cibse Journal

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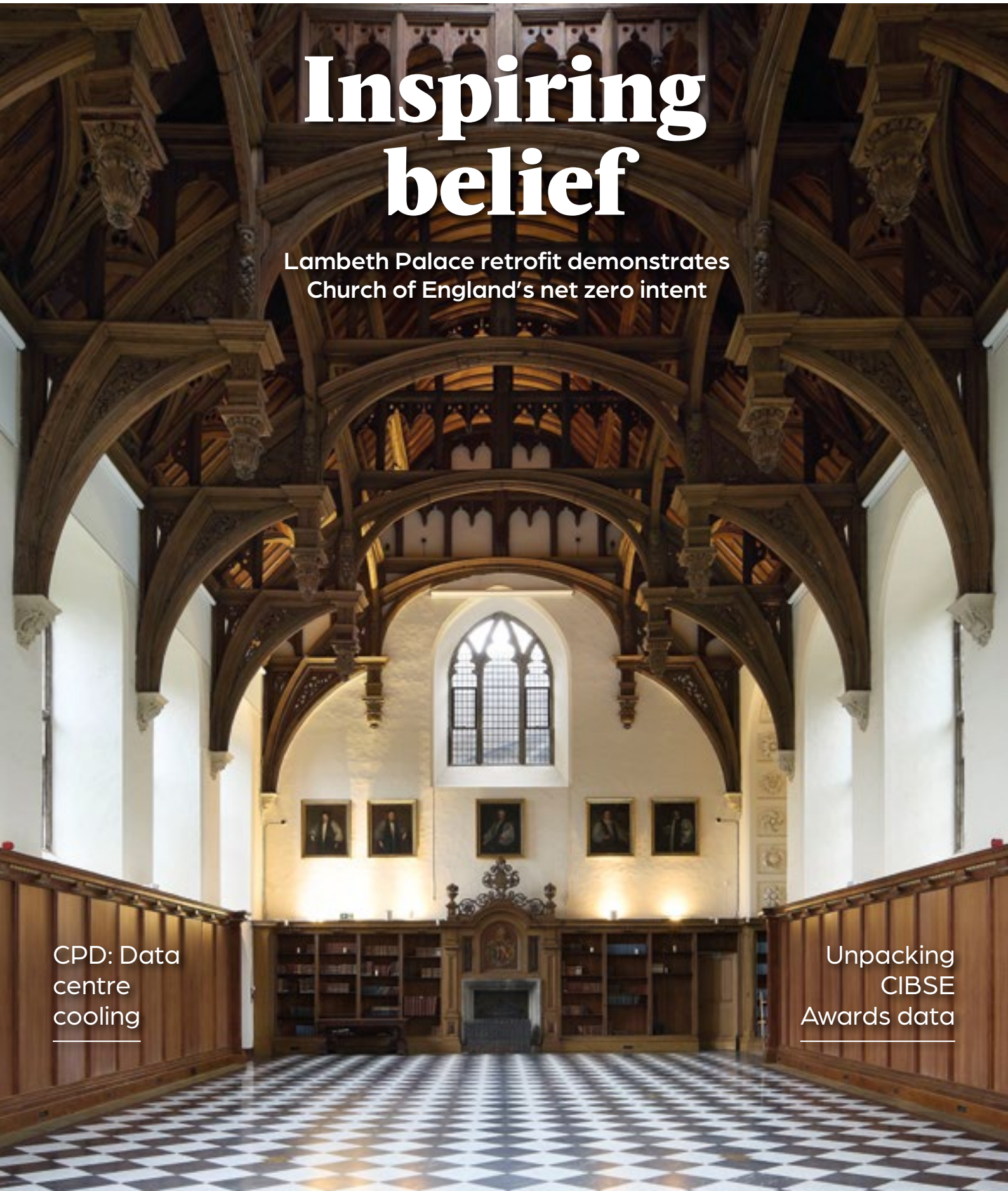
The magazine of the Chartered Institution of Building Services Engineers



Inspiring belief

Lambeth Palace retrofit demonstrates Church of England's net zero intent

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Still on course

There has been broad political consensus in the UK on green policy ever since former Prime Minister Margaret Thatcher spoke out on the need to tackle climate change in 1989.

This cross-party commitment to decarbonise buildings and processes led to the Climate Change Act in 2008, which, ultimately, committed the UK government to reduce greenhouse gas emissions by 100% by 2050.

The political winds are now changing, however. Reform UK's success in local elections has caused doubt over whether the country will be pursuing these policies in the long term. During its recent party conference, Reform – which is currently leading in UK polls – passed a motion calling for the repeal of the 2008 Climate Change Act, and leader Nigel Farage pledged to 'scrap ridiculous, harmful, wasteful, net zero policies'.

Conservatives have responded to Reform's threat by saying that, if elected, they would also put the brakes on decarbonisation, with leader Kemi Badenoch pledging to 'maximise extraction' to get 'all our oil and gas out of the North Sea'.

The Liberal Democrats, Labour and the Green Party are still committed to net zero, however, and at their recent party conference the Lib Dems said they would create an Energy Security Bank, offering up to £20,000 per household for home energy upgrades. The proposed retrofits would save the average household up to £500 per year, the party claims.

Decarbonisation strategies driving much of building design today are unlikely to be derailed by a 'drill, baby, drill' mentality. Building owners understand that efficient buildings, run on clean energy, lead to operational savings for themselves and occupiers. The adoption of building performance metrics is also growing, as the analysis of CIBSE Awards data by Julie Godefroy shows (page 18). She noted a significant increase in commercial building entries, showing a positive trend towards more reporting, disclosure and collaboration on building performance.

There is also plenty of innovation around decarbonisation in the data centre sector, which is seeing an explosion in demand because of the rise in computing power required for artificial intelligence. Our CPD on page 49 shows how liquid cooling is helping to minimise energy and water use in a rapidly expanding sector.

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Chris Ridge
Why hybridised products are threatening the safety and performance of pre-insulated pipework

Andy Pearson
This month, two CPDs look at liquid cooling in data centre applications and VRF systems in hotel retrofits


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Chemical engineer is new construction minister

Major government reshuffle comes after resignation of Deputy Prime Minister Angela Rayner

Chemical engineer Chris McDonald has been appointed as construction minister – taking on responsibilities within the Department for Business and Trade and the Department for Energy Security and Net Zero (DESNZ) – after being elected as an MP just over a year ago.

He replaces Sarah Jones, who has moved to the Home Office as part of a government reshuffle triggered by the resignation of Deputy Prime Minister Angela Rayner earlier this month.

McDonald was CEO of the Materials Processing Institute in Tees Valley before being elected MP for Stockton North last July. His responsibilities include: energy sector supply chains; energy infrastructure investments; green jobs and growth; and industrial decarbonisation.

Steve Reed OBE has taken on Rayner's housing duties as secretary of state for housing, communities and local government.

The reshuffle has also resulted in Chester MP Samantha Dixon taking over as building safety minister at the Ministry of Housing, Communities and Local Government. She replaces Alex Norris, who has moved to the Home Office.

Dixon's responsibilities include the Building Safety Regulator and remediation, energy efficiency, fire, planning casework, and the response to the Grenfell Inquiry.

Scottish MP Martin McCluskey has been appointed minister for energy consumers, and his responsibilities will include: business and commercial buildings decarbonisation; clean heat and the Boiler Upgrade Scheme; domestic energy efficiency; fuel poverty; heat networks; public sector decarbonisation; and the forthcoming Warm Homes Plan.

Rutherglen MP Michael Shanks, meanwhile, has been promoted from parliamentary under-secretary at DESNZ to minister of state. His remit has been expanded to include carbon capture and hydrogen.

Reform county councils challenge net zero policies

Reform UK-controlled councils are pushing back on efforts to tackle climate change after the party's breakthrough success in May's local elections.

Kent County Council has voted to rescind its climate emergency declaration, which was passed in 2019 and set out the authority's ambition to reduce greenhouse gas emissions to net zero by 2050. The motion to rescind, passed by an overwhelming majority, said the declaration is based on the 'unproven' claim that climate change is caused by human activity. This flies in the face of the scientific consensus on global warming.

North Northamptonshire Council, meanwhile, has unanimously voted to delay its net zero emissions target from 2030 to 2050, while Durham County Council is reportedly considering scrapping plans to install rooftop solar panels on its buildings.

In his speech at the party's annual conference in Birmingham this month, Reform UK's deputy leader, Richard Tice, said it has 'serious questions' about battery-storage projects.

Badenoch pledges to maximise North Sea fossil fuel extraction

Conservative leader Kemi Badenoch has pledged that her party, if elected, will remove all net zero requirements on oil and gas companies drilling in the North Sea. In a speech in Aberdeen on 2 September, she said her party would remove requirements on oil and gas companies to reduce emissions at their facilities or develop technologies such as carbon storage. If elected to government, the Conservatives would focus solely on 'maximising extraction' to get 'all our oil and gas out of the North Sea', Badenoch said.

Ductwork warning issued ahead of Awaab's Law

Trade bodies warn of mould growth from poor installation

The Building Engineering Services Association (BESA) and Thermal Insulation Contractors Association (TICA) have warned that operatives, often working for multi-trade firms, are putting lives at risk by carrying out work beyond their competence.

The associations cited a recent project on which an unqualified multi-trade contractor installed ductwork with serious safety flaws. It featured poorly insulated ducting, which created condensation and mould growth.

Chris Ridge, TICA's technical director, highlighted the incorrect use of flammable rigid insulation board on the project, which the two associations fear may be 'the tip of the iceberg' rather than an isolated example.

BESA and TICA stress that clients must verify competence and organisational capability before appointing contractors for safety-critical building services work.

'Condensation can quickly allow mould to germinate. This growth then produces spores that spread to other damp areas, multiplying the issues,' said Nathan Wood, BESA's London & South East regional chair.

Awaab's Law is due to come into force on 27 October, and will set strict deadlines for landlords to investigate and fix damp and mould. 'Without properly trained and accredited contractors, it risks becoming a box-ticking exercise rather than a safeguard for residents' health,' said Wood.

Liberal Democrats plan retrofit bank

The Liberal Democrats have unveiled plans to create a new bank to offer households loans, worth up to £20,000, for home energy upgrades.

In her speech at the party's conference in Bournemouth, the Lib Dems' treasury spokesperson, Daisy Cooper, said the Energy Security Bank would offer loans to middle-income households that are currently unable to access grants for installing measures such as solar panels, heat pumps and insulation. Community energy groups and small businesses could also benefit.

The bank's £2bn upfront costs would be funded by a time-limited windfall tax on banks, and the party claims the proposed retrofits would reduce energy bills by £500 a year for average households.

Daikin and EDF join forces to ramp up heat pump installation

EDF has partnered with Daikin UK in a bid to boost heat pump installations by enabling installers without MCS certification to access the Boiler Upgrade Scheme. EDF Heat Pumps, the installation subsidiary of energy supplier EDF Energy, has launched HPIN (Heat Pump Installer Network) Direct to train installers so they can work without becoming MCS certified themselves. EDF Heat Pumps managing director Clayton Browne said: 'We often hear there are not enough installers for the demand in heat pumps. With HPIN Direct, we are changing this, so we can get thousands more installers trained and installing heat pumps.'

EC wants feedback on electrification plan

The European Commission's (EC's) Directorate-General for Energy has launched calls for evidence and open public consultations on the EU's Electrification Action Plan and Heating and Cooling Strategy. They will continue until 20 November and the feedback will inform the EC's work on these initiatives, which are due to be published in the first quarter of 2026. Both initiatives are designed to support the EU's energy affordability and competitiveness, and reinforce the bloc's energy security, while helping to achieve energy and climate targets.

