushing the button marked '2' on the theatre-lighting controller produced the 'default lighting setting to be used when playing a film'. After the POE, the lighting control scenes for the exhibition space and auditorium were amended to meet the needs of the staff who manage the space. General lighting control was changed back to absence control, which had a significant impact on lighting use.

Minor glitches aside, The Engine Shed achieves A under the England and Wales EPC system with a notional building of the same type. Under the Scottish Building Standards for an EPC modelled against a single notional building for all building types, the new-build areas are B+ and the whole building C. No wonder the CIBSE Building Performance Awards judges were impressed. CJ

## GROUND UP APPROACH

**Matt Thomas says the GSHP solution has been 'a big success'. In winter the heat pumps take heat from the groundwater and use it to heat the building via the pipes buried in the concrete-floor screed.**

**Four sensors, strategically located around the main shed, control the flowrate of the underfloor heating. The temperature setpoint of the main hall is deliberately lower than in the other spaces to save energy – partly because this original element of the building is not very airtight and partly because visitors, conveniently, will be wearing outdoor clothes when they arrive. Staff have been provided with branded fleeces to wear if they feel cold. They also have to manage the expectations of audience members exiting the seminar room directly into the cooler main hall.**

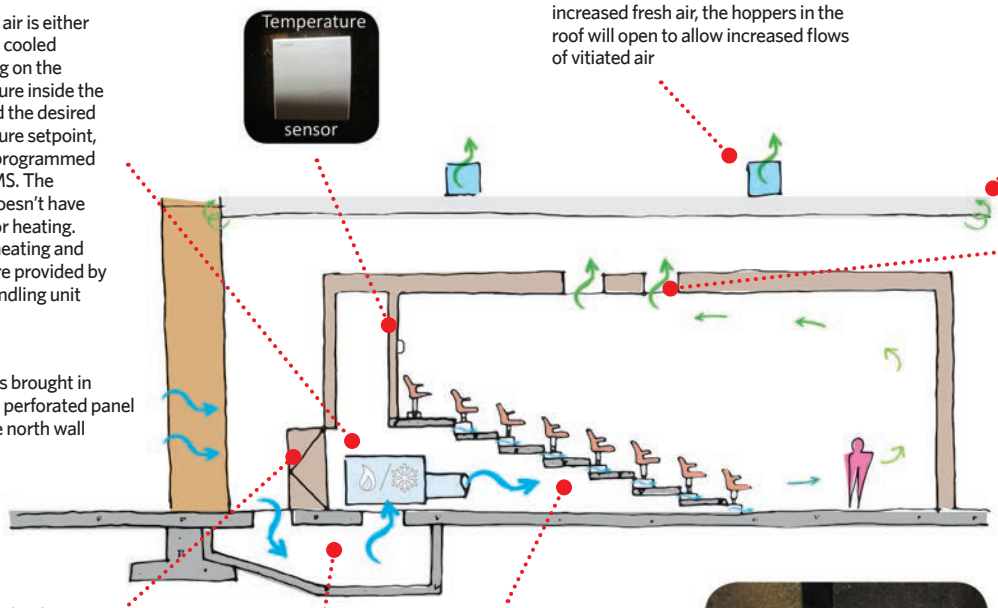
**In summer, the heat pumps are turned off, but the pumps continue to circulate water through the ground loop. This provides ground-cooling to the FCUs directly, via a heat exchanger. 'We've designed the FCUs to operate at a flow temperature of 12°C and a return temperature of 17°C – as opposed to the more usual 7°C flow, 12°C return – to use ground cooling' says Thomas. 'It means the system has a COP of 20, because we're only using pump energy.'**

**Another advantage of this solution is that the heat removed from the building is stored in the ground, so the heat pumps do not have to work quite so hard in winter to provide heat.**

**Overheating analysis was carried out for individual spaces, following TM52. As an experienced client and custodian of an extensive historic estate, 'HES was comfortable learning from its experience of using the building before deciding on future modifications,' says Thomas. The ability to run ground-cooled water through the floor screeds via the underfloor pipework does give HES one mitigating option to address overheating in the future.**

**A page from the building user guide showing how the heating and ventilation work in the lecture theatre**

### Lecture theatre




The fresh air is either heated or cooled depending on the temperature inside the space and the desired temperature setpoint, which is programmed on the BMS. The theatre doesn't have underfloor heating. Instead, heating and cooling are provided by the air handling unit

When the air quality requires increased fresh air, the hoppers in the roof will open to allow increased flows of vitiated air

Stale air is exhausted naturally through the tiny gaps in the building fabric

The stale air gets exhausted through openings in the ceiling. These are acoustically treated to ensure noise doesn't break in from the main shed

Fresh air is brought in through a perforated panel within the north wall

Access to the theatre ventilation equipment, via an access door

Heated or cooled fresh air is blown from grilles located under the raked seating into the theatre

Fresh air is introduced through a duct route under the floor

Theatre door open/close button and lighting touchscreen, with lighting modes right

| Scene | Mode |
|---|---|
| 1 | Cleaners |
| 2 | Film |
| 3 | Presenter |
| 4 | Conference |
| 5 | Projection |
| 6 | TBC |

**The main shed is set at a lower temperature than the lecture theatre because of the nature of the building fabric and purpose of the space**

# UNLOCKING THE SECRETS OF THE 'BLACK BOX'

Changes in controls can deliver big energy savings, but many shy away from tackling the BMS system, says Verco's **Tom Randall**, who sets out his thoughts on control-strategy principles to help demystify the 'black box'

Building management systems (BMSs) and the control strategies they implement are an essential requirement for delivering building performance in operation (see 'Class control: optimising HVAC controls in schools', *CIBSE Journal*, December 2019).

It is common for improvements in control strategies alone to deliver 15-20% reductions in energy use. However, BMSs can be perceived as complex 'black boxes' by many professionals who have the potential to influence how these systems are designed, set up and operated. If some simple, overarching principles for efficient, effective control could be established, these may help demystify the BMS and prompt more detailed discussions between building services engineers, facilities managers and BMS engineers on the development of control strategies that improve performance.

BMS engineers are knowledgeable about implementing efficient control strategies, but are usually not asked to, and avoid the contractual risk of deviating from a specification.

In addition, their work on new buildings comes at the very end, when, invariably, their time has been compressed between project delays and pressure to complete as soon as possible. On existing buildings, facilities management contractual incentives to minimise cost, rather than maximise value, can mean expenditure on BMS subcontractors is limited.

This article proposes such overarching control-strategy principles for fellow professionals, and seeks feedback from readers on potential improvements and oversights.

The proposed principles for control strategies include:

1. **Sufficient demand**
   a. Meet the service need. Not too little, but not too much to achieve the required service outcome: heating, cooling, ventilation, lighting, hot water and frost protection.
   b. Avoid extraneous demands. Most notably, as a result of inadvertent conflicts between systems such as heating and cooling.
2. **Efficient supply**
   a. Select the most efficient system available for the service demand.
   b. Operate the selected system as efficiently as possible.

To ensure the control principles are

effectively implemented, supporting principles include:

1. Ensuring equipment works
2. User-friendly monitoring – for example, views and alarms.

## Sufficient demand: meet the service need

Insufficient heating and cooling will result in a failure to achieve appropriate environmental conditions, which is poor control. Perhaps less obvious is excess provision of a service – for example, when there is no demand for a service and equipment should be off, or where demand varies, such as fresh-air provision.

It is common for ventilation systems to be designed and controlled to provide sufficient fresh air for 100% design occupation during all hours of operation, but a building does not – if ever – become fully occupied instantaneously at 9am. A typical office building has a buildup in occupation at the beginning of the day, a slight reduction over lunchtime, and then an emptying over an hour or so at the end of the day. Even maximum occupation is rarely near full design levels.

The British Council for Offices' (BCO's) *Office Occupancy* report found that offices typically reached 60-70% occupation. By considering the relationship between fan speed and power consumption, a 50-60% reduction in fresh-air fan energy use can be achieved by matching fresh-air delivery to occupation (see Figure 1).

There will be occasions when the efficient overall control of a building requires fan speeds above those required for the level of occupation, notably as an efficient way to provide 'free' cooling. This is picked up by the 'efficient' principle.

## Avoid extraneous demands

There may be scenarios where some areas of a building require heating and others cooling, but a common issue is heating systems unnecessarily conflicting with cooling systems. This results in unintended, unnecessary demands that waste energy and often add to discomfort.

The common manifestations of this are:

1. **AHU v terminal unit:** Air handling units being controlled to provide supply air at a fixed temperature, resulting in air being heated, or cooled, and then the reverse being done by the majority of terminal units (fan coils, VAV boxes and radiators).

> "BMSs can be perceived as complex 'black boxes' by many professionals who have the potential to influence how these systems are designed, set up and operated"

2. **Terminal unit v terminal unit:** Terminal units supplying the same space fighting each other, with one heating and another cooling, usually at 100% capacity. Those sitting beneath these units are unlikely to be comfortable.

These are not hard issues to avoid. In the first scenario, the supply air temperature can be controlled in response to the overall demand of the terminal units – if most are cooling, reduce the supply air temperature. In the second scenario, implement a sensible dead-band between when heating and cooling comes on (I suggest at least 2K; BCO Specification 2019 allows 4K) and ensure temperature setpoints are within a sensible range (between BCO Specification 2019 requirements of 20-24°C).

Grouping terminal units so they implement the majority of heating, or cooling, demand is also an option. Consistently, a 20-30% reduction in terminal unit demands is observed when this is addressed, and usually a reduction in hot and cold complaints.

## Efficient supply: selecting the most efficient system

Most buildings have a range of systems available for heating, cooling, ventilation and daylight. For example, there may be the potential to provide cooling by natural ventilation, running fans, using a heat-recovery system, or through an active cooling system, such as a chiller-fed chilled water system.

Each option will vary in efficiency and capacity. Control strategies should select the most efficient system for the demand required.

## Operate the system as efficiently as possible

Once selected, the system flowrates, flow temperatures and staging should be controlled to operate as efficiently as possible.

It is common, for example, to find a heating system operating at fixed temperatures and flowrates, while the heating demand it is meeting varies. On a milder day, with a fixed flow temperature of, say, 75°C, any heating valve may only be open 20-30% – yet the boiler is operating inefficiently, and certainly not condensing, and heat gains from the distribution pipework may risk bringing on the cooling

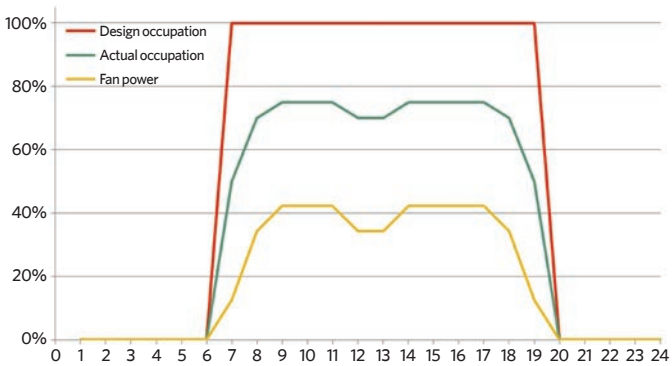



**Figure 1: Potential fan power reduction by responding to actual occupation**

system (see 'Avoid extraneous demands'). An efficient control strategy should reduce the heating circuit temperature until, say, the first heating valve approaches being fully open.

The most efficient staging of the boilers should also be considered, so a discussion with the manufacturer will be valuable. There may be efficiency benefits from varying pump speeds. These days, most pumps and fans have variable speed drives, but, in many cases, they are not connected to the BMS and are just used for commissioning. A cable is often all that's required to make this connection, enabling variable control.

## Supporting principle: equipment works

Time and again, good control is confounded by issues with the equipment being controlled, with the finger (often unfairly) pointed at the controls engineer. For example, temperature sensors for terminal units are frequently in the ceiling void, rather than the room, resulting in inaccurate readings.

Another common example is the addition of a partition wall with a terminal unit on one side and its temperature sensor on the other. I have even come across a dispute between a landlord and tenant over the inadequate provision of heating and cooling. The control strategy was an area of investigation, but it transpired the heating circuit had been directly connected to the chilled water circuit when a fan coil unit had been installed.

More detailed discussions on efficient control strategies will help identify the full value of equipment specified, and reduce the chance of 'value engineering' undermining operation performance.

## Supporting principle: user-friendly monitoring

Sophisticated analytics software and mobile-phone dashboards are becoming prevalent, but creating new views and alarms on existing BMS supervisor computers can be useful.

The common approach to views is to split up central plant by system – heating, cooling, hot water, ventilation – with floor plans showing the location of individual terminal units, so you can drill down to a view for each terminal unit.

Though good for detail, these views make it hard to identify the overall performance of a building and, therefore, how efficiently it is being controlled.

**Use three principles as a guide to frame potential views:**

- **Sufficient:** this could be a single view that shows boiler, chiller and fan activity compared with primary drivers of demand, such as outside air temperature and indications of occupation (for example, from $CO_2$ sensors and/or PIR data shared from the lighting system). This would show whether provision of services is adequately matching demand.
- **Efficient:** for each service, a single view could show all the potential systems available to deliver it, and their level of activity. This would allow identification of whether the most appropriate system is operating and being run efficiently.
- **Avoiding conflict:** a single page could summarise heating and cooling demand from AHUs, alongside the average heating and cooling demand of the terminal units on each floor. High demands for both heating and cooling would merit investigation.

In addition, alarms could be set up that build on these views, triggering when parameters are met and indicating that the principles are not being followed.

Such views and alarms can also help identify equipment failures.

The example terminal unit summary view given in Figure 2 helps monitor for simultaneous heating and cooling, but also helps identify a failed AHU cooling system on the eighth floor and incorrectly installed fan coil unit actuators on the third floor.

There is much detail that sits beneath these proposed principles, but the expertise exists in the building energy management industry to work with designers and operators to develop the detail.

Those conversations can only happen if all relevant professionals have the confidence to have them, and if performance requirements exist in design and operation specifications.