BESA's new ventilation hygiene guide

The Building Engineering Services Association (BESA) has launched a free guide for the industrial and commercial ventilation hygiene sector. Developed in partnership with the Association of Ductwork Contractors and Allied Services, and business consultancy Milford & Marah, it outlines requirements for cleaning industrial and commercial ventilation systems, including in critical healthcare environments, as well as safety considerations for higher-risk buildings under the Building Safety Act.

Billions pledged for nuclear and AI in UK-US agreement

Tech Prosperity Deal paves way for new AI Growth Zone

An AI Growth Zone will be established in the North East after the government unveiled a new agreement with the USA. The Tech Prosperity Deal, signed during US President Donald Trump's state visit, will result in more than £31bn being invested in artificial intelligence (AI) and tech infrastructure across the UK.

It will be the second AI Growth Zone in the country – the first being in Oxfordshire – and will offer data centres fast-track planning consent and Grid connections. North Tyneside's Cobalt Park will be one of the sites to receive initial deployment of semi-conductor chips for OpenAI's Stargate UK project.

Designation as an AI Growth Zone could attract an additional £20bn of investment in a former industrial site in Blyth, Northumberland, where private equity investor Blackstone has already committed £10bn for new data centres.

The UK government has also made an agreement with the US to fast-track nuclear power regulation. Under the Atlantic Partnership for Advanced Nuclear Energy, if a reactor has passed 'rigorous' safety checks in either the UK or the US, this work can be used by the other party to support its assessment, avoiding duplication of work. This will speed up approvals for advanced designs, such as Rolls-Royce's small modular reactor (SMR), to around 24 months, the UK government claims.

A new AI Growth Zone is planned for the North East

Several nuclear deals were also announced, including plans by US developer X-energy and Centrica to build up to 12 advanced modular reactors in Hartlepool, paving the way for the rollout of 6GW across the UK.

Other projects include an £11bn plan to develop advanced data centres, powered by SMRs, at Nottinghamshire's former Cottam coal-fired power station, and a scheme to build micro modular nuclear power plants to supply power for the expansion of DP World's London Gateway port and business park.

Care sector decarbonisation 'encouraging' despite cost fears

Nearly half the care home managers surveyed for a new poll by Baxi have decarbonised the heating systems in their properties, and almost all of the rest are taking steps to do so.

The survey of 400 managers found that 46% had already decarbonised their heating systems, with a further 50% taking steps to do so.

However, 42% said gas boilers are currently still their main source of heating.

The poll found strong interest in exploring decarbonisation options, but running costs were a key consideration for 85% of respondents. Nearly all (94%) of the managers expect to have a budget for decarbonisation, although the survey found that lack of expertise and resources remain barriers for many care homes.

Jeff House, director of external affairs and policy at Baxi, said the 'clear appetite' among care leaders to decarbonise heating and hot-water provision is 'encouraging', but he called on the government to introduce dedicated funding to help upgrade homes.

Amazon to develop TM65 for grocery refrigeration

Embodied carbon methodology addendum due in 2026

Amazon is working with global consulting firm Effecterra and CIBSE experts to develop an addendum to the TM65 embodied carbon methodology for new commercial grocery refrigeration systems.

The global retailer, which owns the Amazon Fresh and Whole Foods Market grocery chains, is studying how CIBSE's TM65 methodology, which quantifies and reduces embodied carbon in building services, can be applied to commercial refrigeration equipment and systems.

Development of the methodology for the addendum has already received approval from CIBSE's Knowledge Management Committee technical council.

As the project moves into the data-collection phase, the team is seeking help from manufacturers and owners to gather the critical information needed to create baselines for materials and components that make up commercial refrigeration systems.

Amazon has previously supported the development of a TM65 addendum for logistics (TM65.3) and North America (TM65NA). See 'Amazon's Mission to measure more', *CIBSE Journal*, May 2025. The new TM is due to be launched next year.

Please contact Tristam Coffin at **tristam.coffin@effecterra.com** to understand how you can support the programme.

Go-ahead for Elstree studio redevelopment

AXA IM Alts has secured planning permission to redevelop around half of the BBC's Elstree Centre TV and film studio in Borehamwood, and the asset manager says it will be targeting Breaam Outstanding for the project.

The scheme, approved by Hertsmere Borough Council, will more than quadruple the studio's stage space to around 100,000ft². The other half of the 16-acre site has recently been upgraded by the BBC, which occupies it under a long-term lease.

The redevelopment will be assessed against the Albert Studio Sustainability Standard, an environmental impact assessment for film studios. The campus will be rebranded as 'Fairbanks Studios', after actor Douglas Fairbanks Jr, who once owned the studios.

Engineers vie for title of Employer of the Year

The shortlists for CIBSE Employer of the Year, sponsored by CIBSE Patrons, have been revealed.

The award celebrates companies that support and nurture young engineers, promoting their development through training, mentoring and initiatives that prioritise them within the business.

Prizes for three categories and an overall winner will be presented at the Young Engineer Awards at Senate House, UCL, on 9 October.

Shortlisted in the small company category are: Aynam Energy Ltd, Noquet Building Services and S I Sealy & Associates. In the medium-size category, the finalists are Atelier Ten, FairHeat, Hilson Moran and Scotch Partners, while Aecom, Hoare Lea and Otis are shortlisted in the large company section.

Counterbalancing failed in Lisbon funicular tragedy

'Relationship was lost' between cars, says CIBSE's Cooper

The Lisbon funicular's counterbalancing system was not operating correctly when the popular attraction crashed, resulting in 16 deaths, CIBSE's President Elect, Dave Cooper MBE, has said.

The Glória Funicular uses a system in which two cars counterbalance each other, meaning they always mirror each other's position and pass each other at the halfway point. The cars, which carry around three million passengers a year, are attached to opposite ends of a haulage cable, with electric motors on the vehicles providing traction.

On 3 September, however, one of the cars derailed at a bend in the street and crashed into a building, leaving 16 people dead and 21 injured.

In an interview with *New Civil Engineer*, Cooper, who is chief executive of The Lift & Escalator Consultancy, said the fact that the unaffected carriage was at the bottom while the other was on the slope when it lost control indicates that something had happened to the counterbalancing system. 'Clearly the relationship between the cars has been lost,' he said.

'The obvious main point of failure is the suspension ropes, as seems to be the case with Glória,' added Cooper, who is also a visiting professor at the University of Northampton.

Lisbon transport operator Carris said maintenance had been carried out as usual ahead of the accident.

Heating appliance earns bitcoins while warming your home

An Austrian firm has launched an electric heater incorporating bitcoin-mining hardware.

Austrian sustainable heating company 21energy's has launched Ofen 2 an electric heater that incorporates Bitcoin-mining hardware.

The unit provides up to 1kW of heat output while operating at a reported 32–35dB. It combines convective and radiant heating with mining chips capable of 42TH·s^{-1} (trillion cryptographic calculations per second) at an energy efficiency of about 23.5J·TH^{-1} (joules consumed per trillion calculations).

Control is via Wi-Fi, with plug-and-play setup and app-based monitoring.

According to the manufacturer, the thermal performance is equivalent to that of a conventional electric heater, but the integrated computing load allows some recovery of energy costs through Bitcoin rewards.

Potential benefits are cited for users with variable electricity tariffs or onsite photovoltaic panels.

The product illustrates the growing intersection of HVAC systems, digital technologies, and decentralised energy applications.

For more information visit: bit.ly/CJOfen02

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cibse News

CIBSE welcomes the delegation from the Shanghai Association of Science and Technology

CIBSE welcomes Shanghai delegation to new premises

Association of Science and Technology explores key CIBSE initiatives at Saffron Hill head office

CIBSE welcomed a delegation from the Shanghai Association of Science and Technology (SAST) to its new head offices, in London, last month.

The delegation met the Institution's CEO, Ruth Carter, President Vince Arnold, technical director Dr Anastasia Mylona, director of membership Richard Goldsbrough, and head of government affairs Sam Baptist, for an engaging and insightful visit.

The SAST delegation learned about CIBSE membership, network, history and Royal Charter status. Dr Mylona highlighted key examples of CIBSE's work in driving industry standards and best practice, including the recently launched Weather Data Set and the UK Net Zero Carbon Buildings Standard.

The delegation expressed interest in CIBSE's pioneering approach, noting the significance of CIBSE leading initiatives that are later adopted by the UK government — testament to CIBSE's influence and expertise.

It also discussed opportunities for collaboration and expansion in China.

Training

Fire safety courses

Strengthen your expertise in managing fire risks with CIBSE's suite of fire safety courses.

The 'Fire safety management' course will show attendees how to make an assessment of the means of escape from an existing building, taking into account exit widths and travel distances. In addition, it will: explain fire safety law and science; look at managing the systems and people within a building, to ensure the means of escape and supporting systems remain effective; and examine fire risk assessment and the link to compliance with the fire safety order.

The 'Fire safety in construction course' explores Approved Document B fire safety in design of buildings, covering the means of escape, internal and external fire spread, and access and facilities for firefighters.

www.cibse.org/training

For full details and booking:
www.cibse.org/training

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12–14 November
3–5 December

Mechanical services overview
13 October

The importance of energy efficient buildings
15 October

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16 October
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11 December

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12 December

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16 December

Building services explained
18–19 December

MENA Awards highlight talent and innovation

Engineers, projects and companies from across region are competing for 27 accolades

The CIBSE Middle East and North Africa (MENA) Awards shortlist has been announced, showcasing the wealth of talent and innovation in the region.

Formerly known as the CIBSE UAE Annual Awards, the accolades have been revitalised and relaunched this year, and celebrate the outstanding achievements of engineers, projects and companies across the MENA region.

There are 27 awards up for grabs, in four categories: Projects, People, Companies, and Products and Innovations.


Dubai Exhibition Centre

Among those shortlisted in the nine Projects awards are: Masdar City net zero energy mosque, by Arup; HSBC Jumeirah branch, by WSP Middle East; and Dubai Exhibition Centre Campus Legacy, by Egis.

There are also nine categories focused on individuals whose dedication and hard work contribute to industry achievements. These awards showcase engineers at each stage of their career, from graduates and young engineers to executives.

In the Companies category, awards will be presented for Consultancy, Contractor and Manufacturer/Supplier of the Year, recognising the contribution of each to making buildings safe, comfortable and healthy places to live and work.

Products making an impact in digital engineering, embodied carbon, sustainability and lighting will be rewarded in the Products and Innovations category, which showcases the huge array of technological advancements and sustainable solutions being developed to achieve net zero goals.

The winner of the CIBSE UAE Student Design Competition 2025 will also be announced at the awards ceremony. This year's theme is 'Intelligent buildings', and students were challenged to design or retrofit a building that integrates intelligent systems and real-time energy optimisation.

The MENA Awards have been produced in collaboration with the CIBSE UAE Region, and thanks go to the headline sponsor, FJ Group.

They serve as a platform to recognise excellence in building services engineering, highlighting innovative projects and professionals who are setting new standards in sustainability, safety and performance.

The awards ceremony is on 30 October, at the W Hotel in Dubai, and will bring together industry leaders and innovators to acknowledge exemplary contributions to the built environment.

To view the shortlist in full, and to book your place to find out who takes home the trophies, visit: bit.ly/CJMenaAw25

Coming soon

SLL Young Lighter Final 2025

22 October, online, and London and Manchester

The final will be hosted in London and Manchester, with finalists presenting their submissions. The competition provides an opportunity for those in the early years of their career to showcase their talent and vision to the lighting community and beyond.
bit.ly/CJYL25

SFE Façade Design and Engineering Awards

5 November, Old Billingsgate, London

The SFE Façade 2025 Design and Engineering Awards recognise and reward excellence and achievements in façade engineering, raising the profile of, and drawing attention to, the importance of this discipline. The shortlist has been announced, so be there on the night to find out who takes home the trophies.
bit.ly/CJSFEAw

UK Net Zero Carbon Buildings Standard in practice

6 November, Royal College of Physicians, London

This one-day conference brings together developers, designers and policy-makers who discuss turning results of the UK Net Zero Carbon Buildings Standard (UK NZCBS) into real-world action. Speakers include David Partridge, UK NZCBS chair, and Katie Clemence-Jackson, UK NZCBS CEO.
bit.ly/CJNZCBS25

Build2Perform Live

19-20 November, elementalLONDON, Excel London

CIBSE's Build2Perform Live conference will take place across two theatres. Sessions will cover the future of heating and cooling, decarbonisation, climate resilience, health and wellbeing, data centres in a net zero future, and NABERS UK.
elementallondon.show

CIBSE Board Member shares expertise

CIBSE Board Member Professor Dejan Mumovic gave talks on climate resilience and building performance in the education sector during a lecture and presentation tour in Australia.

Representing CIBSE, Mumovic delivered presentations at the universities of New South Wales and Sydney. He explored how resilience in school buildings must go beyond withstanding physical stressors to actively create environments that support health, wellbeing and learning outcomes.

In Brisbane, he took part in a Lunch and Learn session with the CIBSE ANZ committee, discussing the future of building services in education settings.

30 years of talent: CIBSE Young Engineers Awards finalists revealed

Graduate of the Year title up for grabs as 30th anniversary of accolades is celebrated at UCL's Senate House, London, on 9 October

The shortlists have been unveiled for the 30th Young Engineers Awards.

Ten finalists in the Graduate of the Year category will present on: 'Engineering for impact: how can we make carbon reduction real, measurable and meaningful?' before a winner is declared.

The winner of the Young Engineer Indoor Environment Quality Design Challenge, sponsored by Zehnder Group UK, will also be announced on the night.

The full YEA shortlist is:

CIBSE Undergraduate of the Year

- Serra Ardor, UCL
- Vincent Carslake, University of Sheffield
- Ching-Tai Chang, UCL
- Lawrence Copestick, University of Sheffield
- Brandon Hall, University of Nottingham
- Beau Langdale, University of Nottingham
- Shek Lun Leong, Leeds Beckett University (franchised partner Asian Institute of Built Environment)
- Ritika Maladkar, University of Nottingham

UCL's Senate House will host the awards

- Yuill Petrie, Heriot-Watt University
- Kaifeng Zhu, University of Nottingham

CIBSE Apprentice of the Year Sponsored by Troup, Bywaters & Anders

Level 3-4

- Thyra Al-Feena, MZA Consulting Engineers
- Abigail Guest, East Riding of Yorkshire Council
- Lucy Kedian, CPW
- Isobel Powers, WSP UK

Level 5-7

- Kai Barlow, Waterman Building Services
- Callum Chamberlain, Hoare Lea
- Jake Mitchell, Aecom
- Ethan Reid, WSP UK
- Adia Sadeqee, MZA Consulting Engineers

CIBSE ASHRAE Graduate of the Year Sponsored by Swegon

- Molly Behling, University of the West of England and Hilson Moran
- Kasia Garbocz, University of Nottingham and Aecom
- Rachael Gilbert, University of Central Lancashire and Troup, Bywaters & Anders
- Hannah Gray, University of Edinburgh and Foster + Partners
- Athiya Junaid, Heriot-Watt University Dubai and WSP
- Andrea MacKenzie, University of Bath and FairHeat
- Esther Memeh, University of Loughborough and Savills M&E Consulting
- Joshua Mountain, LSBU and Aecom
- Hasan Shwaish, University of Sheffield and Arup
- Michael Tomkinson, University of Salford and Clancy Consulting

See the Employer of the Year shortlist on page 10. Visit www.cibse.org/yea

Consultation opens on combustion plant

The Environment Agency is consulting on amendments to standard rules permits for medium combustion plant (MCP) and specified generators.

MCP is defined as plant where fuel is burned to generate heat or power, while specified generators include diesel generators, peaking plant and gas engines used for standby power.

The changes proposed are: to remove specific standard rules sets, which are currently underused; correct errors in tables in other standard rules; add gas oil substitutes and hydrogen as a fuel; and remove the restriction on caps and cowls, and horizontal stacks.

For the full proposals visit: bit.ly/CJMCPcon25
To contribute to CIBSE's response, visit: bit.ly/CJCCon by 24 October. The consultation closes on 9 November.

Williams Refrigeration adopts ECV scheme

Norfolk-based Williams Refrigeration has adopted CIBSE Certification's Embodied Carbon Verification (ECV) scheme.

The ISO 14001-certified manufacturer is using the standardised ECV scheme to quantify and reduce embodied carbon across its refrigeration equipment.

The formal verification process for CIBSE TM65 calculations serves to reinforce data integrity and accuracy while ensuring alignment with established industry sustainability standards and expectations.

By implementing the CIBSE TM65 methodology in conjunction with CIBSE Certification's ECV scheme, Williams Refrigeration is aiming to meet increasing market demand for independently verified, low carbon solutions.

New Fellows, Members and Associates

FELLOWS

Sadaba, Sergio
London, United Kingdom

White, Peter
Southend-On-Sea, United Kingdom

MEMBER

Ahmadi, Marzieh
Manchester, United Kingdom

Burkill, Ellie
London, United Kingdom

Doleschall, Lorinc
Waterlooville, United Kingdom

Ehalape Gamage, Asanka
London, United Kingdom

Elmahrouky, Ali
Hawalli, Kuwait

Elshafiey, Osama
Riyadh, Saudi Arabia

Fawzy, Mohamed
Eastleigh, United Kingdom

Fry, Harry
London, United Kingdom

Guillergan, Jade
Dubai, United Arab Emirates

Holland, Samuel
Plymouth, United Kingdom

Horne, Peter
London, United Kingdom

Hui, Chi Fai
Shatin, Hong Kong

Konda, Rami Reddy
Bengaluru, India

Kuntz, Daniel
Dubai, United Arab Emirates

Kuyipayil, Mohamed Faizal
Riyadh, Saudi Arabia

Land, Rhydian
London, United Kingdom

Lau, Hoi Sing Candy
Kowloon, Hong Kong

Lau, Wai Kit
Tung Chung, Hong Kong

Lee, Man Pan
Tseung Kwan, Hong Kong

Lee, Tsz Yuen
Kowloon, Hong Kong

Lee, Chun Ki
London, United Kingdom

Leung, Hiu-Fung
Tuen Mun, Hong Kong

Leung, Ka Chuen
Tseung Kwan, Hong Kong

Li, Ko Kei
Tseung Kwan, Hong Kong

Li, Kwok Yung
NT, Hong Kong

Li, Wai Kit
NT, Hong Kong

Linville-Boud, David Alexander
Burnley, United Kingdom

Lu, Mingming
Hung Hom, Hong Kong

Ma, Chi Pong
Sai Wan Ho, Hong Kong

Mak, Tsun Ting
Sha Tin, Hong Kong

Mak, Ying Yeung
Sha Tin, Hong Kong

Martin, George
Parsippany, United States

McGhie, Aidan
Glasgow, United Kingdom

McKever, Cara
Glasgow, United Kingdom

Middleton, Thomas
Sydney, Australia

Murray, Adam
Colchester, United Kingdom

Newman, Jordan
Hornchurch, United Kingdom

O'Brien, Terry
Woburn Sands, United Kingdom

O'Donovan, Niamh
Salford, United Kingdom

O'Shaughnessy, Dave
London, United Kingdom

Oraklibel, Aytac
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Osborne, Gregory
Keynsham, United Kingdom

Pang, Kenji Yiu Kei
NT, Hong Kong

Paszkiewicz, Ewa
Warsaw, Poland

Poon, Kam Lung
Kowloon, Hong Kong

Qian, Xueni
Yuen Long, Hong Kong

Ragab, Hussein
Dubai, United Arab Emirates

Ramanantham, Baskaran
Dubai, United Arab Emirates

Reilly, Micheal
Dubai, United Arab Emirates

Richardson, William
Doncaster, United Kingdom

Ross, Danny
Edinburgh, United Kingdom

Ryan, Rachel
Limerick, Ireland

Salvankar, Shweta
Manchester, United Kingdom

Samarita, Dan Ehrald
Abu Dhabi, United Arab Emirates

Savovic, Dalibor
London, United Kingdom

Segrave, Gerard
Kildalkey, Ireland

Senanayake, Chamara Prageeth
Turku, Finland

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Whiteside, Scott
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Newark, United Kingdom

Lyons, Matt
York, United Kingdom

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Leeds, United Kingdom

Price, Neil
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Robbiati, Harry
London, United Kingdom

Talukder, Mahee
Leeds, United Kingdom

Taylor, Harrison
Crawshawbooth, United Kingdom

Making sure homes are really decent

Proposed reforms to the Decent Homes Standard are broadly welcome, but CIBSE believes more attention must be paid to ventilation and air quality, electrical standards and overheating, says **Julie Godefroy**

The government recently consulted on updates to the Decent Homes Standard (DHS) and Minimum Energy Efficiency Standards (MEES). It came shortly after the consultation on reforms to Energy Performance Certificates (EPCs).

The DHS has not been updated for two decades, and CIBSE supports the general direction – that is, upgrading standards and aligning expectations in the social and private rented sectors.

The social rented sector would now be subject to MEES, a marked improvement on the current requirement for social rented properties to achieve a minimum EPC rating of F, which is wholly inadequate to reduce fuel poverty and provide healthy and comfortable homes. Equally, the private rented sector would now be subject to the DHS, a useful change considering that while 10% of social rented properties failed to meet the DHS in 2023, 21% of private rented homes did.

Reform to the EPC system acknowledged that a wider range of metrics may be needed depending on the policy objectives for which EPCs are used. CIBSE agrees that, in the context of the DHS, the fabric criterion should be used, to reduce fuel poverty risk and improve winter comfort. However, as pointed out in our response to the EPC consultation[1], the proposed Fabric Energy Efficiency Standard is highly theoretical and not measurable.

Alternative metrics should be used. As pointed out by the National Retrofit Hub[2], MEES could better deliver health, fuel poverty and comfort outcomes, with more ambition and monitoring of these.

The DHS proposes new damp and mould requirements, which CIBSE supports in principle. Currently, however, these would rely on the Housing Health and Safety Rating System (HHSRS), which has not been updated for two decades. We recommend a review, and liaising with the UK Centre for Moisture in Buildings to consider the latest evidence and risk-assessment techniques.

CIBSE also recommends more attention be given to air quality and ventilation. Rather than just requiring that mechanical ventilation systems be kept in a good state of repair, this should be expanded to all ventilation systems, such as local extract fans – and they should require a good state of operation. Overall, the standard should require the provision of adequate ventilation and not only apply to systems that are already present.

More attention should also be placed on standards in electrical systems, which have evolved significantly since the last DHS update.

The DHS consultation proposes the introduction of requirements for window safety. CIBSE supports this, but restrictors need to be well thought through or they will excessively restrict airflow and increase overheating risk. With good design there is an opportunity to improve ventilation and/or reduce overheating risk. For example, window safety design can allow for secure openings at night for ventilation and provide shading in the day.