I hope these principles can be part of promoting such conversations, demystifying the BMS 'black box' and recognising good control as an essential factor in delivering buildings that perform. **CJ**

**TOM RANDALL** is head of building optimisation services at Verco

## CIBSE CONTROLS & IT SPECIAL INTEREST GROUP

**CIBSE is rejuvenating the Controls & IT Special Interest Group – a forum for ideas, discussion, and education on all aspects of the design, specification, supply, installation and servicing of IT equipment and systems, as well as building controls equipment and systems. We want to build a group with expertise that connects the chain of controls manufacturers, designers, installers and maintainers. Although seen as a 'black art' or 'black box' technology, controls can have a huge impact on operational performance. The group's first task is to do an assessment of knowledge needs, considering how to generate and disseminate clear and robust guidance on controls. There are silos of intelligence, not just hardware. In a time of technology turbulence, where the field is changing rapidly, accessible information on the subject is more important than ever. To get involved, contact groups@cibse.org**

| | Temperatures | Heating demand | Cooling demand |
|---|---|---|---|
| 8th floor | 22.1°C | 2.8% | 69.7% |
| 7th floor | 23.7°C | 0.0% | 25.6% |
| 6th floor | 23.0°C | 0.0% | 38.0% |
| 5th floor | 23.4°C | 2.8% | 45.1% |
| 4th floor | 24.0°C | 6.8% | 27.2% |
| 3rd floor | 24.2°C | 0.0% | 53.2% |
| 2nd floor | 23.8°C | 1.0% | 25.0% |
| 1st floor | 22.9°C | 3.0% | 45.3% |
| Gnd floor | 23.5°C | 0.0% | 18.0% |
| B-1 floor | 24.1°C | 0.0% | 34.0% |
| B-2 floor | 23.4°C | 0.0% | 5.7% |

**Figure 2: Simple BMS view of average terminal unit demands to monitor performance**

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# OPTIMISING THERMAL STORE DESIGN FOR CHP

In his second instalment on modern CHP design, Remeha's **Ryan Kirkwood** explores use of thermal stores and how this can maximise CHP efficiency

This part of the guide to combined heat and power (CHP) efficiency looks at thermal stores, the control of heat injection, and the factors affecting sizing. The first article (A condensing guide to CHP efficiency, *CIBSE Journal*, November 2019) analysed different design configurations of CHP, the detrimental effect on performance of pre-heat designs (CHP in series return with boilers), and the advantages of four-pipe and two-pipe thermal store configurations.

To optimise a CHP's thermal and electrical capacity, it's essential to understand the building's profile and base load through dynamic building simulation or hour-by-hour calculation – and by looking at how a thermal store or buffer vessel is to be used. Having a properly designed thermal store allows the CHP to provide thermal space for discharged heat and give a volume of heat that can be injected into the system when the CHP is at 100% output, reducing boiler firing time.

## Thermal store

A thermal store stratifies a thermal layer, offering usable heat at the same flow temperature as the heat source. When heat is required, fluid is removed from the warm layer on the top of the store. Under steady-state conditions – where heat in = heat out – the thermocline layer is static.

A well-stratified, charged tank can have thousands of litres of water at system flow temperature (or greater), which can inject heat into the system when the CHP is at maximum load. This will delay the boilers from firing, allowing peak demands greater than CHP maximum thermal output to be satisfied.

A thermal store can also provide heat if the system's output is less than the CHP's minimum downturn. This principle applies if the thermal load is small compared with the electrical requirements. In both cases, some manufacturers use a dry-air cooler to dump heat to atmosphere, a practice that Remeha cannot condone. In both examples, the thermal store capacity and charge status dictate how long the boost and alternate thermal path functions can operate.

"A well-stratified, charged tank can have thousands of litres of water at system flow temperature"

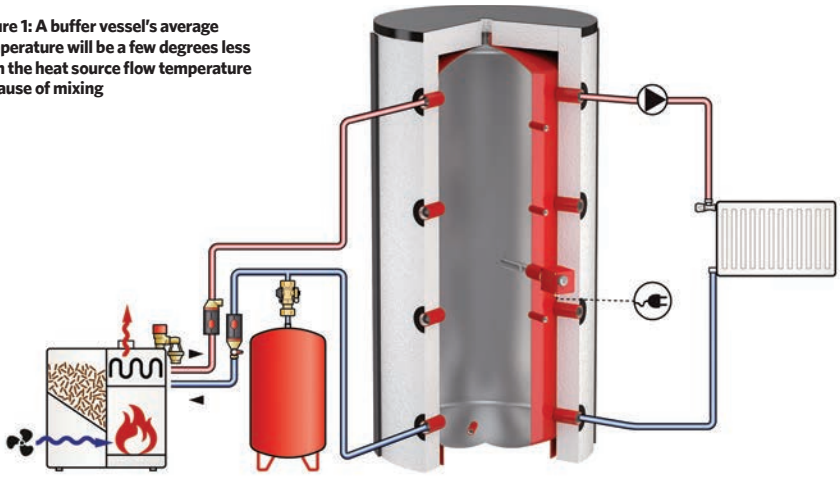

**Figure 1: A buffer vessel's average temperature will be a few degrees less than the heat source flow temperature because of mixing**

## Buffer vessel

The average temperature of a buffer vessel will be a few degrees less than the heat source flow temperature due to mixing. The usable energy (or exergy) in the non-stratified buffer vessel will be less than a stratified thermal store although both have the same overall stored energy. Turbulence and interacting flows of different temperature water within the tank must be minimised for the thermocline to form. Entering water velocities of less than $0.15 m \cdot s^{-1}$ and internal sparge pipes or diffusers to reduce incoming water velocities in the tank will improve the opportunity for a stratification and useful thermal storage.

## Topping the peaks

First, decide whether the CHP should be thermally or electrically led. Many design guides offer advice on how to choose the

primary control philosophy, so the focus here is on the discharge side.

The modified parallel arrangement (four-pipe configuration) in Figure 1, explored in part one, introduced the concept that the discharge pump (B) actively controls the tank charging (energy in > energy out), discharging (energy in < energy out) or equilibrium (no net change in energy). The correct flowrate (Q) sizing of pump (B) is key to the success of modern CHP design. If (QB) > (QA), the store will discharge while the CHP is running, increasing the peak output of CHP-generated heat into the building. The heat injection is a finite function of volume store – and the store must not be fully depleted, as this can cause mixing. However, this safe volume percentage discharge limitation can be overcome using a two-port store, as outlined in part one, but at the expense of a more constrained installation.

Figure 2 is for a simulated building with a typical transient daytime load profile and a CHP sized to meet the base load. By 5am, the store has been fully charged by the CHP. At 6am, the thermal store's energy is released to assist the CHP in meeting the peak, while the boilers do not fire. At 8am-9am, the BMS sees that the tank has reached its safe-percentage depleted levels by monitoring temperature sensors. QB is reduced to match QA, bringing the thermal store back into equilibrium. This continues until 7pm, when the load drops off and the CHP starts to recharge the store. The heat demand is less than the CHP output and, now, QB < QA. The CHP continues to run at full output, charging the store overnight.

This example assumes an electrical base load, equal to the CHP maximum output, that is always used by auxiliary, small power and lighting loads, or exported to the grid.

Boiler firing and cascading should be achieved using flow and return temperature sensors on the system side, as well as on the thermal store flow. If the store's safe-discharge percentage has been exceeded and the output temperature is less than the system set point, a temporary increase in boiler flow temperature should be used to regain the system set point temperature. We strongly advise that an allowance is made for iterations on the BMS set points and timings, to achieve the best results across seasonal commissioning visits.

## Sizing the thermal store

CIBSE AM12 states that to establish the optimum size of the store, it is necessary to use an hour-by-hour operating model, preferably for the whole year, and to carry out a series of calculations with a range of store sizes. The size of the thermal store affects the system's ability to hold off the boilers.

Figure 3 shows the same building profile as in Figure 2, but with a store of half the thermal capacity. In this example, the boilers are used more in the morning (start-up) to meet the demand, and the store charges very quickly. This reduces the CHP's ability to run on full output overnight and requires the CHP to turn down to just above minimum output. A store sized for the full CHP thermal output overnight will always be favourable, but to ascertain the optimum store size for your project, consider:

- Plant area and height restrictions
- Typical winter, summer and transient day loads for electrical and thermal demands
- The size of CHP required for base load and the size proposed (oversized to meet compliance, for example)
- Building load profile/use.

As CIBSE guidance suggests, modelling the proposed configurations will help with understanding of a system's performance and outline the control philosophy required to maximise use of the CHP's generated heat. CJ

**RYAN KIRKWOOD** is specification manager at Remeha

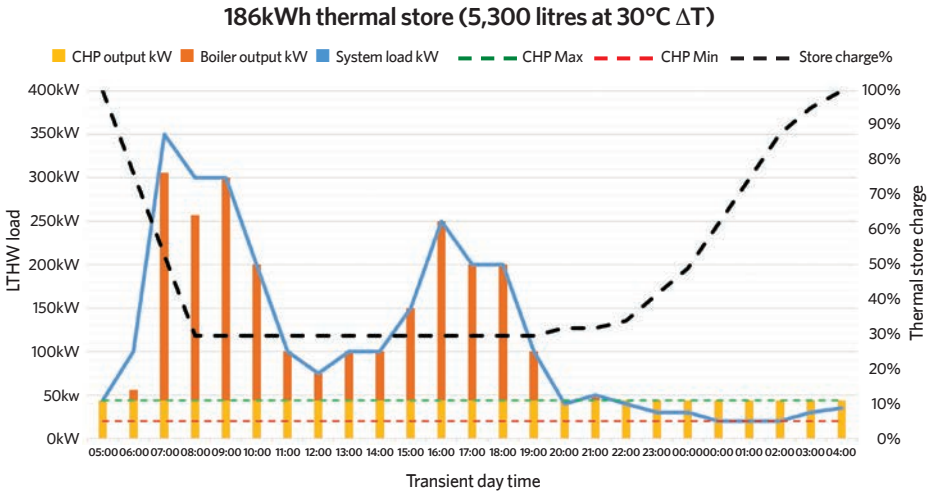


**Figure 2: A simulated building with a typical transient daytime load profile and a CHP sized to meet the base load**

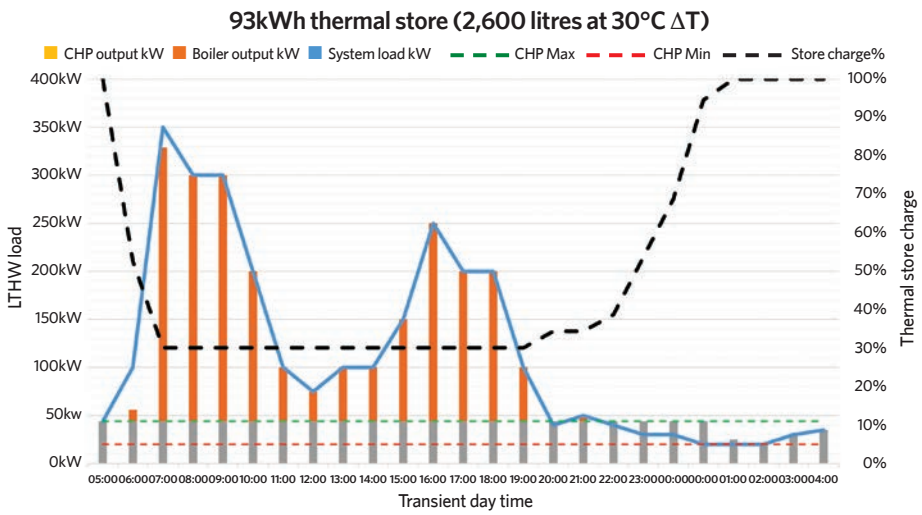


**Figure 3: A simulated building as per Figure 2, but with half the thermal storage capacity**

### BETTER BY DESIGN

**Having a properly designed thermal store allows the CHP to do two things:**

- **Provide thermal space to discharge heat to when the system load < CHP load before the CHP modulates down, or while under full downturn modulation.**
- **Provide a volume of heat that can be injected into the system when the CHP is at 100% output, thus reducing boiler firing time.**

# BUILDING A PLATFORM FOR CHANGE

Early engagement with the project team, collaboration, and standardisation of products are crucial if we are to improve offsite manufacturing for housing, according to participants at *CIBSE Journal*'s roundtable. **Amanda Birch** reports

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To improve dramatically the efficiency of the UK's offsite manufacturing sector for housing, factors such as early engagement of specialists, collaboration across the supply chain, and standardisation of products will be key. These were just some of the ideas discussed at *CIBSE Journal*'s roundtable, held at the Royal Pharmaceutical Society in February and sponsored by Hager, a manufacturer of electrical distribution solutions.

An important message from the event was that achieving meaningful change, where offsite manufacturing performs as effectively as it does in the automotive industry, will require a radical shift in mindset and a move away from traditional building practices.

Jane Yorke, residential market manager at Hager, said she wanted to understand better the issues that roundtable participants faced through the supply chain. 'I can see that we all need to work more collaboratively, and offsite manufacturing must take a more standardised approach so the supply chain is more robust to support these ventures,' she said.

Neil Pennell, head of design, innovation and property solutions at Landsec, cut through some confusing terminology by explaining the different types of offsite manufacture.

He said modular construction, often referred to as a 'volumetric solution', is where cube-shaped rooms are transported to site by lorry and connected to create buildings. Platform frame construction, another method of offsite manufacturing, involves the transportation of flat-packed, individual components, assembled on site.

Pennell added that a glossary of offsite manufacturing terms is being developed, which should help bring clarity to the sector.

## Early collaboration

The participants agreed that offsite manufacturing can produce excellent results when the conditions are right. Key components for its success are a committed and intelligent client, and early engagement, suggested Ian Lock, business development director at Baxi Heating UK.

'We develop and supply prefabricated central plants and utility solutions, and one of our most successful projects is Battersea Power Station,' he said. 'It was successful for a number of reasons. The client had the ambition to drive and support offsite manufacture from the outset and, by virtue of that, we were involved early in the process.