Finally, the reliance of the DHS on the HHSRS to limit overheating risk should be reconsidered. The HHSRS is mainly applied once a problem is identified, rather than being a proactive design standard. The DHS should encourage prevention and mitigation measures, especially passive approaches, which provide resilience and do not create a risk of increased energy costs and fuel poverty. This is particularly important because overheating is more prevalent in households living in social housing, on low incomes, or with members aged over state pension age[3]. ●

● **Dr Julie Godefroy is CIBSE's head of net zero**

Ongoing and upcoming consultations

Consultations that CIBSE intends to hold are at www.cibse.org/consultations. These include the Heat Networks Technical Assurance Scheme – a crucial part of delivering heat decarbonisation and consumer protection, including energy costs and service levels. The consultation is not yet open, but is expected in 2025. A number of overview documents are already available bit.ly/CJJA25CPD5.

References:
[1] CIBSE response to reforms to the Energy Performance of Buildings regime consultation, **bit.ly/CJEPBRres**
[2] Minimum Energy Efficiency Standards: Delivering for tenants, National Retrofit Hub, **bit.ly/CJNRHMEES**
[3] Lomas et al; Dwelling and household characteristics' influence on reported and measured summertime overheating, 2021 **bit.ly/CJLomasOH21**

Call for Nominations 2026: Officers, and Board and Council Members

Each year at the Annual General Meeting (AGM) in June, new Officers, Board Members and Council Members of CIBSE take office. We are now inviting nominations for the positions that will become vacant in 2026.

The CIBSE Board is the Institution's governing body. It comprises seven Officers – President, President Elect, three vice-presidents, honorary treasurer, and immediate Past President – along with five elected Board Members. All positions are subject to eligibility requirements set out in the byelaws and regulations. Candidates are considered by the CIBSE Nominations Panel, which reviews eligibility and suitability before advising the Board on suitable candidates.

- The **President Elect** must be a Fellow of the Institution and must have served as either a vice-president or the honorary treasurer.
- The **vice-presidents and honorary treasurer** are appointed by the Board, based on recommendations from the Nominations Panel.
- **Board Members** are elected from eligible Corporate Members who have been considered by the Nominations Panel.

The CIBSE Council is a consultative body that advises the Board on Institution policy. It includes several elected members, alongside representatives from all Groups, Regions, Societies and Standing Committees. Typically, three elected Council Member positions become available each year, rotating through a three-year term. We are now inviting CIBSE Members to propose candidates for the following roles, to take office at the AGM in June 2026:

- **President Elect** (must be a CIBSE Fellow and have served as a vice-president or honorary treasurer)
- **Board Members** (must be Corporate Members; the number of vacancies depends on appointments to Officer roles)
- **Council Members** (three vacancies).

The Board will determine which candidates to nominate for appointment or election. Candidates who are not recommended by the Nominations Panel or the Board, but who meet the eligibility criteria, may still stand for election by securing the support of 10 Corporate Members, in which case a ballot will be held.

Members may nominate themselves or propose colleagues who are willing and eligible. More information – including role descriptions, eligibility criteria and the nominations form – is at: **bit.ly/4lT882g**

Deadline for submissions: 15 October 2025

City Multi Hybrid VRF – even more relevant 10 years on

Use of water to transfer energy means no refrigerant in occupied spaces and lower embodied carbon, says Mitsubishi Electric's Graham Temple

This month, we celebrate the 10th anniversary of our unique City Multi Hybrid VRF, which delivers the design flexibility and performance of variable refrigerant flow (VRF) with benefits normally associated with water-based chillers.

It uses R32 refrigerant between the outdoor compressor and an internal branch controller. From there, water is used to transfer energy, so there is no refrigerant in occupied spaces and no need for leak-detection equipment or annual leak-detection maintenance. This helps combat the issue of refrigerant leakage in occupied spaces for BS EN378 compliance and starts to address the F-gas phasedown by using less refrigerant.

While still delivering everything for which it was developed, changes over the past 10 years mean the benefits of Hybrid VRF have become highly relevant in today's market – answering carbon-reduction demands and helping limit the amount of flammable refrigerant inside buildings.

It still provides the flexibility of design and operation that has made VRF air conditioning the market leader, but the use of water in most of the Hybrid VRF system means the off-coil temperatures are gentler for occupants.

New refrigerants with a lower global warming potential come with an increased risk of flammability, so its ability to remove or reduce the volume of refrigerants from inside buildings and occupied spaces makes Hybrid VRF an attractive option.

Ten years ago, flammable refrigerants were rarely an issue in building services, but they are now – Hybrid VRF helps solve this problem.

It also helps reduce the embodied carbon of the building services and delivers the best compromise of whole life carbon. Ten years ago, embodied carbon was rarely considered as an issue in building services, but it certainly is now – Hybrid VRF helps solve this problem, too.

We always knew that City Multi Hybrid VRF was well ahead of its time and, on its 10th Anniversary, it is still providing answers to the challenges facing buildings.

Graham Temple is marketing manager at Mitsubishi Electric

Evidence of progress

The future of construction is here. **Julie Godefroy's** analysis of the 2025 CIBSE Building Performance Awards demonstrates that the principles of performance-based design are gaining widespread adoption

What does it take to deliver buildings that perform in practice? Each year, the CIBSE Building Performance Awards put that question to the test, with submissions providing detailed evidence of how projects operate once occupied.

Our annual review of entries has become a vital barometer of building performance, offering insight into energy use, indoor environment and delivery practices. Since 2021, a standardised data form has raised the quality and consistency of submissions, allowing meaningful benchmarking across projects. The data informs updates to awards categories, and helps CIBSE's contribution to initiatives such as the UK Net Zero Carbon Buildings Standard (UK NZCBS).

This year's analysis shows marked improvements in the reliability of energy data and wider uptake of post-occupancy evaluation (POE), with many projects' energy use being well below the national average. At the same time, challenges remain – particularly around onsite renewable reporting, district heating, embodied carbon, and refrigerants.

Globe Point in Leeds was named Project of the Year – New-build Workplaces at the 2025 CIBSE Building Performance Awards

Quality of the data

The analysis confirms that the quality and scope of building performance data keeps increasing, with fewer areas of data uncertainty and wider coverage of building performance.

The majority of entries show data that is complete and reliable enough to estimate energy use intensity (EUI) with reasonable confidence, or with only a small level of uncertainty (64%). This is a marked increase from a few years ago.

An important caveat relates to onsite generation: photovoltaics (PVs) were present in more than half of the project entries and, for many of these buildings, some uncertainty was reported over the amount of renewable energy generated on site and/or used by the building. There was either no information available, or only the total generated was known, not the portion used by the building. This meant a full EUI could not be established. District heating also limited assessment of the full EUI, as, typically, only the heat delivered was provided, not the full energy used to generate and distribute that heat.

Apart from that, essential information that tended not to be available was annual water use and peak electricity demand. This was expected because these metrics are less commonly gathered, and it was only last year that this was deemed essential information in the data form.

What the data tells us

As in the previous year, the new-build entries, and several retrofit entries, tended to have much lower energy use than the average building stock, sometimes significantly. While only a high-level comparison is possible, some projects – both new build and retrofit – were close to or met the UK NZCBS Pilot energy-use limits.

Building footprint information was required for the first time this year, to benchmark renewable energy generation against targets in the NZCBS. This will be reported in the *Journal* once a large enough sample of data is available.

The data forms also request information on whether an embodied carbon assessment has been carried out for the whole building (and, if so, the results), whether building services were included in the assessment (and, if so, the methodology used), and details on refrigerants.

Project of the Year entries need at least one year of operation, so they reflect design practice from several years ago. As a result, only around 40% of entrants stated that they had carried out

a whole building embodied carbon assessment. Similarly, where information on refrigerants is available, it relates largely to refrigerants of relatively high global warming potential (GWP), such as R410a and R134a, compared with the latest R32 (where the UK NZCBS Pilot limit is pegged) or other low-GWP refrigerants.

What the data tells us on project delivery

The majority of projects used energy performance modelling, rather than just compliance modelling. For example, CIBSE TM54, Passivhaus Planning Package (PHPP) or the Design for Performance (DfP) framework, which is used for NABERS UK. Many also set energy performance targets – rather than regulatory ones – such as EUIs, NABERS UK ratings and Passivhaus/Enerphit targets. Some of these were contractual targets.

Most projects carried out POE. As well as energy use, indoor air quality, temperature monitoring and occupant surveys were seen among the entries. In recent years, CIBSE has broadened the eligible time bracket for projects, to reflect longer periods (2–3 years) of monitoring and fine-tuning when consultants remain involved to improve building performance.

Commercial picks up performance baton

Compared with previous years, when entries were dominated by owner-occupier buildings, there was a significant increase in the number of submissions from the commercial sector, including from speculative multitenanted buildings, industrial parks, and portfolios. This indicates a positive trend towards more reporting, disclosure and landlord-tenant collaboration on building performance. Similarly, the majority of entries in the domestic sector were from multiresidential schemes, rather

Interior of the Entopia Building, the overall champion at the 2025 CIBSE Building Performance Awards

Analysis of the 2025 entries

20%

of projects followed Soft Landings, with most others reporting at least some similar activities (2024: 60%)

47%

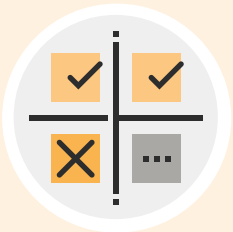
of projects had energy performance targets at the design stage (eg, total energy use, NABERS rating) of which 57% were contractual (2024: 70% stated targets)

60%

of projects had carried out energy performance modelling – eg, DfP, TM54 or PHPP (2024: 50%)

93%

of projects did a form of POE beyond just energy use (eg, user surveys, IEQ monitoring) (2024: 100%)

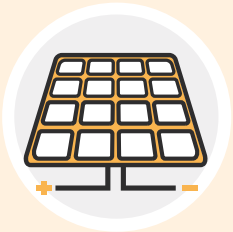


64%

of entries had an EUI based on reliable and complete information, or only had a small ambiguity (2024: 80%)

47%

of projects were all-electric (2024: 50%), including several retrofits; 20% were served by district heating (2024: none)



67%

of entries and 57% of new-build entries had onsite renewables, all PVs (2024: 60% overall, 100% of new build)

40%

of entries had carried out an embodied carbon assessment of the whole building (2024: 30%)

than individual homes or very small schemes.

Ensuring building performance and collating data can be challenging in these sectors, and entrants reported a mix of measures to address the challenges. These included intensive liaison between the developers/owners and the commercial tenants/residents, from the strategic levels (to align corporate objectives) through to the fit-out teams, building managers and occupants. There were also longer periods of handover, occupant surveys and fine-tuning, with regular feedback to occupants.

The use of technology was also prevalent, including real-time energy monitoring, live apps to report faults in services and metering equipment, and remote indoor environmental quality sensors in residential units.

Entrants were keen to highlight the benefits of these approaches, with positive occupant feedback, as well as energy performance improvements. The Portfolio winner, Cathedral Hill Industrial Estate, reported a 220% increase in rental value following its decarbonisation works.

Future awards entry forms will seek to gather more information, to share lessons with the wider industry and reward teams that manage to address these sectoral challenges. ●

Evolution of the Building Performance Awards

There are two new categories on Building Performance Evaluation for the 2026 awards: one for practice and one for technical solutions.

A new Portfolio category, under Project of the Year, reflects the growing number of entries of this type, and the specific efforts and solutions they call for.