'Upfront involvement, which includes talking about the solution before we went into detailed design, was crucial, otherwise you


## ROUNDTABLE PARTICIPANTS

**From left: Nick Whitehouse** industry adviser, Buildoffsite **Ian Lock** business development director, Baxi Heating **Jerry Lehane** board director, ChapmanBDSP **Jane Yorke** residential market manager, Hager **Chair: Alex Smith** editor, *CIBSE Journal* **Matthew Teague** marketing project manager, Tata Steel Europe **Neil Pennell** head of design, innovation and property solutions, Landsec **Laura O'Leary** director, MZA Consulting Engineers **Doug Baldock** transformation lead, Laing O'Rourke

"We're only learning from disasters like Grenfell. We shouldn't have to get to that point for radical changes to be made" – Laura O'Leary

miss the opportunity for mass customisation via a modular platform.'

Laura O'Leary, director at MZA Consulting Engineers, agreed, and said that 'in the past 18 months, we've seen that collaborating with key specialists early on leads to better coordination from the outset and a successful design. A more detailed design is delivered from an earlier stage, but it gives everyone – including the client – trust and cost certainty; it's definitely the way forward.'

Jerry Lehane, board director at ChapmanBDSP, who also worked on the Battersea Power Station project, said being locked in early meant a need to optimise the design at this stage. At this point, there is also a crossover between disciplines, with which – he stressed – everyone needs to be comfortable.

'The consultant needs to do a higher level of design to be able to make sure it is optimised,' he said. 'You are solidifying at this point what the building form is, and it's too late to go back at stage three or stage four, when you might be optimising around products.'

Lehane also advised a direct and open relationship with the client be established and additional due diligence undertaken on the designer's part. These elemental changes on each bit of the supply chain, he added, can really start to make a difference when the modular approach is used.

To ensure a wider adoption of offsite manufacturing, Doug Baldock, transformation lead at Laing O'Rourke, said new, flexible products that suit the manufacturing process »

"The supply chain is coming up against barriers from the consultants, who have design guidance they have to stick to on projects for consistency" – Doug Baldock

"The consultant needs to do a higher level of design to be able to make sure it is optimised" – Jerry Lehane

"Offsite manufacturing needs to take a more standardised approach so the supply chain is robust" – Jane Yorke

"Platform-frame construction is an interesting offshoot because it's taking offsite back to an automotive-chassis approach" – Matthew Teague

"If we haven't got the skills and design fraternity to go offsite, it will inhibit clients, and vice versa" – Nick Whitehouse

» should be developed. To illustrate his point, he cited a Laing O'Rourke project.

'We've been working with a ventilation manufacturer to provide a system that fits with our modular steel frame,' said Baldock. 'However, the frame constrains how the M&E components flow through it. We need a product manufacturer who can adapt their product set to suit our manufacturing process and our product. If we're moving towards a manufacturing process where takt time and productivity are improved continuously, we need products that allow us to do that.'

Matthew Teague, Tata Steel architect, drew comparisons with the automotive industry and housing, and said there was sufficient scope for leverage and continuous improvement in the supply chain where entrants like Laing O'Rourke could make a real difference.

Baldock agreed, highlighting that delivering 10,000 homes a year using modern methods of manufacturing is achievable for Laing O'Rourke – but the supply chain could find it very challenging to meet this target.

'To get to the stage where we are producing housing like the automotive industry, which is the holy grail, we will have to see everyone in the supply chain coming together to optimise the products,' said Baldock. 'Only then will the industry benefit, because the cost comes down, the quality goes up, and more skilled jobs are created.'

Lock and O'Leary agreed, adding that collaboration within the supply chain, standardisation of products, and a shift in mindset are key factors for encouraging mass customisation in offsite manufacturing.

## Keeping it standard

Pennell cautioned that it was critical for manufacturers to standardise the information around components. Accurate details on the materials – where they come from, their content and embodied energy – should be included. 'As a client, we need that information, and we use databases that are generic in their nature, but we can make significant changes,' he said.

'We currently have a commercial development that uses platform frame construction and we have a lot of information around embodied carbon. We carried out an assessment on the building design and it employs almost 20% less embodied carbon. It's a steel and concrete building, and we're using less materials, and a more optimised solution, as a result.'

Nick Whitehouse, architect and industry adviser at Buildoffsite, agreed that declaring information about materials is crucial, and »


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» added that the end-of-life and reusable aspect of materials and products should be considered and designed with this in mind.

'If we haven't got the professional skills and design fraternity to go offsite, it will inhibit clients, and vice versa,' said Whitehouse. 'Clients are critical; they start everything. We need the big, expert clients who have the historical data and experience to inform and improve everything we do, and this is currently missing.'

Baldock said another obstacle to productive offsite manufacture are the Building Regulations and British standards to which consultants have to adhere. 'We're finding that the supply chain is coming up against barriers from the consultants, who have design guidance they have to stick to on projects for consistency,' he said.

'We need to get to a point where offsite manufacturing is really productive, is a scalable manufacture-led product, where the design fundamentally changes, and where you work upfront and design to rules that can be quickly adjusted to suit an automated process.

'This would free up good consultant engineers who can deal with some bigger issues, such as finding clever ways of saving energy and meeting zero carbon targets.'

If the market volume grows, and 150,000 homes a year are produced, it will be better to have lots of manufacturers that can play a part and produce bits to create, Pennell added.

Having this volume enables the scale that allows manufacturers to invest. He likened it to the 'chicken and egg' situation, where we need to get past the small scale we're in now.

The message of standardising products was emphasised again. Pennell said this approach will help the industry to grow volume and create the ability to justify investment. Otherwise, if we're not careful, he added, other successful players in offsite manufacturing – such as the Japanese and the Americans – will take the market away from the UK.


Chair Alex Smith

'It's understanding where government intervention is and how they will take this forward,' said O'Leary. 'It's getting to this commonality, yet getting more standardised. At the moment, we're only learning from the things that were successful, or from disasters – such as Grenfell. We shouldn't have to get to that point for radical changes to be made.'

Teague added that this is what happened to containerisation. There is no benefit in reinventing the container, which is what the industry is doing all the time. 'This is where platform DfMA construction is an interesting development because it's taking offsite back to an automotive-chassis approach,' he said. 'This solution allows several typologies to use the same basic components.'

According to Lock, the two big growth areas for new-build are the private rental sector and affordable housing. He said there is a real appetite and opportunity for a sweeping change in offsite manufacture, and that this sector offers the robustness needed to accelerate prefabrication. However, he warned that we currently have an inconsistent energy strategy across the UK, and this needs to be resolved before we embark on a big push in offsite manufacturing for housing.

'The collaborative approach is where we need to be looking,' said Yorke. 'I welcome us coming together at a much earlier stage in the design process, and that we focus on what the client is trying to achieve and consider the creative solutions for delivering this.'

The event ended on an upbeat note, with participants feeling positive about the future of offsite manufacturing, although it will take collaboration, partnership, early intervention, and sharing of knowledge to move forward. 'With change comes great disruption,' said Pennell. 'There are lots of barriers – some regulatory, some insurance, some in the way we procure, and some because the workforce is set up to do it one way. We have to translate those skills into a different way of working.'

This will require a big reskilling of people and drawing in new talent, added Pennell, who said – although it will be a challenge – many things were now coming together, including the climate change imperative, resource scarcity, and a need to do things efficiently and for the UK to get the most out of its industries.

'If we get this right,' he said, 'we can export it, but we have to work more collectively to make it happen.' CJ

"If we're not careful, other successful players in offsite manufacturing – such as the Japanese and the Americans – will take the market away from the UK" – Neil Pennell

"Upfront involvement, which includes talking about the solution before we go into detailed design, is crucial, otherwise you miss the opportunity for mass customisation" – Ian Lock

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# A DIGITAL PIONEER

Jagannatha Reddy's commitment to innovation in digital processes and collaboration earned him the title of best digital engineer 2019 at the Society of Digital Engineering Digital Awards. **Liza Young** finds out more

Reddy accepting his award via Skype

Jagannatha Reddy

Jagannatha Reddy, electrical design engineer at Arcadis, won the title of best digital engineer at the Society of Digital Engineering Digital Awards 2019. He swayed the judges with the 'sheer breadth and depth of digital engineering that he has pioneered and championed for Arcadis'.

Reddy joined Arcadis as an assistant engineer in 2014, before being promoted to engineer in 2016 and design engineer in 2018. He is currently lead digital engineer (building services) and electrical design engineer. His biggest achievement has been streamlining the transfer of information between architects' BIM models and the simulation models used by engineers. 'It is one of the simple, elegant things that Jagan has done,' says judge Carl Collins. 'Most organisations haven't even considered using his methods.'

Judges were also impressed with how Reddy transformed the way Arcadis teams collaborate and exchange information by adopting Microsoft Teams software to ensure there is only 'one version of the truth'. 'He has done loads of little things like this that have helped Arcadis be more competitive,' says Collins.

## The integration challenge

Reddy spent six months looking at the potential of integrating 3D modelling software tools – such as Revit and AECOsim Building Designer – with design-simulation software such as DIALux, Amtech and IES VE.

The normal working practice is to recreate a version of the building for analysis and simulation, but Reddy wanted to see if information could be imported directly from the main modelling platform into the simulation software. He used Revit's inbuilt export functions to save information in file formats such as gbXML [Green building eXtensible Mark-up Language] and IFC [Industry Foundation Classes]. He then tested how much information came through when importing those files into analytical software, such as DIALux and IES Virtual Environment.

While the transfer of information from the modelling platform to the analytical platform was not complete, Reddy found that it transferred enough to be useful and saved a significant amount of time compared with creating that information from scratch in the analytical platform. 'It is time-consuming to transfer information manually and, when you have to adhere to a tight schedule, it is possible to miss some information, which can reduce the quality [of a project],' says Reddy.

The method, Collins adds, removes many errors that you would normally see when there are two, unrelated models: one for creating deliverables (drawings, schedules and so on) and a separate one for analysis – heating and cooling loads, lighting and power requirements.

Reddy created digital workflows, which are now embedded in Arcadis projects. Figure 1 is an example of how workflows have been simplified. 'I am passionate about making a difference through innovation and technology,' he says. 'During this journey, I have learned a lot and gained a global network of like-minded people.'

### Transferring information between AECOsim and DIALux

Conventional approach

3D (AECOsim) to 2D export → Import 2D to DIALux → Perform DIALux calculations and export to 2D CAD → Import 2D CAD to AECOsim and model the luminaire arrangement → Engineer cross-checks luminaire arrangement with DIALux calculation

**Figure 1: The conventional approach requires creation of model again in DIALux, which can result in loss of information or errors while transferring data**

## Microsoft Teams

As part of the Arcadis-UK building services digital engineering core team, Reddy implemented Microsoft Teams (MS Teams) workspace, for better collaboration and communication on projects. Project team members can access all the applications – including latest-version file locations, site permissions, status of works, key milestones and design coordination – from a single workspace in real time, saving unnecessary conversations via email.

Reddy combined desktop application ProjectWise with Microsoft Office 365, and added the new web-based ProjectWise 365 application (a Bentley tool for BIM collaboration) as a tab to the digital workspace. This allows the team to access project information from anywhere. Digital twin models can also be accessed in the BIM tool.

'This is a game changer and a significant milestone in our digital journey,' says Niranjan Sahoo, Arcadis project engineering manager, who encouraged the use of MS Teams for his Beckton depot project, and recommended that all disciplines follow up on the results.

As well as ProjectWise 365 services, Reddy added tabs for software applications including: SharePoint; Holobuilder (360-degree site images); PowerBI (project management); Planner (key deliverables, actions and individual/team assignments); voice/video calls; and meetings information. This created one common, transparent workspace for accessing all project-related data and communications.

He also developed the guides and templates to help the wider Arcadis team understand and implement online share and collaboration spaces for other projects and disciplines.

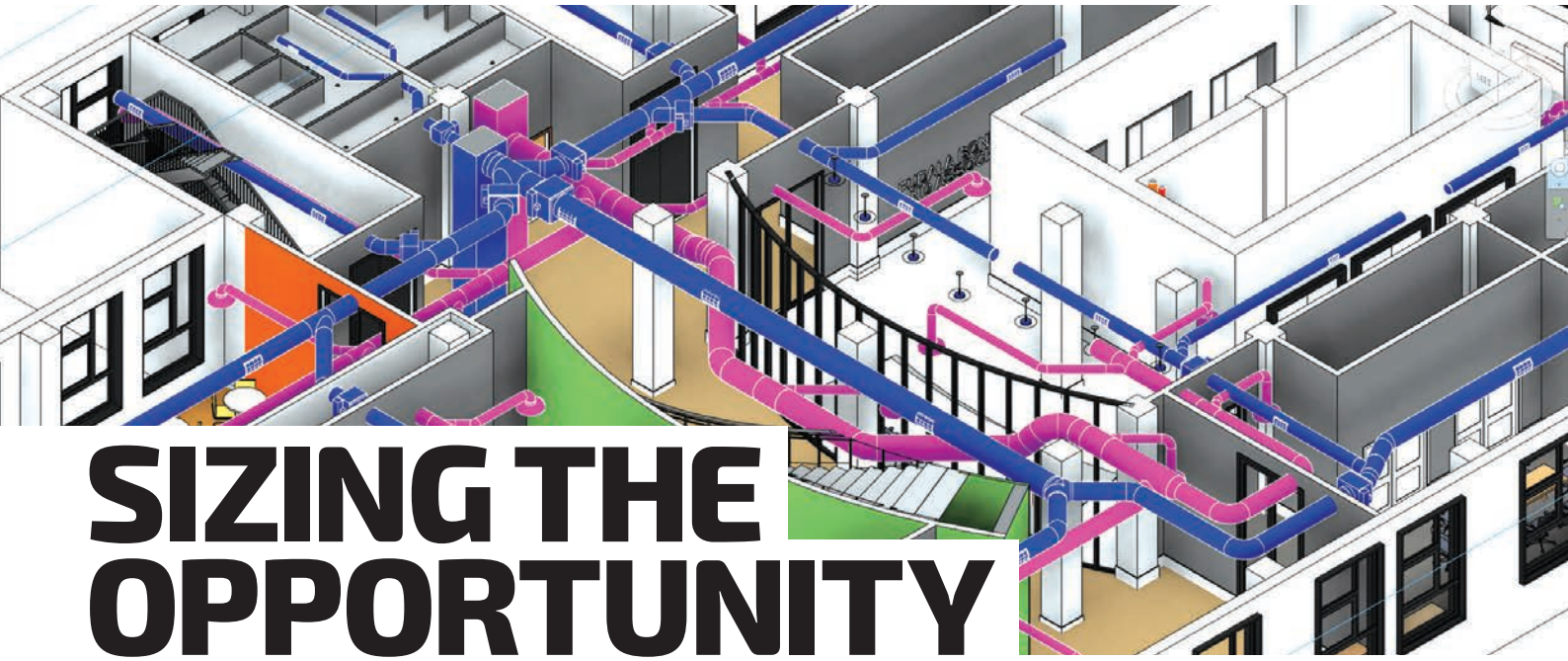
All project data is stored in the associated online collaborative platform, reducing the hassle of finding information and the confusion of having multiple versions, revisions and folder structures. The 'thread' conversations in the online workspace are tailored to Arcadis's project requirements, and project members can respond to messages or start new conversations.