Changes to the Project of the Year data collection forms for 2026 include:

- **More information on refrigerants' impact, including GWP, charge, and leakage if known**
- **Information on the building footprint where there is onsite generation, to allow benchmarking against the UK NZCBS targets**
- **More information on embodied carbon assessments**
- **Water consumption is now deemed essential (rather than optional) information, to reflect increased pressures on water supplies, particularly in the South East**
- **More information on peak demand is now also included in essential information. This reflects increased attention to demand management as buildings electrify**
- **If information is not available, entrants have the option to simply say so.**

The 2026 CIBSE Building Performance Awards are now closed for entries, and will take place on 5 March 2026 at the Park Plaza. For more information, visit: www.cibse.org/bpa

CIBSE BUILDING PERFORMANCE AWARDS 2026

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Future-proofing history: The Blore Building, dating from 1833, was included in the first phase of refurbishment, which took a fabric-first approach

Holy electric

Balancing history and innovation, the £40m retrofit of Lambeth Palace demonstrates how a holistic approach can secure a low carbon future for historic estates. **Andy Pearson** reports

In 2020, the Church of England's General Synod voted to work towards the Church becoming carbon net zero by 2030 – an ambitious target for a body whose estate includes 20th-century village halls, Anglo-Saxon churches, medieval cathedrals and Victorian vicarages. So, how can it be transformed?

Two years after the Synod vote, work started on the £40m refurbishment of Lambeth Palace. As a demonstration project, it was extremely ambitious. Lambeth Palace is the Archbishop of Canterbury's 800-year-old, Grade I-listed, Thames-side home. As well as incorporating the primary residence of the Church of England's spiritual leader, the collection of buildings includes a Tudor gatehouse, 17th-century cloisters, and a Victorian function and administration block.

The task of transforming the estate was awarded to Arup, working with Wright & Wright Architects. They adopted a holistic approach to the palace's transformation to show that it is possible to balance the need for preservation with the urgent requirement for energy efficiency.

The retrofit is the first major overhaul of the palace since works, in the 1950s, to repair bomb damage from the Blitz during World War II. Wright & Wright and Arup drew up a masterplan that, alongside sustainability, set out to improve accessibility. The challenge then was how to phase the works.

'One of the principles we developed was to devise a methodology that meant we did not have to go back and do the same thing twice,' says Edward Clarke, associate director at Arup.

'It would be unforgivable to dig up the courtyard and then have to dig it up again.'

Phasing was made more complicated by the need to keep some spaces open throughout the works. 'The brief was that the archbishop should have a residence available at all times, offices and spaces where he could entertain and meet people, and a place for prayer,' Clarke explains.

It was decided that the first phase should concentrate on refurbishing the 17th-century Great Hall and the 1833 Blore Building – the palace's administrative hub – and include provision of the services for subsequent phases.

A 3D survey of the campus was carried out using a specialised 3D scanning camera that creates highly detailed digital twins of real-world spaces. This allowed the team to walk around the buildings virtually. The downside, however, was that the survey did not reveal the hidden services.

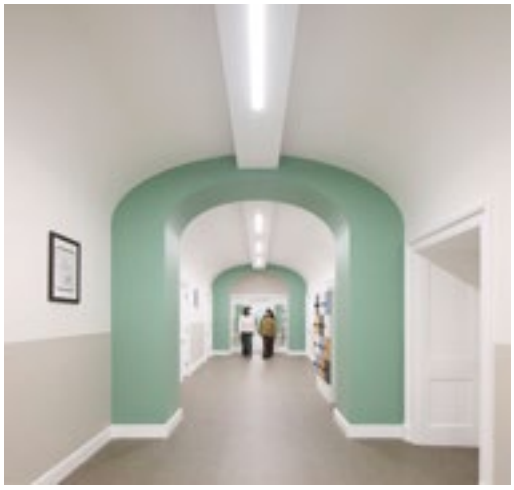
'It can only show things that the lasers can point at it; sadly, it doesn't include x-rays, so we sometimes had to guess where pipes were routed and the size of the risers, based on experience and from our conversations with the palace's facilities management team.'

A low-pressure hot-water heating system served from gas boilers, hidden beneath the palace's 13th-century chapel, provided heat for the complex. Clarke describes the system as 'desperately inefficient' with 'a complete lack of controls'. From the subterranean boiler house, pipes followed 'eccentric' routes, crossing roofs and dropping down risers, to serve radiators warming the palace's eclectic mix of buildings.

The refurbishment adopted a 'fabric-first approach' to reducing energy demand. This involved digitally modelling the building to decide where it was most cost-effective to improve fabric thermal performance. Installing loft insulation provided the 'biggest bang for our buck', according to Clarke, but the walls were left untouched: 'You have stone on the outside and fine finishes on the inside, so there is no way of adding insulation – and, when the walls are 1.2m thick, adding insulation wouldn't make that much difference in any case.' Insulation was also added piecemeal to the ground floor. 'If we were pulling up floorboards or lifting slabs, it was cost-effective to add insulation, but it wasn't worth lifting slabs just to add insulation beyond 3m from the perimeter,' explains Clarke.

The most significant energy efficiency improvement by far was replacing the windows. 'The mock-Tudor windows looked historic, but

'When the walls are 1.2m thick, adding insulation wouldn't make that much difference' – Edward Clarke



Worth the wait: The retrofit is the first major overhaul of Lambeth Palace since the 1950s

Phasing PVs

There was a lot of discussion about the number and location of the PVs, which had to be hidden from sight, but which also had to avoid being shaded by Lambeth Palace's towers and other features. 'We settled on an area of panels hidden behind the crenellations of the parapet wall of the Blore Building,' says Arup's Edward Clarke. (Read about the PV installation at King's College Chapel, Cambridge, 'Renewing tradition', *CIBSE Journal*, December 2024, p26, bit.ly/CJDec24.)

Additional areas of PVs are planned for later phases of the project, including on the roofs of the Victorian cottages, which, Clarke says, 'are not as historically important as the main palace'. These roofs are not currently capable of supporting the weight of the PVs, so installation has been scheduled for later in the project, when the roofs are due for replacement.

'In advance of their installation, we've provided the infrastructure to harvest the power from these PVs and deliver it to the main building when battery storage will be installed,' explains Clarke.

'The output from the Blore Building PVs is used instantaneously by the palace, but when the larger PV array is fitted onto the cottages, and the battery is installed, we'll have the option to peak lop electric demand.'

were actually replaced in the 1950s after bomb damage; they should have been Georgian,' says Clarke, who adds that Wright & Wright had a good relationship with the planners, so they were able to replace all 160 windows with high-performance sash windows. 'That reduced energy demand by 41%.'

With the fabric improvements in place, a digital model was used to predict heat losses from each room. 'We tested every room to see what the heat load would be. We took a fairly conservative view, particularly on the airtightness, which was difficult to evaluate,' explains Clarke.

Having estimated the total heat load, Arup explored options for supplying the palace with low carbon heat. The site's proximity to the Thames meant water source heat pumps were considered to extract heat from the river. The consultant looked into drilling boreholes and installing a horizontal array in the palace's large garden. Even solar thermal was considered. However, Clarke says 'the winner by far' was air source heat pumps (ASHPs), which were 'locked into the design' from its concept. The scheme uses three 250kW ASHPs, which 'provide enough heat for the entire site, with some spare capacity once the refurbishment has been completed', Clarke adds. Any surplus could be used to heat the neighbouring Garden Museum.

Old and new: The ASHPs (above, right) are behind a metal screen mounted on a platform raised above the ground (above, left), at the back of the palace

The three heat pumps are housed in a new energy centre in a yard at the back of the palace, which previously served as a car park and bin store. They are hidden behind a metal screen mounted on a platform raised above the ground, to maintain the parking spaces. Clarke describes it as 'one of the most beautiful energy centres I've ever done'. Adjacent to this is a new electrical substation. 'The heat pumps are now the most power-hungry things on site, so locating them adjacent to the incoming power supply makes complete sense,' adds Clarke.

The new energy centre is connected to the palace by heating mains routed through and around the archaeology buried in one of the courtyards. Archaeological studies revealed walls and traces of former buildings, all of which had to be carefully documented and protected.

'You dig, you find the archaeology, then you work out the best route around it,' says Clarke. To minimise the size of the trench, the connecting pipes were manufactured and pre-insulated off site as a single unit sized to fit the route precisely.

Once inside the Blore building, the heating flow and return were run in an existing 600mm-deep trench beneath the floor of the vaulted, ground-floor corridor. From here, branch pipework rises up, mostly in existing risers, to the second-floor guest bedrooms.

'We tried to route the new pipework discreetly using existing risers, notches in joists and holes in

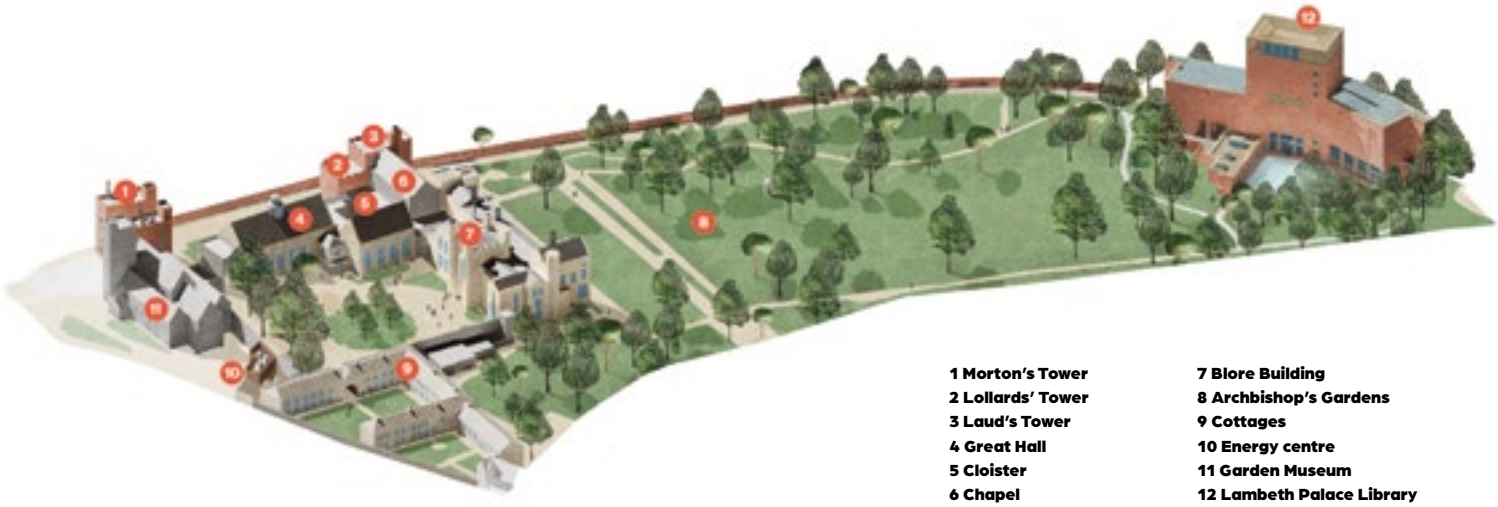
Policing the rainwater systems

The climate resilience of the palace's rainwater system and its ability to cope with storm flows was investigated.

The project was fortunate to have the Metropolitan Police headquartered in an adjacent building. According to Clarke, the service was keen to practise flying its new drones and asked if it could do so above the palace grounds.

A deal was agreed whereby the police had to follow a flight path that traced the route of the rainwater guttering, which they had to video. Arup then used the footage to modify some of the roof falls, and to add drainage outlets and downpipes where problems were highlighted.

Clarke says the palace makes use of a wide variety of rainwater-harvesting technologies 'to demonstrate what could be done with the Church's wider estate. Systems vary in sophistication, from a water butt to a more elaborate harvesting system that processes the rainwater for use in flushing toilets in the main entertaining areas'.



1 Morton's Tower
2 Lollards' Tower
3 Laud's Tower
4 Great Hall
5 Cloister
6 Chapel
7 Blore Building
8 Archbishop's Gardens
9 Cottages
10 Energy centre
11 Garden Museum
12 Lambeth Palace Library

the floorboards,' explains Clarke. Where additional risers were required, they were created in sections of the building that had been bomb damaged, because 'the heritage had already been lost', says Clarke.

New radiators were installed. At 50°C flow and 45°C return, the heating temperatures from the ASHP are lower than the 82°C/71°C flow and return provided by the palace's old gas boilers. New cast iron replacement radiators were installed, sized appropriately for the lower-temperature heating circuit. The old cast iron radiators were sold for architectural salvage.

As well as supplying the phase one works, the ASHPs provide heat for areas of the palace that will be refurbished in subsequent phases, such as the Victorian cottages and Tudor gatehouse. In these areas, existing heat emitters will remain in place, with the heating circuits serving them hydraulically separated by a new heat exchanger.

Pick 'n' mix: The Lambeth Palace site contains buildings of varying ages and various architectural styles

Arup had to estimate what the heat output would be from the existing emitters now being served by the lower-temperature heat pump circuit. It found that some emitters were capable of providing sufficient heat to keep a space comfortable, while others were not. 'For some occupied spaces, we had to supplement existing emitters with electric heating to keep occupants comfortable on very cold days,' Clarke explains.

The ASHPs also preheat the domestic hot-water cylinders serving the kitchens and principal accommodation in the main buildings. Top-up heat is provided by electric immersion heaters. Electric is also used to heat domestic hot water local to remote tea points, kitchenettes and washrooms.

Phase one of the scheme includes an area of photovoltaic (PV) panels to generate electricity on site. These had to be carefully positioned on this historic site (see panel, 'Phasing PVs').

The phase one works were completed at the end of June and the building is in the process of being handed over. 'We're working with the contractor to monitor how systems are performing by checking BMS data, which is how we now know our estimate for airtightness was too conservative – the palace is actually much more airtight then we'd hoped,' Clarke says.

The project's mix of pragmatism and ambition has, according to the Archbishop of Canterbury's website, resulted in the palace's annual CO_2 emissions dropping from 647,000kg to 233,000kg under phase one. Emissions are set to fall to 81,000kg when all proposed works and subsequent phases are complete. Offsetting will be used for the remaining emissions to enable the project to reach net zero. ●

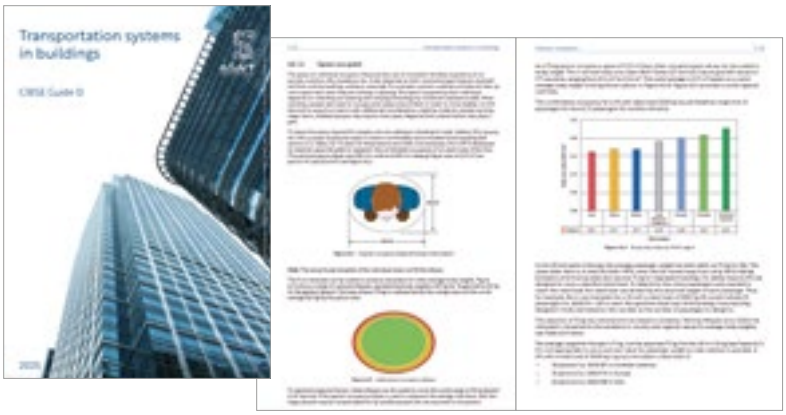
Moving with the times

The latest update to *Guide D Transportation in Buildings* coincided with the launch of the Society of Vertical Transportation, which gives its members greater professional recognition for their work in the sector

The release of the 2025 edition of *CIBSE Guide D Transportation in Buildings*, and the launch of the Society of Vertical Transportation (SoVT), marked two landmark moments for the vertical transportation profession.

Both were formally unveiled at a seminar in September, attended by CIBSE President Vince Arnold and CEO Ruth Carter. Their presence signalled the strength of CIBSE's commitment to these initiatives. Guide D and SoVT reinforce the Institution's dedication to technical excellence and professional recognition across building services.

Here, CIBSE Journal asks co-technical editor Dr Richard Peters about the update to Guide D.



Guide D is available in the CIBSE Knowledge Portal: www.cibse.org/knowledge.

Q: What is CIBSE Guide D?
A: Guide D is the definitive reference for vertical transportation within building services. Covering the design, planning, specification and operation of lifts, escalators and moving walks, it is an essential tool for engineers, consultants, architects and regulators. For more than three decades, it has shaped best practice and underpinned professional competence in the sector.

Q: What is new in the 2025 edition?
A: The latest edition reflects how the industry is evolving. There are substantial updates on: sustainability and energy efficiency, recognising global climate targets; digitalisation and interoperability, as data-driven systems reshape building design and operation; safety and accessibility, reflecting lessons from recent regulation and the growing focus on inclusive design; and advanced traffic planning and control, ensuring systems are resilient, efficient and adaptable to modern building needs. These updates reinforce Guide D as the go-to technical authority.

Q: Who contributed to the new edition?
A: Guide D: 2025 is the product of a remarkable collaborative effort. Elizabeth Evans (Peters Research) was managing editor, and the technical editors were Jonathan Beebe (consultant), Nick Mellor (Lift and Escalator Industry Association), myself Dr Richard Peters (Peters Research) and Adam Scott (Sweco; The Vertical Transportation Studio).

The editors are keen to acknowledge the army of authors and reviewers, past and present, whose expertise makes Guide D so authoritative. Also remembered is the unique contribution of the late Dr Gina Barney HonFCIBSE, who was instrumental in developing Guide D and the CIBSE Lifts Group from the 1990s onwards. Her contribution was so significant that it now takes a committee of one managing and four technical editors to carry forward her legacy.

Tribute is also paid to Ken Butcher, who has edited the guide since its inception, ensuring its consistency and authority across successive editions.

Q: The release of the new guide coincided with the launch of SoVT – what is this?
A: It is CIBSE's newest professional society, building on the legacy of the CIBSE Lifts Group. It exists to support everyone involved in vertical transportation, from students to senior consultants, and from designers to installers.

SoVT is working in partnership with CIBSE, which provides professional registration pathways that recognise competence specifically in vertical transportation (VT). This fills an important gap; while vocational qualifications are available at entry level, there has been no dedicated route for professional recognition in vertical transportation design, consultancy and management until now. Membership grades span Affiliate and Student

to Licentiate, Associate, Member and Fellow, with corresponding professional post-nominals: LSoVT, ASoVT, MSoVT, and FSoVT.

Q: Why has it been launched now?
A: The move from Group to Society was inspired by long-term ambition and regulatory change. As Michael Bottomley, outgoing chair of the CIBSE Lifts Group and incoming chair of SoVT, explained at the launch: 'The Lifts Group has, for the past 30 years, been the backbone supporting CIBSE Guide D, and now the guide bears the name and logo of the SoVT. Our ambition is to become a worldwide hub for VT technology and the education of VT professionals.'

As the industry adapts to building safety legislation, sustainability pressures and globalisation, the creation of SoVT ensures that it can demonstrate professional standards and competence at every level.

Q: How will members benefit?
A: SoVT members, as part of CIBSE, gain access to professional recognition through: Engineering Council registration; accredited CPD to keep skills sharp and knowledge current; a global professional network of VT specialists and building services engineers; exclusive technical resources, including Guide D and other CIBSE publications; and events, conferences and seminars, providing networking and learning opportunities.

Q: What happened at the launch?
A: The official launch took place at Kettering Park Hotel last month. The seminar showcased the technical content of Guide D.

Vince Arnold, CIBSE President, welcomed delegates and underlined CIBSE's continuing support for Guides and Societies. Ruth Carter, CIBSE CEO, set out the Institution's growth and future direction, and talked about the significance of SoVT and Guide D.

From left: CIBSE CEO Ruth Carter, CIBSE President Vince Arnold, SoVT chair Michael Bottomley and Richard Goldsbrough, CIBSE director of membership

Bottomley explained the transition to SoVT and its wider inclusivity, while Richard Goldsbrough, CIBSE director of membership, gave a presentation on the new membership framework. The event also featured authors giving a detailed overview of the guide.

Guide D 2025 and the SoVT represent two sides of the same coin: technical excellence and professional recognition. Together, they ensure that vertical transportation remains at the forefront of building services, combining rigour, innovation and community for the decades ahead.

Both initiatives carry the full endorsement of CIBSE's Board, demonstrating the Institution's commitment to sustaining and advancing this vital sector. ●

A webinar Introduction to SoVT Membership takes place on Thursday 6 November. Book online at bit.ly/CJsoVTweb25
For more on the SoVT: www.cibse.org/sovt

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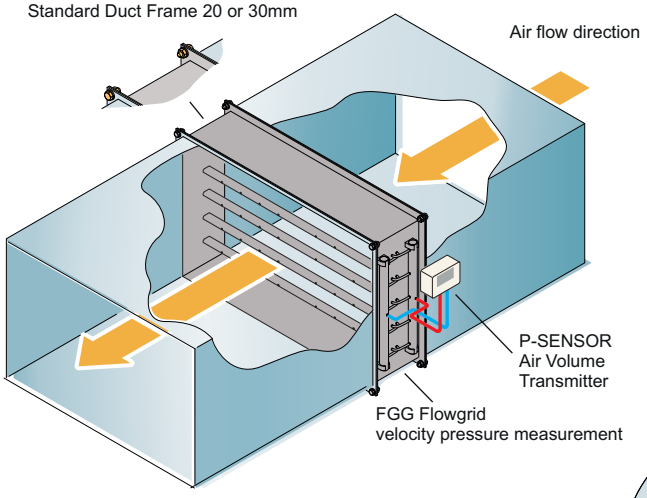
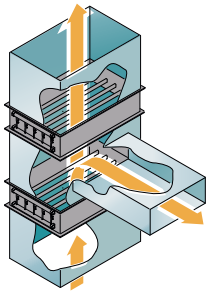
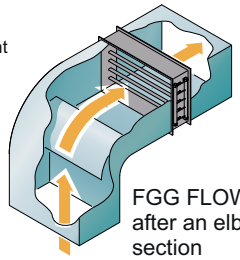
FGG FLOWGRID and P-SENSOR providing accurate average air volume measurement in ducts.



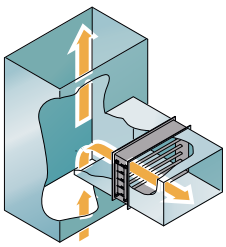
P-SENSOR
With LCD display
and keyboard



FGG FLOWGRID
before and after a
T- duct section



FGG FLOWGRID
after an elbow duct
section



FGG FLOWGRID
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Booking carbon savings

Parametric optimisation and real-time modelling guided early design choices at a new luxury hotel in Spain, cutting embodied and operational carbon. Aecom's **Inés Idzikowski Pérez** on how performance, cost and client aspirations were aligned

Sustainability in the built environment has evolved beyond energy efficiency. Today, professionals must consider a broader set of key performance indicators (KPIs) from the earliest stages of design. Yet early-stage decisions are often made with limited definition, making it challenging to balance ambition with feasibility.