'This is the modern, chat-based collaboration platform, which has made the team work together more effectively, and improved efficiency,' says Reddy, who has implemented the system on two recent projects: the C2C Station Transformations programme, for which Arcadis is doing the building services design for six stations, and the design and build of the Step-Free Access Tranche 2 for London Underground. Arcadis estimates the initiatives will save 30-50% of staff time, compared with conventional approaches.

Reddy's main focus for 2020 is digitising project records ready for handover. 'Whatever solution we provide to the client, there will be a digital handover document for the operations and maintenance team,' he says. 'This will save time, cost and environmental wastage.' CJ

Integrated approach


**Reduces duplication of work leading to 50-70% savings in time**



# SIZING THE OPPORTUNITY

Integrated design and dynamic modelling can help overcome the problem of HVAC oversizing, says Autodesk's **Steven Butler**

Oversizing of HVAC systems is a £224bn problem globally, according to a joint study by Autodesk and the Rocky Mountain Institute (RMI).[1]

This found that using traditional static-load and rule-of-thumb approaches to system sizing can result in a 50% oversizing of systems.[2] This reduces occupiable space, raises capital and operating costs, and decreases occupant comfort.

Right-sizing is the process of designing systems that can treat occupiable spaces during normal conditions, while allowing a small amount of overrun for exceptionally hot or cold days. This article looks at how integrated building design and dynamic modelling can support this. To succeed, these methods need the right approach and inputs, and an iterative and collaborative process.

HVAC right-sizing will also be crucial to meet the ambitious goal of decarbonising Europe's building stock by 2050.[3] Around 75% of buildings in the EU were built before 1990, and an estimated 97% need an upgrade,[4] putting mechanical, electrical and plumbing professionals in a strong position to improve the energy performance of existing and new building stock. For a typical commercial building in the EU, right-sizing could reduce greenhouse gas emissions by as much as 0.44 metric tonnes of $CO_2$-equivalent per year.[5]

## The approach: design-assist and dynamic modelling

BIM has lowered barriers to early-stage energy analysis dramatically. With the design file now providing the basis for analysis from early stages – including concept design – the opportunity for the engineer to engage as a collaborative adviser arises much sooner. By automating aspects of energy simulation, including creation of the analytical model, software has further opened the door for this change in practice.

Insight building performance analysis software gives Revit users a guide to better building energy and environmental performance throughout the building life-cycle. Engineers can use its sensitivity analysis to guide clients and architects to the most desirable energy conservation measures. The software shows how prospective design changes affect heating and cooling loads, and energy use intensity.

Using the model and integrated building performance analysis data eliminates the need to build a separate model for energy analysis. On upload, a range of potential design outcomes are simulated through energy cost-range factors, to help engineers identify key energy performance drivers quickly, and dynamically compare design scenarios. Interaction with performance indicators, benchmarks, factors, ranges and specifications gives real-time cause-and-effect feedback early in the project. By using the cloud, dynamic modelling can be performed early and often.

Beginning the process in the conceptual design phase and carrying it through the entire design phase allows decisions to be made at the right time, with the right information – potentially minimising loads and optimising equipment selection to achieve better building performance with right-sized designs. Insight supports a variety of workflows, including whole-building energy and lighting analysis, solar radiation and shading, daylighting, and heating and cooling loads analysis.

> "HVAC right-sizing will also be crucial to meet the ambitious goal of decarbonising Europe's building stock by 2050"

## Inputs

Any analysis is only as good as the data it is fed. All calculations are subject to the 'garbage in, garbage out' principle, so it is important to use relevant data and the correct assumptions. Take the allowance made in cooling systems for the additional heat emitted by the lighting scheme, for example. Has the luminaire type proposed by the electrical engineer been modelled by the mechanical engineer? It is not uncommon to allow 12W per m² for the lighting load in the cooling calculation, but if LED lamps are being proposed, this figure will be too high – and the cooling system will be oversized. Decisions like these are more easily captured and iterated using analysis tools.

Similar considerations should be given to the incident solar irradiation according to the building's orientation. Again, it is not uncommon to provide a general factor, but how true would this be in real-world scenarios? With the ability to parse large quantities of data across many different calculations quickly and easily, we can perform analysis with a higher degree of precision without additional work overhead. This helps us get closer to the 'right size' value earlier, and iterations of the design will be smaller, as we start from a better position.

There are numerous factors to consider to ensure right-sizing, including solar gain, occupant behaviour and equipment loads (see panel, 'Factors affecting right-sizing'). Occupant activity levels, connected plug loads (small power), solar gain, and the effect of overshading from surrounding structures should also be taken into account – as should future weather data, using resources such as CIBSE's Weather Files **www.cibse.org/weatherdata** The software gives a platform to model these scenarios quickly.

## Model early, revise continuously

Being able to model early with a small amount of information allows key design decisions to be made. These can then be iterated rapidly as more detailed information becomes available. Revit enables the engineer to create systems zones from the architect's model, and associate plant and equipment, air systems or water loops to serve individual spaces or the whole building. Once analytical spaces have been created, and a system and zoning strategy established, energy analysis, comfort and system sizing can begin.

Using the EnergyPlus2 service and the OpenStudio API, engineers can run a set of predefined scripts for analysis – or customise the open-source scripts provided – to run almost any kind of services-related system analysis. The results are delivered back in Revit, where more detailed design can start.

## Conclusion

Right-sizing is more easily addressed using technology. We can simulate conditions, analyse results and make more informed decisions – and the process engages the engineer in more BIM-based workflows.

Traditional methods for sizing equipment often result in expensive, underperforming systems that lead to suboptimal duct and pipe-sizing. Integrated design and dynamic modelling enable real data – or accurate estimates tailored to the project – to drive better outcomes, facilitating model-based iteration and collaboration, modelling early and often, and revising continuously, with little or no impact on project schedule.

Overall, the process gives greater return on investment for the client, who can save on capital and operational expenses, gain more leasable area from reduced services, and offer occupants greater comfort. Research suggests that right-sizing can reduce HVAC first and system components costs by as much as 23%. It also offers energy and greenhouse gas savings for existing building infrastructure, reducing overheating of buildings as part of renovation projects. **CJ**

**STEVEN BUTLER** is a senior industry strategist for MEP at Autodesk

### References:

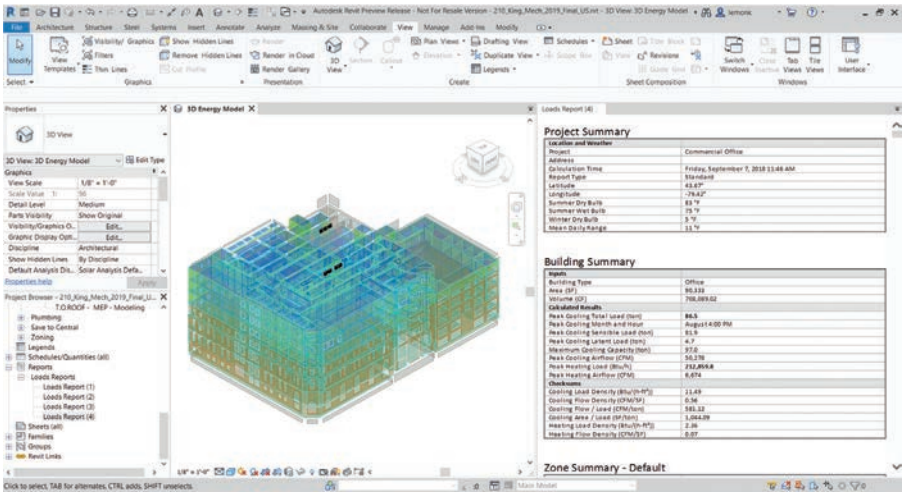

1 140Mtoe – total commercial buildings energy in EU28 (EU Buildings Database, 2011-2015); 1toe = 11629 kWh; 296 x 10-6 tonnes $CO_2$e.kWh$^{-1}$ (EU database, 2016 $CO_2$ emission intensity); HVAC is 40% of building energy (Navigant Research); Average savings of 3.5% from proper HVAC sizing; 15.364 million commercial buildings in EU (EU Buildings Database, 2011-2015); (140 x $10^6$)toe x 11629 kWh.toe$^{-1}$ x (296 x $10^{-6}$) t $CO_2$e.kWh$^{-1}$ x 40% x 3.5% x (1/15.364*$10^6$) = 0.439 tonnes $CO_2$e per average building.

2 Mowris, R and Jones, E, *Peak demand and energy savings from properly sized and matched air conditioners*, 2008 ACEEE Summer Study on Energy Efficiency in Buildings.

3 As laid out in the Energy Performance of Buildings Regulations in England and Wales, the Climate Change Act, the EU's Energy Performance of Buildings Directive (EPBD) and the Energy Efficiency Directive.

4 Factsheet on upgrading buildings, Buildings Performance Institute Europe, **bit.ly/CJMar20BPIE**

5 Estimate based on total commercial buildings energy in EU28 of 140Mtoe (EU Buildings Database, 2011-2015), 3.968*10^7Btu/toe, 341.

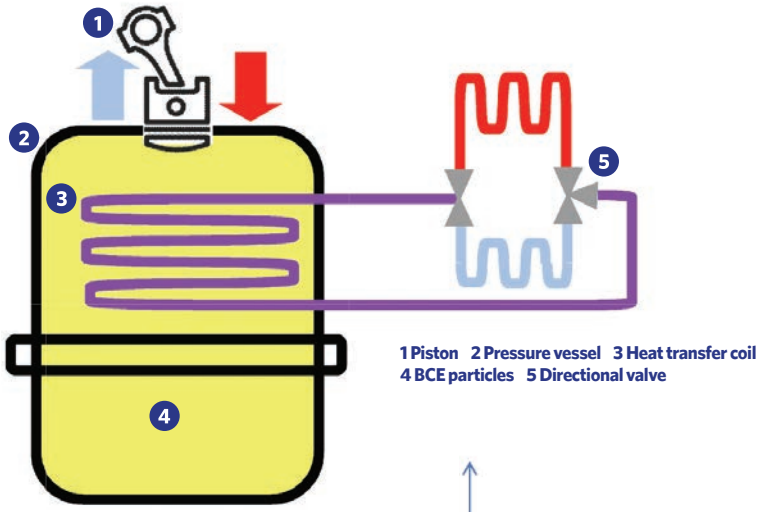

**Insight software gives Revit users a guide to better energy and environmental performance during the building life-cycle**

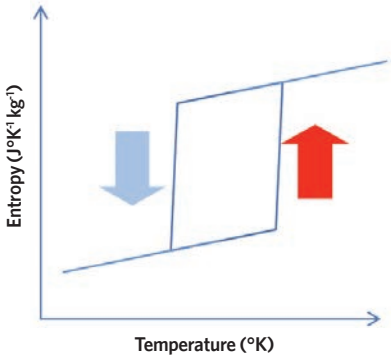
## FACTORS AFFECTING RIGHT-SIZING

- **Solar** – where and when will solar irradiation affect our building?
- **Equipment** – what is adding heat to different spaces?
- **People** – how many people will occupy the space, what will they be doing, and what clothing effects will there be?
- **Systems** – how much heat is added or removed by the delivery system?
- **Contra-loads** – is there anything in the space that will do part of the system job for you?
- **Local variables** – is the heat-island effect significant?
- **Variables over time** – how will the climate around my building change over time?

# DOWN TO ZERO

A Cambridge start-up is pioneering a breakthrough technology, based on the barocaloric effect, to develop a radical zero-GWP cooling system. **Phil Lattimore** reports




System operation

**Pressure is applied cyclically via a piston to BCE particles loaded into a pressure vessel. The BCE particles will become warmer upon application of positive pressure and cooler upon pressure release. A directional valve synchronised with the piston action directs alternately warmed and cooled heat-transfer fluid to the hot sink and cold load respectively. Thus, the cold load becomes progressively cooler and the hot sink progressively warmer with each pressure cycle.**

The reduction of fluorinated greenhouse gas (F-Gas) emissions is a key part of climate change policy. The F-Gas Regulation aims to cut the EU's F-Gas emissions by two-thirds by 2030, compared with 2014 levels,[1] which will mean the phasing out of many refrigerants with global warming potential (GWP).

Cambridge-based Barocal is developing a zero-GWP alternative to refrigerants that harnesses the barocaloric effect (BCE) – when materials undergo large thermal changes on application and removal of pressure – to develop cooling systems. Built on work by Dr Xavier Moya, research director and co-founder of Barocal, and his team, the company has identified organic solid materials that exhibit 'giant' barocaloric cooling effects when subjected to external pressures of up to 5,000bar, but, typically, less than 2,000bar.

Moya and his team have been working on the materials at the University of Cambridge, in collaboration with the Universitat de Barcelona and the Universitat Politècnica de Catalunya. Four years ago, they discovered organic barocaloric materials that produced much higher changes in temperature and thermal capacity. In 2019, Barocal was formed to commercialise the process.