To address this, Aecom has developed a suite of digital toolsets, including Aecomzero, a parametric optimisation platform that enables project teams to test multiple design strategies simultaneously across a range of KPIs. Rather than treating sustainability as a downstream check, the tool helps embed performance decisions from the outset.

In a recent project in Spain, it guided design decisions that delivered a 36% reduction in embodied carbon and up to an 11% reduction in energy use at concept-stage.

Vivood Landscape Hotels is a hospitality operator whose hotels are designed for those seeking nature and disconnection, typically located in scenic areas near urban centres. The project involved a new hotel in mountains northwest of Madrid, adjacent to a reservoir and within a protected natural area. The west-facing orientation, seasonal climate variation and unreliable water infrastructure presented unique design challenges.

The hotel team, who trained as architects, approached us with a concept aligned with their values – landscape integration, privacy and unobstructed views. While they had no formal sustainability standard or certification goals, they were open to strategies that delivered measurable impact within budget constraints.

This paper was presented at the 2025 CIBSE IBPSA-England Technical Symposium. Visit www.cibse.org/symposium to download past papers and see details of the 2026 event.

The optimisation tool

Aecomzero is built on Ladybug Tools and Grasshopper for Rhino, with EnergyPlus for energy modelling, Excel for cost and carbon calculations, and Human UI for the dashboard interface. The tool enables real-time feedback across multiple KPIs, and is structured as a series of modular analysis packs, adaptable to each project.

For Vivood, we focused on four core priorities in collaboration with the client: energy, water, embodied carbon and cost. Other indicators, such as daylight and biodiversity, were considered, but were excluded to maintain analytical clarity and relevance at concept stage.

The process began by establishing a baseline reflecting the client's concept, typical materials and compliance with national building regulations. From there, the project was divided into optimisation packages, primarily by geometry, but also by material and system definition, enabling targeted evaluation.

Unlike traditional linear workflows, where sustainability assessments follow design iterations, the tool supports a circular process. Design options are explored directly within the tool, with live feedback on environmental performance. This integrative approach required front-loaded collaboration with architects and MEP and structural engineers, and data

collection to support cost and carbon analysis.

Each design parameter – geometry, materials and systems – was interconnected, allowing us to assess trade-offs and synergies across KPIs. The tool's dashboard visualises the impact of design decisions in real time. Parameters are grouped into categories, such as glazing ratios, shading elements, material selections, HVAC and PV options, and water strategies. Strategies are tiered (base, good, better, best), enabling combinations based on discipline recommendations and client input.

This visualisation fostered cross-disciplinary awareness of environmental impacts and engaged the client in sustainability decisions. While the tool prioritises speed and conceptual clarity over detailed accuracy, it supports informed choices effectively without delaying design progress.

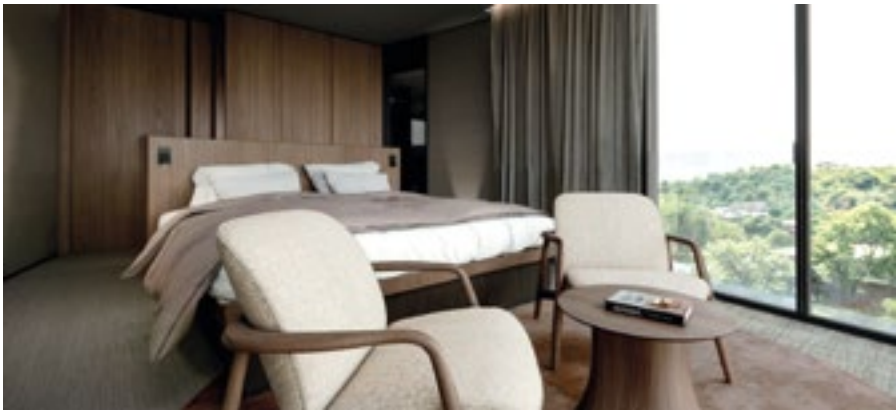
Performance outcomes

At the end of concept design, the tool helped guide several key decisions, driving a balance between optimised performance and cost. Options such as low carbon concrete and high recycled-content reinforcement proved to deliver significant embodied carbon savings at marginal cost uplift, which the client accepted.

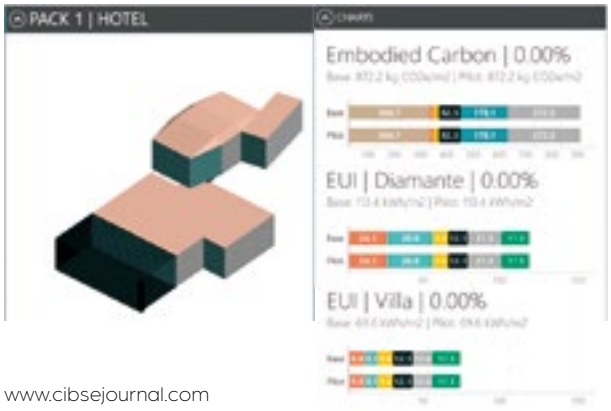
A debate over timber or Tapialblock for façades concluded that, while both performed similarly, environmentally, timber carried higher cost, and Tapialblock raised durability concerns. Timber was selected, which resulted in a significant carbon reduction compared with the baseline glass-reinforced concrete panel.

The proposed size reduction of the pools offered carbon and cost benefits, but was rejected to preserve brand identity. Similarly, a reduction of the underground car park was found to be unfeasible from the hotel's operational perspective. However, changing the landscape retaining walls from concrete to gabions proved cost and carbon efficient.

Overall, a 36% reduction in embodied carbon was achieved at concept stage, along with a modest cost reduction of 1% – and, crucially, the decisions taken avoided any capital expenditure (capex) increase.



The team behind Vivood Landscape Hotels all trained as architects



One section of the Aecomzero optimisation platform, where design decisions are visualised in real time

Internal finishes were found to have limited overall carbon impact, with most alternatives carrying a cost penalty, so the baseline specification was retained.

Glazing ratios and specifications were decisive. Reducing west-facing glazing and upgrading glass performance cut energy demand, while respecting the client's preference for uncluttered façades and uninterrupted views.

Air source heat pumps serving multiple rooms, combined with photovoltaic arrays on larger roofs, further reduced energy use and operational carbon (the project is all-electric).

Overall, the design achieved up to 11% energy-use reduction for the worst-performing Diamond units, compared with a baseline that followed the already stringent Spanish Nearly Zero Energy Building regulations.

Given the already over-capacity local network, water strategies were prioritised despite the added upfront cost. Measures included low-flow fixtures, greywater reuse for irrigation, and a greywater circuit for toilet flushing. These achieved a 28% reduction in potable demand and a 39% reduction in wastewater generation, with an increase in capex, but reduction in operating expenditure.

Conclusion

The project has planning permission and is nearing construction. A majority of strategies identified through the optimisation tool at concept stage have been developed into detail design, to align with Breeam Excellent accreditation. . While the tool's accuracy is limited to the elements modelled and relies on early-stage assumptions, its value is in embedding sustainability from the start. It enabled meaningful engagement with the client and design disciplines, reduced the need for costly redesigns, and delivered measurable environmental benefits. ●

● **Inés Idzikowski Pérez is a senior sustainability consultant at Aecom**

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Engineering a sustainable stay

With 24/7 operation, intensive energy demands and frequent refurbishments, hotels are among the toughest buildings to decarbonise. Given that the upcoming UK Net Zero Carbon Buildings Standard has sector carbon limits, **Molly Tooher-Rudd** looks at the challenges of achieving net zero hotels

Hotels rank among the most energy-intensive buildings, operating around the clock to satisfy guests' high expectations. Heating, ventilation and air conditioning, kitchens, swimming pools and laundry – all contribute to high operational emissions, which account for a large proportion of the hospitality sectors' carbon emissions. These, in turn, make up 1% of the UK's total carbon emissions.

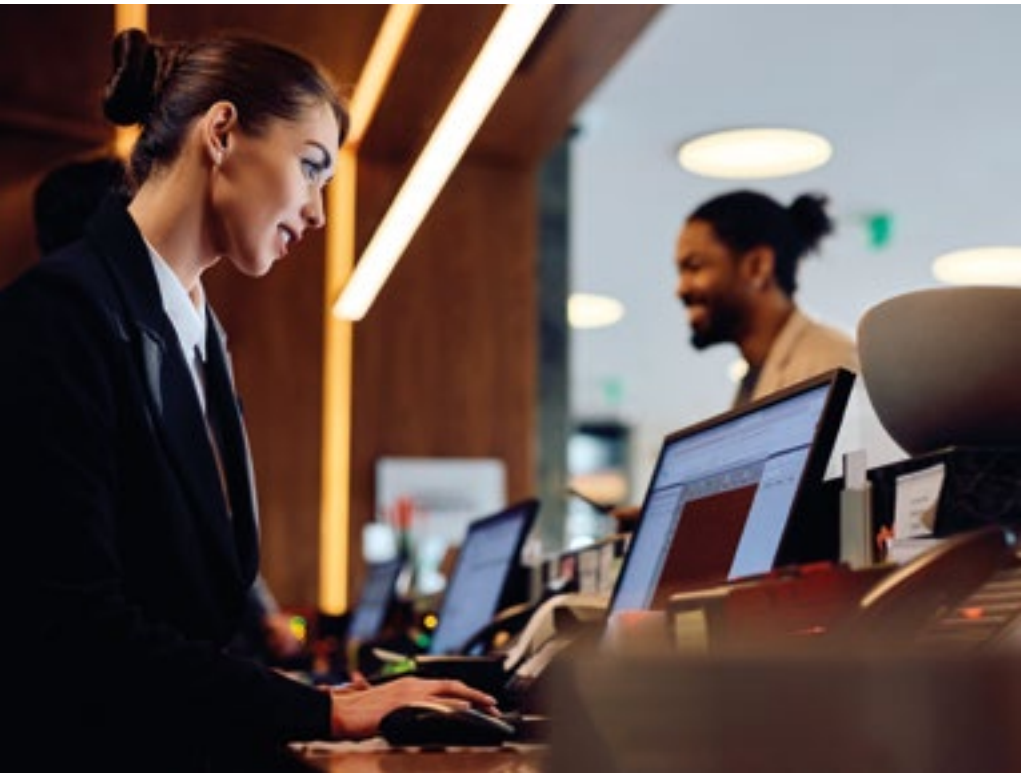
Designers will be encouraged to pay more attention to the carbon intensity of hotels when the first version of the UK Net Zero Carbon Buildings Standard (UK NZCBS) is published later this year.

The cross-industry, voluntary standard aims to provide a single, consistent and science-based definition of what constitutes a 'net zero carbon building'. It addresses operational and embodied carbon, and sets specific limits for both, to ensure a holistic approach to carbon reduction. To prove good performance, buildings must have 12 months of verified data, and there are rules on fossil fuels, renewables and refrigerants. A pilot version of the standard launched in September 2024, giving the industry the opportunity to test the feasibility of draft carbon limits for 13 building sectors, including hotels.

CIBSE Journal spoke to Mark Palmer, engineering director at Max Fordham, Ryan Horder and Juan Ferrari, both heads of hospitality & retail at Hoare Lea, and Joe Parr, performance engineer at Hoare Lea, to see how the standard might shape design strategies in the hotel sector.

Operational energy limits

Of the mandatory requirements in the standard, Horder identifies operational energy as the biggest challenge.



'Maintaining continuous conditioning and hot water availability can conflict with energy-saving efforts,' he says.