The technology uses a reversible Brayton cycle – a thermodynamic sequence that describes the workings of a constant-pressure heat engine – to provide continuous cooling using barocaloric materials. Pressure is applied to the barocaloric solid material in a pressure vessel to stimulate an increase in temperature, and a heat-transfer inert fluid is heated by the barocaloric mass to transfer the heat away. As pressure is released in the material, it cools down in a reversible manner, and this cools the heat-transfer fluid, which is used for external cooling. This cycle can be repeated to provide continuous cooling.

'When you apply pressure, you get a phase change related to the crystalline structure of the solid,' says Barocal co-founder and managing director William Averdieck. 'Some of these materials have disordered, long molecular tails, and when you compress them, they become more ordered, with an associated change in energy levels.' An analogy is when carbon is transformed into diamond by application of high pressure and temperature, says Averdieck. However, with Barocal's materials, short-term pressure changes at ambient temperatures create phase changes.

One of the materials covered by the patent is neopentyl glycol. 'When pressure is applied up to 5,000bar, its crystalline structure changes. What was amazing was the change in entropy per kg, which was in the order of what you observe with gas compression cycles,' says Averdieck.

According to Barocal, the materials can exhibit similar cooling capacities to those achieved in commercial refrigerant gases (for example, 600kJ·K$^{-1}$·kg$^{-1}$). The process can achieve temperature changes of between 20-40°C, depending on the pressures applied, says Barocal.

The challenge is to turn the system's theoretical potential into a commercial solution. As well as ensuring it is safe, reliable and maintainable, Averdieck says the system needs to be energy efficient.

'We know it's a zero-GWP material but, ultimately, it's also about how much electricity we use,' he says. 'With refrigeration, generally one third of the greenhouse gas emissions come from the refrigerant and two-thirds from the energy used. Our challenge is to develop systems that generate the necessary pressures while being economic with energy.'

Barocal's concept has been shortlisted for the Global Cooling Prize, which includes a $200,000 award to develop a prototype. 'We're several years away from commercialisation, but if we show success with our technology, I'm sure we can engage with air conditioning manufacturers and open opportunities for the business to develop,' says Averdieck. **CJ**

**References:**

1 Fluorinated greenhouse gases, EC website, accessed Feb 20 **bit.ly/CJMar20Baro**

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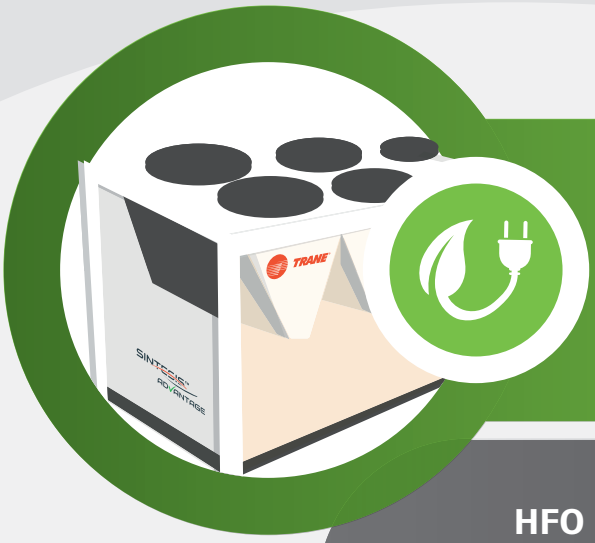

## ELECTRIFICATION OF HEATING

Heat pumps offer an alternative and green solution for heating

## HFO & LOW-GWP REFRIGERANT

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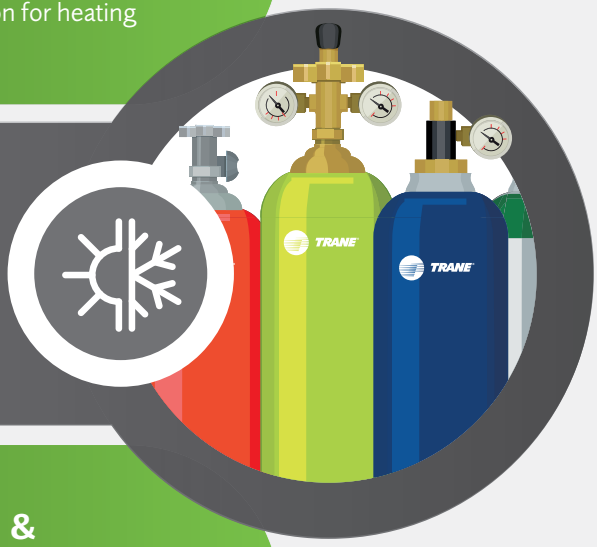

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Cost model

# Later living

The demand for luxury developments for older people is on the rise. Aecom's **Andrew Freeman** looks at the costs of providing onsite healthcare, as well as facilities such as wine rooms, cinemas and spas

This cost model focuses on a generic luxury 'later living' development in the south of England, formed of 50 apartments comprising 20 one-bed units, 25 two-bed units, and five two-bed 'close-care units' that provide care and facilities for people with dementia.

These high-end developments include a 24-hour concierge and onsite nursing staff, and specialise in providing high-quality onsite amenities. They can include a restaurant, hair salon, gym, sauna, swimming pool and treatment rooms, wine room, cinema and drawing rooms.

This cost model will consider the costs of all of these. The approach is not to compromise on facilities and location just because the age of the population is higher.

## Innovative technologies

'Smart floors' are installed in the close-care apartments, and are designed to detect falls and alert staff to a resident in difficulty. The technology installed under floor coverings can learn residents' movements and set parameters so that alarms are not falsely triggered.

These apartments can also feature lighting to assist dementia patients. Additional lighting may be incorporated within fixed furniture, to establish zones within the apartments, while low-level night-time lighting can be installed in bathrooms and kitchens. Wayfinding lighting can also be put into floor finishes.

The introduction of controls to provide circadian lighting is next in the pipeline. Control of the lighting within rooms and zones is pre-set remotely, to give the optimal level and type of lighting for individual apartments/residents.

Aspirating smoke systems can be installed to detect fires at the earliest opportunity, and there is the potential for fire-suppression systems within cooker hoods that isolate heat sources and discharge a fine mist. This system means clean-up is minimised in the event of discharge.

Leak-detection and flow-monitor devices can be incorporated into bathrooms, kitchens and other wet areas, to prevent flooding and accidental overflows from baths and sinks.

## Healthcare

Healthcare is provided on site through trained medical staff who are provided with sleeping accommodation and are available 24 hours a day. Within the 'later living' developments, residents can select the level of care that best suits their needs and medical requirements. On larger developments, it is not uncommon to see a small medical facility that offers services such as a visiting physiotherapist, a later-living specialist or a doctor.

A limited number of apartments will have nurse call points and medical gases, to meet the additional care requirements of certain residents.

## Concierge service and security

Access control and CCTV within later-living developments are at an enhanced level, and will often include CCTV within lifts, corridors and stairwells to assist in the tracking and monitoring of residents. The level of cameras and security is designed to be non-intrusive.

A priority for these developments is to provide residents with space to socialise, which is seen as essential to their health and wellbeing. They are designed to encourage interaction and engagement, and the focal point for socialisation are the 'drawing rooms' – which are based on a library – or music rooms.

Restaurants can include wine rooms, and can be enhanced with »

> "A priority for these developments is to provide residents with space to socialise, which is seen as essential to their health and wellbeing"

| Shell and core rates | Based on an GIA 9,000m² | | |
|---|---|---|---|
| | Total (£) | £/m² on GIA | £/ft² on GIA |
| **Sanitaryware** Sanitaryware to communal areas, including changing rooms, restaurant, and so on. Includes subcontractor prelims. | £28,000 | £3.11 | £0.29 |
| **Disposal installations** Rainwater and soil/waste drainage (insulated HDPE pipes). Includes testing and commissioning, and subcontractor prelims. | £290,000 | £32.22 | £2.99 |
| **Water installations** Boosted cold water to apartments, including plant. Boosted cold water distribution and hot-water generation to communal areas. Includes testing and commissioning, and subcontractor prelims. | £321,000 | £35.67 | £3.31 |
| **Heat source** Heat-generation plant and pipework, including boilers, CHP, pumps, and so on. Flues to atmosphere. Includes testing and commissioning, and subcontractor prelims. | £187,000 | £20.78 | £1.93 |
| **Space heating and air-treatment systems** LTHW distribution to apartments and communal areas. Air cooled chillers and associated plant generating chilled water. CHW distribution to apartments and communal areas. Includes testing and commissioning, and subcontractor prelims. | £653,000 | £72.56 | £6.74 |
| **Ventilation** Core smoke extract, with environmental boost to corridors. Central kitchen extract system. Includes testing and commissioning, and subcontractor prelims. | £259,000 | £28.78 | £2.67 |
| **Electrical installations** General LV and ryefield installation to apartments. Small power, containment, and earthing and bonding. Lighting to basement and feature lighting. Car-charging points. Includes testing and commissioning, and subcontractor prelims. | £891,000 | £99.00 | £9.20 |
| **Gas installation** Gas supply to plantrooms and kitchens. Includes testing and commissioning, and subcontractor prelims. | £32,000 | £3.56 | £0.33 |
| **Protective installation** Sprinkler installation to ground-floor communal space and apartments. Dry risers. Lightning protection. Includes testing and commissioning, and subcontractor prelims. | £156,000 | £17.33 | £1.61 |
| **Communication, security and control systems** Fire-alarm installation and disabled refuge call system. Door-entry system, IRS system, fibre installation, telephone installation and data. Access control and closed circuit television. General containment. Medical alert system within shell and core areas. BMS system, including energy monitoring system. Includes testing and commissioning, and subcontractor prelims. | £772,000 | £85.78 | £7.97 |
| **Builders work in connection with services** | £108,000 | £12.00 | £1.11 |
| **Shell and core total costs** | **£3,697,000** | **£410.78** | **£38.16** |

| Communal areas fit-out rates | Based on an NIA 1,350m² | | |
|---|---|---|---|
| | Total (£) | £/m² on GIA | £/ft² on GIA |
| **Reception** Includes heating and cooling, ventilation, small power, lighting, fire detection and IT/AV. Excludes pendant lighting. Includes testing and commissioning, and subcontractor prelims. | £83,000 | £61.48 | £5.71 |
| **Restaurant** Includes heating and cooling, ventilation, small power, lighting, fire detection, sound system and IT/AV. Excludes pendant lighting. Includes testing and commissioning, and subcontractor prelims. | £173,000 | £128.15 | £11.91 |
| **Restaurant kitchen** Boosted cold water to apartments, including plant. Boosted cold-water distribution and hot-water generation to communal areas. Includes testing and commissioning, and subcontractor prelims. | | | Shell and Core |
| **Wine room** Includes temperature control, ventilation, small power, lighting, fire detection, sound system and IT/AV. Excludes pendant feature lighting. Includes testing and commissioning, and subcontractor prelims. | £64,000 | £47.41 | £4.40 |
| **Gym and studios** Includes heating and cooling, ventilation, small power, lighting, fire detection, sound system and IT/AV. | £83,000 | £61.48 | £5.71 |
| **Sauna, swimming pool and treatment rooms** Includes heating and cooling, ventilation, small power, lighting, fire detection, sound system and IT/AV. Excludes plant for sauna and swimming pool. Includes testing and commissioning, and subcontractor prelims. | £314,000 | £232.59 | £21.61 |
| **Beauty/hair salon** Includes heating and cooling, ventilation, small power, lighting, fire detection, sound system and IT/AV. Includes testing and commissioning, and subcontractor prelims. | £42,000 | £31.11 | £2.89 |
| **Cinema room** Includes heating and cooling, ventilation, small power, lighting and fire detection. Includes IT/AV equipment for cinema system. Includes testing and commissioning, and subcontractor prelims. | £127,000 | £94.07 | £8.74 |
| **Drawing rooms** Includes heating and cooling, ventilation, small power, lighting, fire detection, sound system and IT/AV. Excludes pendant feature lighting. Includes testing and commissioning, and subcontractor prelims. | £166,000 | £122.96 | £11.42 |
| **Communal areas fit-out total costs** | **£1,052,000** | **£779.26** | **£72.40** |

**'Later life' developments are designed to encourage interaction and engagement between residents, with drawing rooms and music rooms**

| Apartment fit-out rates | Based on an NIA 5,000m² | | |
|---|---|---|---|
| | Total (£) | £/m² on GIA | £/ft² on GIA |
| **Sanitaryware**<br>1 Bed comprising an en suite with WC, WHB, individual bath and shower, and a water closet with WC and WHB.<br>2 Bed comprising master en suite with a WC, WHB, individual bath and shower, a secondary en suite with a WC, WHB and shower, and a water closet with WC and WHB.<br>Includes subcontractor prelims. | £589,000 | £117.80 | £10.94 |
| **Disposal installations**<br>Waste pipework serving sanitaryware and white goods. Condensate pipework to fan coil units, interface units and mechanical ventilation heat recovery unit. Includes testing and commissioning, and subcontractor prelims. | £52,000 | £10.40 | £0.97 |
| **Water installations**<br>Copper hot and cold water pipework, complete with phenolic foam insulation, serving sanitaryware and white goods. Includes testing and commissioning, and subcontractor prelims. | £234,000 | £46.80 | £4.35 |
| **Heat source**<br>Heat interface unit with energy meter. Chilled water valve set with energy meter. Includes testing and commissioning, and subcontractor prelims. | £194,000 | £38.80 | £3.60 |
| **Space heating and air treatment systems**<br>LTHW underfloor heating throughout, providing heating. Two-pipe fan coil units in bedrooms, living areas and kitchen, to provide cooling. Heated towel rails in bathrooms.Includes testing and commissioning, and subcontractor prelims. | £938,000 | £187.60 | £17.43 |
| **Ventilation**<br>Mechanical ventilation heat recovery (MVHR) unit with PVC ductwork, complete with attenuation and linear grilles. The fresh air and exhaust ductwork is insulated. MVHR boost system, including override switch within the utility cupboard and kitchen, double pole light switches in bathrooms, providing a boost function. No allowance for kitchen extract hood or ductwork. Includes testing and commissioning, and subcontractor prelims. | £290,000 | £58.00 | £5.39 |
| **Electrical installations**<br>Consumer unit. Small power with brushed-finished sockets. Lighting, including downlights, cove linear lighting in bedrooms, mirror lighting, downlighters within kitchen cabinets, low-level wayfinder lighting, and 5-amp sockets. Includes testing and commissioning, and subcontractor prelims. | £815,000 | £163.00 | £15.14 |
| **Protective installation**<br>Sprinkler installation with individual flow switches. Includes testing and commissioning, and subcontractor prelims. | £108,000 | £21.60 | £2.01 |
| **Communication, security and control systems**<br>LD1 fire-detection system. TV and data, with brushed-finished sockets. Security wireways for future intruder-detection installation. Video-entry panel, and smart heating/cooling and lighting control. Includes testing and commissioning, and subcontractor prelims. | £814,000 | £162.80 | £15.12 |
| **Builders' work in connection with services** | £81,000 | £16.20 | £1.51 |
| **Fit-out total costs** | **£4,115,000** | **£823.00** | **£76.46** |

**The cost model is for a development of 50 apartments – 20 one-bed, 25 two-bed, and five two-bed 'close care' apartments**

» feature lighting and music systems. Developments can also incorporate private cinema rooms.

In addition, there will be a fully equipped gym and studios, and often a spa, comprising a swimming pool, sauna and treatment rooms. Hair and beauty services are also available to residents.

These developments will feature private and secure gardens that incorporate sensory areas for residents.

The requirements of residents' extended family are often also considered, with guest suites available for overnight stays. They can also sometimes stay with a resident in their apartment and have in-room catering, while a play area for small children is often provided within the grounds.

## Development details

This cost model is based on a high-end, 'later living' development located in the south of England. The basis of the development is a four-level apartment block with two cores from ground to level three, with a gross internal area (GIA) of 9,000m² and an apartment net internal area (NIA) of 5,000m². There are 50 apartments located from level 1, with the unit mix based on: 20 one-bedroom apartments at an average NIA of 80m²; 25 two-bedroom apartments at an average NIA of 110m²; and five two-bed, 'close care units', at an average NIA of 130m².

The cost model excludes: lifts; external works; utilities; inflation beyond 4th quarter; main contractor's costs; fees and VAT. **CJ**

## ABOUT THE AUTHOR

**ANDREW FREEMAN** is a cost manager based within the London office of Aecom

**The engineering services cost management group of Aecom specialises in the cost estimating, procurement and cost management of building services installations. It is producing a series of cost models for *CIBSE Journal* in 2020 on areas such as data centres and London's commercial buildings.**

| | | | |
|---|---|---|---|
| **Extra over for 'close care' apartments (cost per two-bed apartment)**<br>Extra over for uplifts to dementia care apartments, including: standalone flood/leak detectors to all bathrooms and kitchens; aspirating fire-detection system; full-home automation system, including video-entry panel; medical alert signalling/nurse call within each room; link between leak and temperature detectors and the 'extra care' team; heating/cooling controls; and circadian lighting control. | £24,000 | £184.62 | £17.15 |
| **Fit-out uplift per two-bed 'extra care' apartment** | **£24,000** | **£184.62** | **£17.15** |

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# New generation water-cooled centrifugal compressor chiller range

## Water cooled chiller range with improved energy efficiency

Vintage B - DWSC and DWDC

Daikin Applied has unveiled the new generation of its water cooled centrifugal compressor chiller range, which boasts improved energy efficiency thanks to the inclusion of a new Daikin design refrigerant cooled inverter drive.

Available with a choice of refrigerant, including low global warming potential (GWP) R-513A or R134a in single (DWSC) or dual (DWDC) compressor models


**Duty range: 1,200kW - 9,000kW (DWDC)**

**1,050kW - 4,500kW (DWSC)**

- Available with single and dual compressor options
- Outstanding performance at both full and part-loads
- Low turn down to 10% (DWSC) and 5% (DWDC) without hot gas bypass
- Choice of refrigerant - R-513a or R-134a
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# ComfoAir MVHR units

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The Zehnder ComfoAir range is a new series of heat recovery units designed to enable better and easier specification of ventilation in new properties.

The ComfoAir range, available in four new variants, includes both ceiling and wall mounted variants. Each unit contains a host of innovative features such as automatic true summer by-pass, high heat recovery efficiency and with an integrated humidity sensor to deliver exceptional performance.

The new range helps deliver a comfortable, healthy and energy-efficient indoor climate.

## Features and Benefits

- Series of ceiling and wall mounted MVHR units
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- Volt free contact boost capability
- Our family of SMART features ensure ease of commissioning, bypass activation, elimination of noise and over ventilation and humidity monitoring All to ensure Guaranteed Installed Performance (GIP)

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For further information on our range of heating and ventilation solutions, visit www.zehnder.co.uk.

Our product selector provides complete technical specification details for our MVHR and MEV products. Find out more at www.zehnderproductselector.co.uk

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# Ventilating future homes for health comfort and wellbeing

## This module explores the challenges in maintaining indoor air quality and the application of augmented MVHR in future homes

There is a continuing and increasing interest from building designers, occupants, owners and operators in maintaining internal environments that provide good levels of air quality. The motivation to deliver building systems that positively contribute to the health, wellbeing and productivity of occupants has been heightened by reports from respected institutions and the media of the deleterious impacts of climate change and poor external air quality. This article will review the current challenges in maintaining appropriate internal air quality and consider the application of augmented mechanical ventilation with heat recovery (MVHR) – which may gradually become more prevalent in homes and small commercial applications in traditionally temperate climates that have formerly eschewed mechanical cooling.

The recently published report *The inside story: health effects of indoor air quality on children and young people*[1] drew on many contemporaneous studies, one of which[2] indicates that, from a sample of 1,060 people in the UK, the average person is likely to spend 22 hours a day inside. One of the report's conclusions is that there is evidence of many UK homes without adequate ventilation – and although the health effects of many of the products and materials used in buildings have not been comprehensively studied, there are indications that they could result in harmful health effects.

Ventilation is required in buildings to provide outdoor air for the occupants – who typically inhale less than 0.25 litres per second[3] – but mostly to dilute and extract odours, water vapour and other airborne pollutants. The above-mentioned report provides an excellent summary of contaminants that affect indoor air quality (IAQ), and the box out on page 58 points to a downloadable sheet to explore the impact of ventilation rates on indoor contaminant levels. However, there is also a need to ensure that, by actively ventilating a space with potentially contaminated outdoor air, it does not increase the problems with IAQ – particularly because, as reported by the Lancet Commission on pollution and health,[4] 'pollution is the largest environmental cause of disease and premature death in the world today'.

Ventilation has traditionally been provided in homes and small commercial applications through natural means such as windows, chimney stacks for open fires, and the fortuitous infiltration of outdoor air through cracks and openings in the structure. In more recent years, the mandatory use of trickle vents has attempted to replace these former routes of entry for outdoor air but, although simple, they provide no practical control and may become obstructed in use.

In common with CIBSE (and other principal authorities) the recent National Institute for Health and Care Excellence (NICE) guidance[5] indicates that the best solution is to design out the source of pollutant, and notes that a whole-building approach should be adopted for heating and ventilation. This includes balancing IAQ with standards for energy use, using heating systems that minimise exposure to particulate matter, and ensuring there is permanent, effective ventilation.

There are many ventilation methods that, when designed and implemented appropriately, produce increased rates of »

ventilation, as well as enabling more selective and controlled ventilation. More than half of new-build homes (based on ATTMA dataset 2015-16 data reported by Crawley[6]) are naturally ventilated. However, increasingly challenging conditions – particularly related to overheating and air quality – are encouraging designers to evaluate the need for alternative systems. Any ventilation arrangement that does not incorporate heat recovery will have an indirect operating cost for heating the ventilation air (by the building's heating systems) when it is drawn into the building.

The supporting document for the England Building Regulations Approved Document F (ADF[7]), *Domestic Ventilation Compliance Guide*,[8] has extensive requirements that also provide a useful basis for best-practice installation and commissioning of the various systems. ADF categorises and illustrates ventilation in terms of four generic systems. It is currently under review as part of the development of a UK Future Homes Standard, and a new version is expected later in 2020 that is likely to require performance-based evidence that there is adequate means of ventilation for building occupants.

Where there is an opportunity to include a riser 'stack' duct through the building, passive stack ventilation may be used (ADF System 2 – <1% of installed systems in new homes dataset[6]). This employs a combination of natural stack effect, together with the venturi effect, to draw air from inlet grilles mounted at ceiling level in selected rooms (for example, shower room, kitchen or utility room). This requires no power, is practically silent, and has no direct cost of operation, but the airflow rate will be dependent on the outdoor temperature and wind velocity. Automatic or manually actuated dampers (mounted in the stack) may be used to vary the flow.

Airflow may reverse in summer or at times of high winds, which can cause smuts to be carried into the room from the (inevitably) contaminated ducting. These systems will provide limited summer ventilation – this may be augmented by opening windows as appropriate.

As with all natural and extract-driven ventilation systems, trickle vents – or, possibly multiple, other purpose-made unfiltered openings – will be required to allow the flow of the make-up outdoor air.

Intermittently actuated extract fans – through walls and windows, and with ducted discharges – may be used where there is a specific generation of contaminant, such as in a kitchen or wet room, and the make-up, unfiltered ventilating air is drawn through openings, including trickle vents and fortuitous leakage around doors, windows and gaps in the building fabric (ADF System 1). Using manual or automatic control, this method may be applied as a means of purge or task ventilation, or could be used continuously. Such a simple system may be readily retrofitted, and can be very cheap to install and operate. Although simple in form and operation, however, it may not be operated by the building occupant as intended – for example, because of problems with noise or a lack of understanding – so it may not be an assured method of maintaining good IAQ. Providing multiple building penetrations to accommodate the outlets may be challenging, particularly in multi-storey buildings. Fans may be added to passive stack ventilation ducts (discussed above) to provide a hybrid system for use when there is more ventilation required than is given by natural means only. These can be controlled automatically – for example, through humidity sensors or selective IAQ sensors – or manually.

To remove the uncertainty of natural ventilation and improve controllability, automatically controlled continuous extract systems may be employed (ADF System 3). These are normally ducted systems with a centralised fan unit, typically linked with radial ductwork of 100mm-diameter flexible or rigid plastic rectangular ducts to ceiling grilles mounted in areas requiring extract ventilation. Alternatively, decentralised mechanical extract ventilation (dMEV) is used, which consists of continuously running extract fans. Low-power fans are typically located in every wet room, running continuously at low trickle speeds, which are then boosted as required via automatic or manual control. As the power to move the air is supplied by the fan, any ductwork is able to take a more circuitous route (with the associated increased resistance to flow and additional fan power), and the openings to draw in outdoor air may be smaller or fewer. This system is relatively simple to satisfy

## EXPLORING THE IMPACT OF VENTILATION ON INDOOR CONTAMINANT LEVELS

**A key marker (or 'proxy') that has been used to infer the quality of indoor air in occupied spaces has been the concentration of $CO_2$ in the indoor air, with the assumption that if there is sufficient 'fresh' (outdoor) air to adequately dilute the $CO_2$ emitted through human respiration, there will be an acceptable IAQ. The IAQ sheet on the freely downloadable CIBSE spreadsheet www.cibse.org/Knowledge/Design-Tool-for-IAQ-Analysis provides a useful tool to undertake $CO_2$ analysis for a single zone.**

**So, for example, Figure 1 illustrates that a space occupied from 8am to 6pm with an outdoor air supply rate of 10L·s$^{-1}$ per person will lead to an increase in $CO_2$ of 555ppm (assuming approximately one person per 10m$^2$ floor area exhaling 20 litres $CO_2$ per hour per person). As outdoor $CO_2$ is approximately 410ppm, this would create an indoor $CO_2$ level of less than 1,000ppm – a level that is commonly set as a reasonable limit value.**

**$CO_2$, however, is just one of the many pollutants in indoor air and is related to occupancy. Other contaminants, such as volatile organic compounds (VOCs) and particulates, will not necessarily have any relationship with occupancy, but models – such as the CIBSE spreadsheet – can be readily adapted to explore the impact of ventilation on the concentrations of other pollutants.**

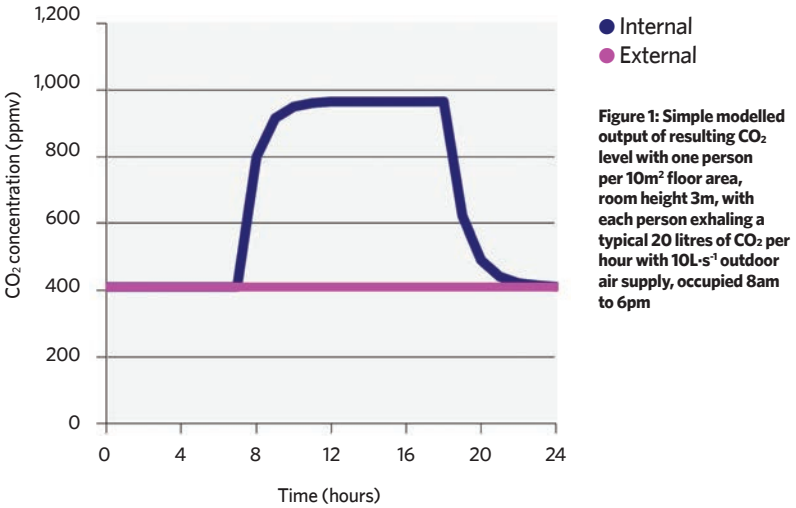


**Figure 1: Simple modelled output of resulting $CO_2$ level with one person per 10m$^2$ floor area, room height 3m, with each person exhaling a typical 20 litres of $CO_2$ per hour with 10L·s$^{-1}$ outdoor air supply, occupied 8am to 6pm**

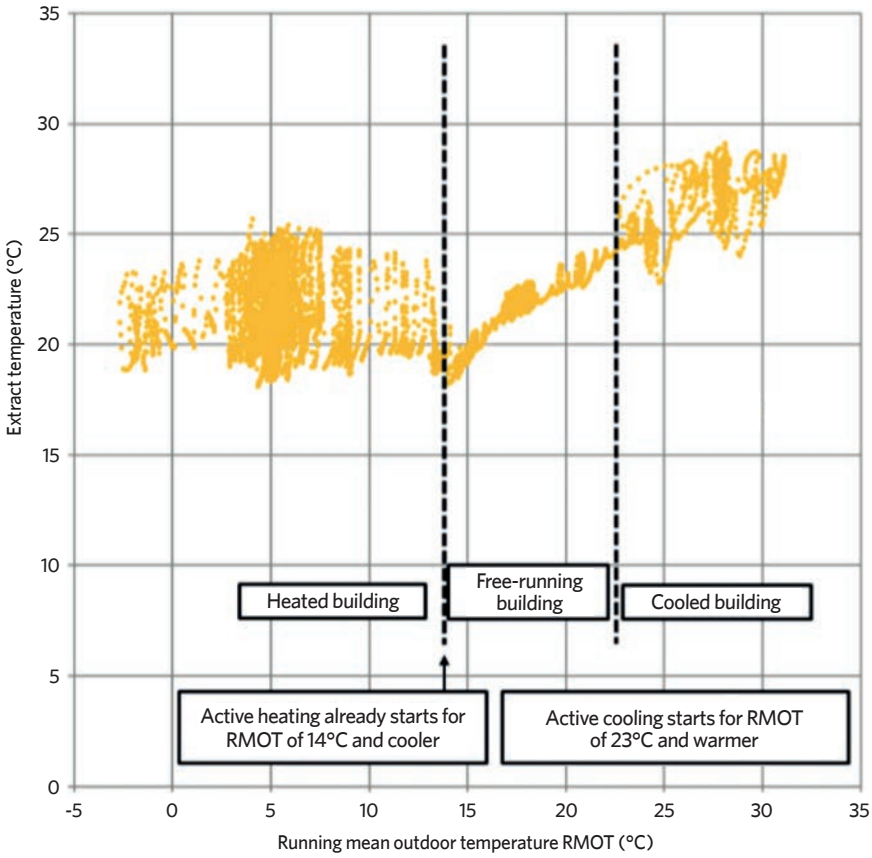


**Figure 2: Extract air temperatures for system with augmented MVHR using coil for summer cooling and winter heating – heating/cooling energy supplied by air-sourced reversible heat pump**

demand through automatic or manual control (to vary flowrates to allow purging). There will be an operational cost for fan power in addition to the heating load, to account for the ventilation air in winter. As the systems are relatively independent of outdoor conditions, they can provide year-round ventilation, and where there is opportunity to open windows – particularly in summer – these may be used to provide additional purge ventilation.

Mechanical extract systems (a combination of Systems 1 and 3) amounted to 11% of installed systems in the new homes dataset.[6]

Driven by a combination of the demands for energy-conscious, good-quality and healthy environments, international 'passive' design standards, and regulatory requirements, deployment of balanced supply and extract MVHR in domestic and small commercial applications is becoming increasingly common (ADF System 4 – 26% of installed systems in new homes dataset[6]). This provides a controllable, balanced ventilation system that would typically employ a parallel plate heat exchanger to recover heat from the discharge air, with a bypass arrangement to allow ventilation without heat recovery when 'free' cooling is required. The heat recovery will significantly reduce the ventilation heating demand. As the supply air is drawn from a ducted inlet, in a location that is least affected by external sources of pollutants – such as at roof level – there is no need for background ventilators. Filters are used on the inlet air stream to (at least) prevent insects and large particulates being drawn into the building. However, there are opportunities for increasing filter efficiency to remove smaller particulate matter and, potentially, other pollutants. Although MVHR can be applied to a single space, it is more normally used to provide balanced ventilation throughout all occupied spaces in a building. MVHR is only practical in buildings with good airtightness – this is discussed more fully, with further explanation of the application of MVHR, in CPD Module 141, *CIBSE Journal*, February 2019.

The siting of the MVHR unit should be such that the building user can safely and easily access the unit, to change filters and periodically clean the heat exchanger.

Systems that include electrically powered fans are likely to need to conform to specific fan power (SFP) limits defined by regulatory requirements (such as those in Table 1 of the England *Domestic Building Services Compliance Guide*[9]). The SFP will depend on the characteristics of the ductwork systems and the pressure drop through any heat-recovery device, the filters, and the total efficiency of the fan. More exacting filtration is likely to increase the fan power, and that may make it more challenging to meet these regulatory requirements.

In recent years, there have been many reported incidences of overheating in homes. Every effort should be made to mitigate the risks of overheating through the building design, as explained in CIBSE TM59.[10] However, there are likely to be many instances where it is not practicable to maintain comfortable and healthy internal peak temperatures using natural, or 'free' cooling methods. Manufacturers are developing products that extend the traditional MVHR unit, by adding a water coil for the outdoor air after the air has passed through the heat recovery section and before the air is supplied into the space. The coil can be used to provide heating or cooling to the air – for example, the water being delivered from a thermal store that seasonally stores heated or cooled water. The heating/cooling source of this could, for example, be heat networks and heat pumps (integrated with heat networks or domestic hot water heat recovery, or air sourced).

In an example system in Modena, Italy (in the northerly part of the subtropical climate zone), a reversible heat pump was used to supply the energy to the thermal store for a home that had been designed as a near-zero energy building. The monitored extract air temperatures plotted against the running mean outdoor air temperature (RMOT), shown in Figure 2, indicate the seasonal operation of the system. Automatic scheduling ensured that cooling was only employed where, in this case, RMOT exceeded 23°C (resulting in room temperatures circa 25°C) – the room setpoint temperature being reset by the outdoor temperature.

Adding active cooling to the MVHR unit will increase the energy use of the building, but may enable the building to be used as a healthy and comfortable environment when otherwise it may have been unusable. Adding cooling to a domestic ventilation system needs very careful consideration, particularly in a temperate location. Similar systems have already been successfully installed across Europe and the US.



Turn to page 64 for further reading and references.

# Module 159

March 2020

» **1. How many hours a day is the average person likely to spend indoors according to the results of the UK survey mentioned in the article?**

- ☐ A 22 hours
- ☐ B 19 hours
- ☐ C 16 hours
- ☐ D 13 hours
- ☐ E 10 hours or fewer

**2. A typical ventilation rate for buildings is 10L·s$^{-1}$ per person. How much air does a human typically inhale every second?**

- ☐ A Less than 1L·s$^{-1}$
- ☐ B 1 to 3L·s$^{-1}$
- ☐ C 3 to 5L·s$^{-1}$
- ☐ D 5 to 8L·s$^{-1}$
- ☐ E 8 to 10L·s$^{-1}$

**3. According to the reported ATTMA dataset, what percentage of systems installed in 2015-16 in new homes were MVHR systems?**

- ☐ A <1%
- ☐ B 11%
- ☐ C 26%
- ☐ D 42%
- ☐ E More than 50%

**4. In the example of the $CO_2$ modelling, what was the approximate room $CO_2$ concentration at 8am?**

- ☐ A 410ppm
- ☐ B 555ppm
- ☐ C 600ppm
- ☐ D 800ppm
- ☐ E 1,000ppm

**5. Which of these is least likely to be true for the augmented MVHR system described in the article?**

- ☐ A It maintains a constant internal temperature throughout the seasons
- ☐ B It requires careful consideration before application in temperate climates
- ☐ C The coil follows the heat-recovery device in the flow of outdoor air
- ☐ D The cooling may be supplied from a heat pump with heat recovery
- ☐ E The heating energy can be supplied from a district heating network

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### Further reading:

There are many sources for further reading, including these publications:
CIBSE TM40 (2006) *Health issues in building services* provides one of the most consolidated collections of CIBSE references for air quality related to ventilation.
CIBSE KS17 *Indoor Air Quality and Ventilation* provides an accessible summary of assembled information taken from CIBSE publications and other standards.
The Zero Carbon Hub 2013 report *Mechanical ventilation with heat recovery in new homes* includes useful, well researched MVHR good practice in section 4.
And the soon-to-be-published update to CIBSE TM40 *Health and wellbeing in building services* will provide current thinking on the requirements for safe and healthy internal environments.

### References:

1 *The inside story: health effects of indoor air quality on children and young people*, Royal College of Physicians/Royal College of Paediatrics and Child Health, January 2020.
2 **www.ribblecycles.co.uk/blog/not-great-outdoors/** – accessed 5 February 2020.
3 **ww3.arb.ca.gov/research/resnotes/notes/94-11.htm** – accessed 7 February 2020.
4 *The Lancet* DOI: (10.1016/S0140-6736(17)32345-0).
5 **www.nice.org.uk/guidance/ng149/chapter/Recommendations#architects-and-designers** – accessed 5 February 2020.
6 Crawley, J, The relationship between airtightness and ventilation in new UK dwellings, CIBSE *BSERT*, 2019, Vol. 40(3) 274–289.
7 *Building Regulation – Ventilation – Approved Document F1*, HM Government, 2018 Means of ventilation.
8 *Domestic Ventilation Compliance Guide: 2010 Edition*, UK DCLG, 2011.
9 *Domestic Building Services Compliance Guide – 2013 edition – for use in England*, HM Government, 2018.
10 CIBSE TM59 *Design methodology for the assessment of overheating risk in homes*, CIBSE 2017.


## Rapid hot water with new Lochinvar electric water heaters

Manufacturer Lochinvar has launched a range of high-performance electric floor-standing storage water heaters for commercial and large residential applications.

Cavalier water heaters are available in seven models, all of which meet the requirements of the EcoDesign (ErP) directive and can operate at working pressures of up to 8 bar.

These water heaters represent a significant advance for this type of technology because they feature factory-fitted, multiple immersion elements for rapid hot-water production. This ranges from three 3kW elements in the lowest output model (9kW) to nine 6kW elements in the highest output (54kW) water heater, which is capable of providing up to 929 litres of continuous hot water per hour at a temperature rise of 50°C.

The immersion elements operate in sequence to give fast recovery of hot water and better efficiency. The Cavalier range is designed for ease of maintenance, with all of the electrical components accessible from the front of the units.

**Visit www.lochinvar.ltd.uk**

## Waterloo has ventilation remedy for major hospital refurbishment

Waterloo Air Products has provided a wide range of air terminal devices for the £170m redevelopment of Glan Clwyd Hospital in North Wales.

These devices met the exacting hygiene standards of a healthcare facility while ensuring the wellbeing and optimum comfort of patients.

With efficient ventilation and air distribution imperative for patients, visitors and staff, Waterloo's Louvre Face Diffusers were specified across the various phases of the project. This versatile, multicone, multidirectional diffuser easily mounts in a lay-in ceiling.

**Visit www.waterloo.co.uk**

## HygroMatik FlexLine

Humidification equipment manufacturer HygroMatik's FlexLine Plus and Process heater steam humidifiers are ideal for use in a range of situations. These include sensitive areas of industrial production, as well as in laboratories and research facilities for the stabilisation of the relative air humidity. Some excellent examples of FlexLine in action include:

- Norfolk Record Office, to preserve archives
- Environmental chamber at Nottingham Trent University, to study how the human body reacts to different climates.

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## Why use mechanical seal pumps?

The Jung Pumpen UK3 Spezial, from Pump Technology, is ideal for brackish water, silage liquor, and liquid fertiliser. It is also perfect for arduous wastewater applications that are heavy with content such as coffee granules and milk skin.

The pump features a mechanical seal that protects the motor and shaft. Other pumps of this size tend to rely on a less effective lip seal.

When the UK3 Spezial is built into the pump technology DrainMinor, it creates a robust and compact, under-the-sink pumping system.

**Call 0118 9821 555 or visit www.pumptechnology.co.uk**

## Making the headlines

White papers are an important reference point, and a great source for engineering specialists to learn more about specific complex issues in a logical format. Grundfos has, over many years, created a portfolio of white papers aimed at helping engineers to better understand a range of pumping challenges.

Designed to be used as a handy reference document, each paper has been carefully developed to get to the heart of the chosen topic, and to break it down so that it is easy to extract the information that will help you.

Among the themes on offer are: water supply in tall buildings; the digital impact on industry; proportional pressure control; and refrigeration and cooling. All of these, and many more, can be found on the Grundfos website and are freely available once you have completed a simple registration.

So, whenever you need to access a reliable, authoritative, accessible pump reference, check it out with Grundfos first.

**Call 01525 850000, email grundfos-uk@sales.grundfos.com or visit www.grundfos.co.uk**

## Minibems welcomes Internet of Things (IoT) specialist as its new chief technical officer

Minibems has appointed Nigel Pugh as its chief technical officer (CTO). A specialist in IoT solutions for the smart-home sector, Pugh brings a wealth of expertise and experience to the role, including development of the Hive platform.

He has more than 20 years' experience in the software industry, and previously headed up development at Alertme.com, where he managed a team that created the platform behind the Hive smart-home solution, which is currently installed in more than one million homes across Europe. A professional member of the British Computer Society, Pugh has an MSc in optoelectronics and undertook postgraduate study at University College London.

He will be responsible for ensuring the Minibems platform offers customer experience, security, reliability and energy savings.

**Call 020 3411 4170 or visit www.minibems.com**

## Vent-Axia supports landmark report by Royal Colleges on indoor air quality

British ventilation manufacturer Vent-Axia has welcomed the latest joint report by the Royal College of Paediatrics and Child Health and the Royal College of Physicians on the health impact of indoor air quality on children and young people. *The inside story: health effects of indoor air quality on children and young people*, published on 28 January, explains that there is growing evidence that respiratory problems among children may be exacerbated by indoor air pollution in homes, schools and nurseries.

**Call 0844 856 0590 or visit www.vent-axia.com**

## Clippers Quay residents benefit from fresh air supplied by Vent-Axia's cooker hood with MVHR

Vent-Axia has supplied ventilation for 614 apartments at Clippers Quay in Salford. Its systems were specified to provide good indoor air quality to the largest build-to-rent development outside London, which will be home to more than 1,200 residents and seven new retail businesses.

One of the UK's largest providers of MEP services, HE Simm, specified and installed the ventilation for Grainger, the UK's largest listed professional landlord, who owns and manages the property.

**Call 0844 856 0590 or visit www.vent-axia.com**


## Swegon launches high-performance comfort modules

Swegon's new Parasol Zenith comfort modules offer a highly flexible option for a wide range of indoor climate projects. These high-capacity products combine cooling, heating and four-way air distribution in one compact unit. They have wide operating parameters and can be adjusted at any stage of a project to cater for changing demand requirements.

The units also provide energy efficient heating, cooling and ventilation using water as the cooling or heating medium rather than refrigerant gas – another benefit at a time when use of these gases is being restricted under the F-Gas Regulation.

The units' double outlets and double heat exchangers allow for a boosted airflow and higher cooling capacity. Such high performance from a compact unit frees up ceiling space and minimises its impact on the interior decor.

With quick-mounting brackets for fast, easy installation, the units are designed to enable rapid commissioning because all settings are adjustable on site.

**Visit www.swegon.com**

## Hamworthy's extended range of water heaters is perfect for refurbishment projects

Commercial boiler manufacturer and water heating expert Hamworthy Heating has extended its Dorchester range of direct-fired water heaters to include the DR-LL and DR-XP.

The Dorchester DR-LL is an atmospheric low $NO_x$ water heater, designed to meet the requirements of ErP regulations and refurbishment projects. It can be used on old systems with existing flues (the draught diverter will need changing), saving on costs for flue replacement. The integral stainless steel burner produces low $NO_x$ emissions (34-45 mg/kWh) and benefits from an automatic gas/air premix burning system for increased efficiency.

The Dorchester DR-XP is a condensing water heater with a stainless steel tank, and is available in two models (38-50kW input) of 184 litres. With an ErP efficiency of 91-93% and $NO_x$ emissions $\leq$ 53 mg/kWh, it is compliant with the latest ErP regulations, which were further restricted in 2018. Thanks to the grade 444 stainless steel tanks, no anodes are required to protect it from corrosion.

**Call 01202 662500, email sales@hamworthy-heating.com or visit www.hamworthy-heating.com**

H&V news AWARDS 2020 | HEADLINE SPONSOR WOLSELEY
30 APRIL 2020 | GROSVENOR HOUSE HOTEL, LONDON

## Panasonic celebrates making 2020 *H&V News* Awards shortlist

Panasonic's Aquarea J-Series air source heat pump has been shortlisted in the Domestic HVAC Product category of the 2020 *H&V News* Awards.

The highly regarded awards celebrate technology and solutions designed to meet today's environmental challenges through innovative products and projects.

Panasonic has created a network of production and research and development (R&D) facilities on a global level, ensuring the distribution of cutting-edge technologies that set the standard for heating and cooling solutions.

**Call 01344 853182 or email uk-aircon@eu.panasonic.com**

## First R32 air-to-water heat pump completes Daikin 'Bluevolution'

Daikin Applied has launched the UK's first air-to-water heat pump range using R32 refrigerant.

The new series features models offering heating capacities from 80kW to 670kW, and completes the Daikin 'Bluevolution' range of products – all of which are available with R32 refrigerant in cooling-only and free-cooling modes.

R32 is an increasingly popular option for specifiers because it has a very low global warming potential of 675, which is one-third that of the commonly used refrigerant R410A.

In 2012, Daikin Applied was the first company in the world to introduce R32 into split air conditioners. As of June last year, it had sold more than 84 million R32 units in 70-plus countries.

**Visit www.daikinapplied.uk**

## Two promotions for Hamworthy sales team

Hamworthy Heating has promoted two members of its sales team. Kevin Potter (left) has been made national sales manager, while Gary Banham is now senior area sales manager for London.

Darren Finley, managing director commercial products, said: 'Kevin has worked at Hamworthy for more than a decade and has built enormous respect from his fellow colleagues. Gary joined us only recently, but has excelled, tutoring other team members in our new management system.'

**Call 01202 662500, email sales@hamworthy-heating.com or visit www.hamworthy-heating.com**

## Dunham-Bush provides Hydrocourse trench heating to Devonshire Park

Dunham-Bush has supplied its Hydrocourse trench heating for the £54m Devonshire Park, Eastbourne, transformation. The redevelopment will create high-quality cultural, conferencing and sporting facilities known as the Devonshire Quarter.

Hydrocourse is a highly effective solution for countering down draughts on cold surfaces. It helps prevent condensation on large glazed areas and outside walls, making it perfect for a wide variety of commercial and institutional buildings.

**Call 02392 488704, email info@dunham-bush.co.uk or visit www.dunham-bush.co.uk**

# DIRECTORY Your guide to building services suppliers

**Tel: 020 7880 6245 Email:** cibsedirectory@redactive.co.uk

### Air Handling

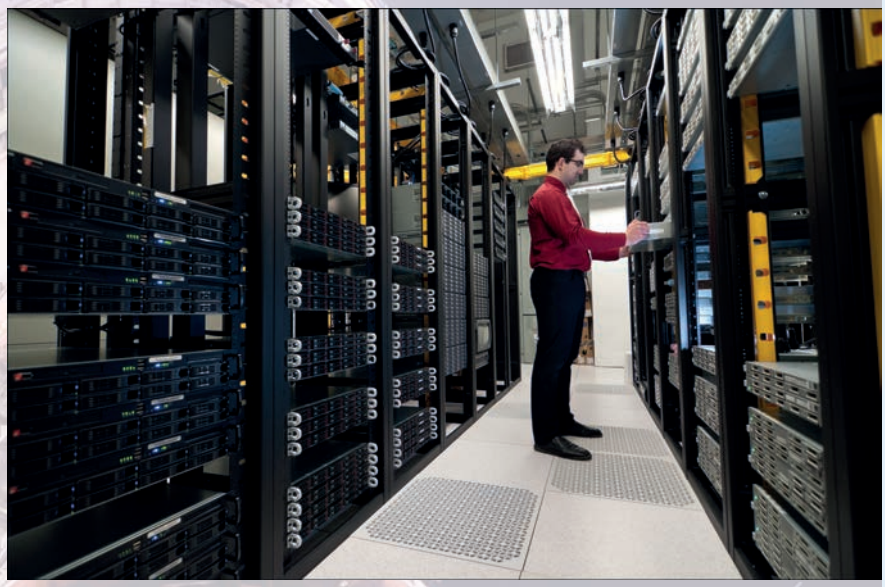


### Energy Efficiency



### Software

# Mechanical & Electrical vacancies at BT



The BT Dynamic Infrastructure Power & Cooling team are a small but highly motivated team delivering a variety of cutting edge M&E solutions to keep the heart of the UK critical IT and communications infrastructure beating.

You will be responsible for design & delivery of Mission Critical MEP infrastructure utilising new and evolving technologies to deliver highly resilient and energy efficient systems in a variety of challenging applications within the hugely diverse BT estate.

You will be part of an infrastructure team comprising: electrical, mechanical and accommodation specialists. You will be involved in providing specialist MEP knowledge in the preparation, management and maintenance of Mission Critical system and related policies, engineering standards and guides.

Energy consumption, together with its associated carbon emissions, is BT's most significant environmental impact. You will be playing a significant part in BT's commitment to an 87% reduction in emissions by 2030 and net zero emissions by 2045.

## Senior Mission Critical Electrical Engineers

- Technical design lead on specific projects
- Creating specifications and providing technical governance/evaluation of project specific tender returns.
- Represent BT, as the nominated technical specialist, during Factory and Site Acceptance Testing (FAT/SAT) for power systems (ac and dc).
- Perform supplier management during specific power system (ac and dc) projects.
- Keep up to date with emerging technologies and trends within the telecommunications industry.
- Bench mark current policies, standards and guides with other industries.
- Perform power system supplier technical audits of their standards, facilities, training and product quality for compliance with BT policies, standards and guides.

## Senior Mission Critical Mechanical (HVAC) Engineers:

- Providing mechanical and cooling design solutions for data centres and network communication sites.
- Specifying and testing HVAC products for acceptance into service
- Driving the installation operation and management of energy efficient cooling solutions
- High level design and project management of cooling installations

**To apply please visit jobs.cibsejournal.com and search "BT"**

# EVENTS

## HIGHLIGHTS

**Roger Sexton**, of Xicato, will speak at the Yorkshire technical event on 29 April

**Julie Godefroy**, of CIBSE, will speak at the North East wellbeing event on 7 April

## NATIONAL EVENTS AND CONFERENCES

**Society of Light and Lighting LightBytes series 2019-2020**
**People, Space, Time, Place**
26 March, Bristol
23 April, Glasgow
The series focuses on light and wellness, with presentations divided into four overarching sessions: People, Space, Time, Place. With guest speaker Dr Eleanora Brembilla, research associate in advanced building daylight modelling at Loughborough University.
**www.cibse.org/sll**

**CIBSE ASHRAE Technical Symposium**
**Engineering buildings, systems and environments for effective operation**
16-17 April, Glasgow
With more than 70 peer-reviewed presentations from experts across the spectrum of the building industry.
**www.cibse.org/symposium**

## CIBSE TRAINING

For details, visit **www.cibse.org/training** or call **020 8772 3640**

**Overview of IET wiring regulations**
3 March, London

**Fire safety in the design, management and use of buildings: BS9999**
4 March, London

**Practical project management**
5 March, London

**Fire risk assessment to PAS 79**
6 March, London

**Fundamentals of digital engineering**
9 March, London

**Mentoring skills workshop**
9 March, London

**Building services explained**
10-12 March, Manchester

**Low carbon consultant design training**
11-12 March, London

**Mechanical services explained**
11-13 March, London

**Below-ground building drainage**
13 March, London

**Effective management of operational risk in buildings**
16 March, London

**Design of heating and chilled-water pipe systems**
16 March, London

**Low carbon consultant EnMS/ISO 50001:2018**
17-19 March, London

**Low carbon consultant building operations**
17-19 March, Manchester

**Above-ground building drainage**
18 March, London

**Electrical services explained**
18-20 March, Manchester

**Fire sprinkler systems: design to BS EN 12845**
23 March, London

**High voltage (11kV) distribution and protection**
25 March, London

**Energy monitoring and targeting**
1 April, London

**Mechanical services one-day overview**
16 April, London

**Low carbon consultant design training**
20-21 April, London

**Energy efficiency Building Regulations: Part L 2020**
27 April, London

**Fundamentals of drainage**
30 April, London

## CIBSE GROUPS, SOCIETIES AND REGIONS

For more information about these events, visit: **www.cibse.org/events**

**Yorkshire: HV-LV protection interface and supply resilience considerations**
4 March, Leeds
With a presentation from Dr Tony Sung, chair of the Electrical Services Group.

**South West: Each for equal – International Women's Day**
4 March, Bristol
In partnership with Women in Property, with speakers sharing their thoughts on how we can work to achieve equality within the industry.

**West Midlands: Health and safety implications for contractors, clients and consultants**
4 March, Birmingham
With speaker Tony Phipps, of Forge Mill Consultancy, looking at guidance and information for contractors, consultants and clients when attending or working in clients' premises.

**Western Australia: the square-kilometre array – a global project**
10 March, Perth
Aurecon's Mark Davie on the project to build the world's largest and most sensitive radio telescope.

**SLL: Beyond the border of standards**
17 March, Glasgow
Seminar, with speaker Henrik Clausen. The latest research on visual and non-visual responses to light.

**West Midlands: Transformer Design**
18 March, Birmingham
Seminar with Nicholas Thompson, of Schneider.

**HCSE: Heat exchangers in heat network**
18 March, Croydon
Technical seminar delivered by Christer Frennfelt, of Swep.

**Using web-based simulation tools for modelling in the built environment**
24 March, Manchester
CIBSE Research event on modelling real-world physics to enhance building design.

**SLL Ready Steady Light**
24 March, Sidcup
Teams compete to design and set up temporary lighting installations.

**West Midlands: Contractual awareness**
1 April, Birmingham
CPD seminar.

**Intelligent Buildings Group: biophilic design brings value**
1 April, London
Seminar including a biophilic classroom case study.

**North East: Health and wellbeing**
7 April, Newcastle upon Tyne
With Dr Julie Godefroy, CIBSE technical manager.

**SLL: Lighting for retail premises LG17**
22 April, Birmingham
Seminar by Simon Robinson, of WSP.

**Yorkshire: AGM and technical event on 'Trends in lighting control'**
29 April, Leeds
Presentation by Roger Sexton, of Xicato.

**Yorkshire: membership briefing**
5 May, Leeds
Routes to CIBSE Associate and Member, and registration with the Engineering Council.

## SLL Lighting Research and Technology Symposium: **Applying Light for Human Health**

18 June, London

Research on the non-visual effect of light has led to deeper scientific understanding, but it has also resulted in premature claims about lighting and human health – leading to concern from lighting professionals, and a call for more substantial evidence.

This symposium, organised by the Society of Light and Lighting (SLL), in association with University College London and Sage Publishing, will look at where – and how – lighting can be applied to support human health. Speakers include Mariana Figueiro, John Mardaljevic, Florence Lam and Arnold Wilkins.

Visit **bit.ly/LRTSymposium2020**

Arnold Wilkins

John Mardaljevic

CIBSE Technical Symposium 2020 | ASHRAE

# Celebrating 10 years

## Engineering Buildings, Systems and Environments for Effective Operation

## 16–17 April 2020 University of Strathclyde, Glasgow

Over 200 industry practitioners, researchers and building users from across the globe will join together at the CIBSE ASHRAE Technical Symposium to share experiences and develop networks.

- 200+ attendees
- 70+ peer-reviewed presentations
- 70 sector expert speakers
- 20+ topical streams on key local and global issues


cibse.org/symposium

# CMR in complete control

**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.**

## DPC CONTROLLER

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

## DPM PRESSURE SENSOR

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

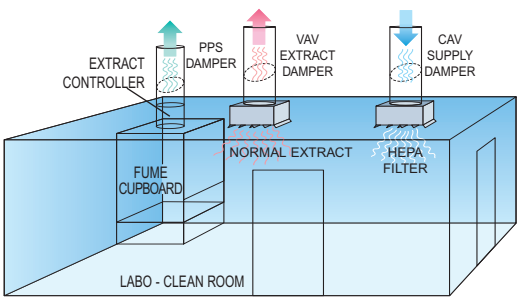
## CAV AND VAV DAMPERS

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

## 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.




## 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.

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