The UK NZCBS sets energy use intensity limits that decline steadily over time. For new-build hotels, the target is 85kWh·m^{-2} in 2025, tightening to 45kWh·m^{-2} by 2040. Retrofits face staged limits, from 120kWh·m^{-2} in 2025 down to 55kWh·m^{-2} by 2040.

The operational limits will force the sector to focus on maintaining good performance, according to Palmer. 'It doesn't matter how good your design is; if the building is not operated in the right way, you won't achieve the standard,' he says.

Parr believes that the early benchmarks for existing hotels are realistic. 'The 2025 interim target of 180kWh·m^{-2} per year aligns closely with the average energy use observed across Hoare Lea's dataset of 146 hotels, of around 187kWh·m^{-2} per year. But performance varies widely, from 50kWh·m^{-2} per year to upwards of 500kWh·m^{-2} per year depending on service intensity.' He suggests the standard create more specific targets for hotel sub-categories, to reflect the diverse nature of the sector.

Technology – such as smart controls, heat recovery and efficient appliances – is also available to drive consumption figures down, but 'consistent action and adoption across the sector is needed', says Ferrari, who adds that indoor environmental quality should not be compromised when striving for energy efficiency. 'Staff and guest wellbeing is linked to indoor environmental quality, so low carbon design should not forget to consider thermal comfort, air quality and lighting.'

Palmer believes there should be some recognition of the challenges of upgrading historical buildings. 'Improving the building-fabric performance of listed buildings can be very limited. In those

cases, it's going to be near impossible to achieve the operational targets. On the other hand, the embodied carbon will be very low because they've been there for hundreds of years.' (See panel, right, for opportunities for decarbonisation.)

Embodied carbon limits

The UK NZCBS sets upfront embodied carbon limits that also tighten progressively: for new-build hotels, from 565kgCO_2e·m^{-2} GIA in 2025 down to 160kgCO_2e·m^{-2} GIA by 2040 and 40kgCO_2e·m^{-2} GIA by 2050. For retrofits, the targets are lower still, recognising the carbon advantage of reuse.

Achieving these targets will be most challenging for new builds, says Palmer: 'In buildings such as swimming pools, the embodied carbon is inherently high because of the types of finishes and the use of steel and concrete.'

Horder notes that embodied carbon in hotels is also influenced heavily by frequent refurbishments and fit-outs, especially in high-end establishments, adding substantially to life-cycle carbon.

Further reduction will have to come from improvement in the embodied carbon of the construction products and materials used, says Palmer.

Standardising low carbon materials and reuse strategies will be essential, adds Ferrari, encouraging life-cycle assessments early in design and prioritising circular economy principles.

Refrigerants and renewables

Some hotel typologies have inherent limits on onsite renewables, with tall buildings and small roof footprints restricting photovoltaic (PV) capacity, but Palmer sees the PV targets as 'fairly achievable', recognising footprint constraints while ensuring opportunities are maximised.

When it comes to refrigerants, the standard sets a global warming potential (GWP) limit of 677kgCO_2e·kg^{-1}, aligned with R32 systems today. Palmer believes the target 'could have been more ambitious', but notes that it still allows variable refrigerant flow (VRF) systems, which have widely adopted R32, while encouraging a shift to lower-GWP options, such as R290 or CO_2.

Reliance on VRF and chillers will increase as fossil fuels are phased out, adds Parr, making leakage control and the selection of low-GWP refrigerants increasingly important.

But Palmer notes that the industry is still too wedded to fossil fuels. 'Too often, backup gas boilers are installed alongside heat pumps. The only way we're not going to burn gas is to not have it on site,' he says.

Hoare Lea is cautiously optimistic about the standard, and emphasises the importance of building stronger datasets for existing hotels to improve understanding of current performance levels and the practical limits of what can be achieved. Palmer, meanwhile, believes collaboration will be key: 'Every aspect – the briefing, design, construction, quality control, handover and post-occupancy monitoring – has to be aligned. Everyone has to contribute to make it successful.' ●

Strategies for hotel decarbonisation

To get to net zero, Hoare Lea recommends:

- **Smart controls:** wireless/IoT systems for room-level occupancy and temperature management.
- **Heat recovery:** capture waste heat from cooling and kitchens to cut energy use.
- **Efficient upgrades:** retrofit LEDs, efficient appliances and low carbon systems.
- **Low-impact lighting:** use modular, serviceable or reused luminaires to reduce embodied carbon.
- **Guest engagement:** promote behaviours such as linen reuse and responsible temperature control.
- **Circadian lighting:** tune light colour temperature to boost wellbeing and save energy.
- **Smart lighting controls:** have occupancy-based and daylight-responsive dimming in shared spaces.
- **Emerging tech:** leverage new systems and operational innovations to bridge retrofit gaps.

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VRF systems in hotel retrofits

This module explores the application of variable refrigerant flow (VRF) systems in hotel retrofits

In response to the climate crisis, many organisations that monitor and report their carbon emissions are placing increasing pressure on hotels to reduce the greenhouse gas emissions associated with their operations. This reflects those organisations' drive to reduce Scope 3 emissions from indirect business activities, including the accommodation of staff during business travel. Hotels are also under scrutiny from the growth of eco-tourism and from booking providers that highlight sustainability credentials.

In the UK, it is estimated that the average amount of carbon emissions generated per occupied room per night in hotels[1] is 10.4kgCO_2e, rising to 11.5kgCO_2e in London.[2] Major hotel brands have made commitments to address this. For example, the Radisson Hotel Group has committed to a science-based net zero target for 2050,[3] while the Accor group has set the same long-term goal, with interim objectives of reducing Scope 1 and 2 emissions by 46%, and Scope 3 emissions by 28% by 2030,[4] relative to a 2019 baseline.

As part of their emissions-reduction strategies, many hotel groups are focusing on their existing assets rather than replacing them with new builds. Many refurbishment projects can offer significant operational carbon savings compared with demolition and reconstruction.

Within these refurbishments, replacement or upgrading of heating, ventilation and air conditioning (HVAC) systems is often a priority. In some cases, this involves moving from older variable refrigerant flow (VRF) systems to newer, more efficient models using refrigerants with a lower global warming potential (GWP). (For a summary of VRF system operation, see the boxout, 'VRF: a quick refresher'.)

This CPD on VRF systems in hotel retrofits is supported by Daikin, which pioneered VRF technology and brought it to market as VRV.

The principal benefits of VRF in hotels include the ability to regulate temperatures in each room individually via local controls, which is valuable given that guests have varying comfort preferences. Systems can be integrated with key-card controls, window contacts and occupancy sensors, so that heating and cooling are reduced or switched off automatically when a room is unoccupied or a window is open.

For a large hotel, multiple VRF systems may be installed, each serving a section of rooms or a zone. In a 150-room example, there may be around a dozen separate VRF systems, each supporting a block of 12 or so rooms.

VRF systems are generally efficient because their variable-speed compressors adjust refrigerant flow to meet demand, improving part-load performance. This is particularly relevant in hotels, which often experience fluctuating occupancy rates and differing load profiles across the building.

Heat recovery VRF systems can move heat extracted from areas requiring cooling to areas that need heating, or use it to preheat domestic hot water (DHW), improving energy use. Additional refinements available from various manufacturers include the ability to vary refrigerant operating conditions, such as

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temperature and flow, to align more closely with the actual thermal loads in each zone and thereby optimise energy use.

Newer generations of VRF systems are increasingly being supplied with integrated safety and monitoring features. These include built-in refrigerant leak detection to comply with A2L refrigerant safety requirements, and connectivity that allows systems to be linked to cloud platforms for remote diagnostics and predictive maintenance. Such functionality enables facilities managers to identify issues before they result in downtime, optimise performance through continuous monitoring, and ensure that leak management and compliance obligations are more easily met.

While VRF systems offer notable advantages in efficiency, control and installation flexibility, they also present some limitations. Their performance in heating mode can be temporarily reduced during defrost cycles, which should be considered in sizing and control strategies. System complexity and the reliance on refrigerant distribution throughout the building can make diagnosis and repair more specialised than with simpler heating or cooling systems, potentially affecting maintenance costs and response times. Because refrigerant pipework extends into occupied spaces, compliance with safety standards – particularly for mildly flammable refrigerants – is essential. In some cases, especially with older buildings, achieving the necessary pipework routing or meeting refrigerant charge limits can add to project complexity.

Environmental considerations have also influenced VRF system development. Historically, most VRF systems have used R410A refrigerant, a blend of R32 and R125, with a 100-year GWP of 2,088, according to the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4),[5] which is classified as A1 (lower toxicity and non-flammable) under BS ISO 817/ ASHRAE 34. Many new systems now use pure R32, which has a significantly lower GWP. (See *CIBSE Journal,* June 2022, CPD module 198 for more discussion on this.)

In regulatory terms, R-32's GWP is defined as 675 under the IPCC AR4 methodology. This value is used for F-gas compliance and refrigerant quota calculations in both the UK and EU, and is slightly below the maximum GWP permitted for refrigerants under the UK Net Zero Carbon Buildings Standard (UKNZCBS). Although the IPCC has published updated GWP values in later assessment reports (AR5 and AR6), UK and EU regulations still reference AR4 figures to ensure consistency in legislation, quota management and international trade reporting. In AR6, the GWP is stated as 771.

When replacing existing systems, an alternative to VRF in some retrofit scenarios is a polyvalent heat pump (sometimes referred to as a 4-pipe heat pump chiller) that can provide both heating and cooling, typically using water as the distribution medium.

However, converting from VRF to such a system normally requires replacing all fan coil units (FCUs) and associated pipework, which can be disruptive to operations. While polyvalent systems can reduce the total refrigerant charge in occupied spaces, the financial and embodied-carbon cost of replacing VRF room units and pipework may limit their suitability in some projects.

The decision to replace a VRF system is often influenced by age and condition. With regular maintenance, VRF systems can operate for 15 years or more, but efficiency can decline over time, parts can become difficult to source, and failures can cause rooms to be taken out of service. Replacing older systems with high-efficiency models can therefore yield operational benefits in addition to energy savings.

A recent UK city hotel retrofit, documented in an Arup case study,[6] replaced the existing heating and cooling plant with heat recovery VRF systems as part of a wider net zero carbon strategy. The system enables heat extracted from areas requiring cooling to be reused in spaces needing heating, improving efficiency and reducing fossil fuel use. The project considered pipework routing within the existing structure, refrigerant charge compliance, and integration with the

From Lot 21 to ESPR: what the shift could mean for VRF systems

The EU's Ecodesign for Sustainable Products Regulation (ESPR), adopted in 2024, builds on existing Ecodesign rules such as Lot 21, which sets minimum seasonal efficiency standards for comfort cooling and heating products. While Lot 21 focuses mainly on operational performance (SEER and SCOP), ESPR will expand requirements to cover whole life environmental impacts.

Environmental Product Declarations (EPDs) are standardised third-party-verified documents quantifying the environmental impacts of a product. CIBSE TM65 is a method for estimating the embodied carbon of building services equipment when full EPD data is not available.

For VRF systems, ESPR could mean mandatory 'product passports' detailing refrigerant type and charge, leakage rates, repairability, recyclability and expected lifespan. Procurement decisions may increasingly weigh circular economy metrics alongside efficiency data, with possible extended producer responsibility for end-of-life recovery.

Although ESPR is not yet in force in the UK, aligning early could help future-proof designs and avoid non-compliance in export markets. For engineers, it offers an opportunity to integrate operational and embodied performance into HVAC system selection.

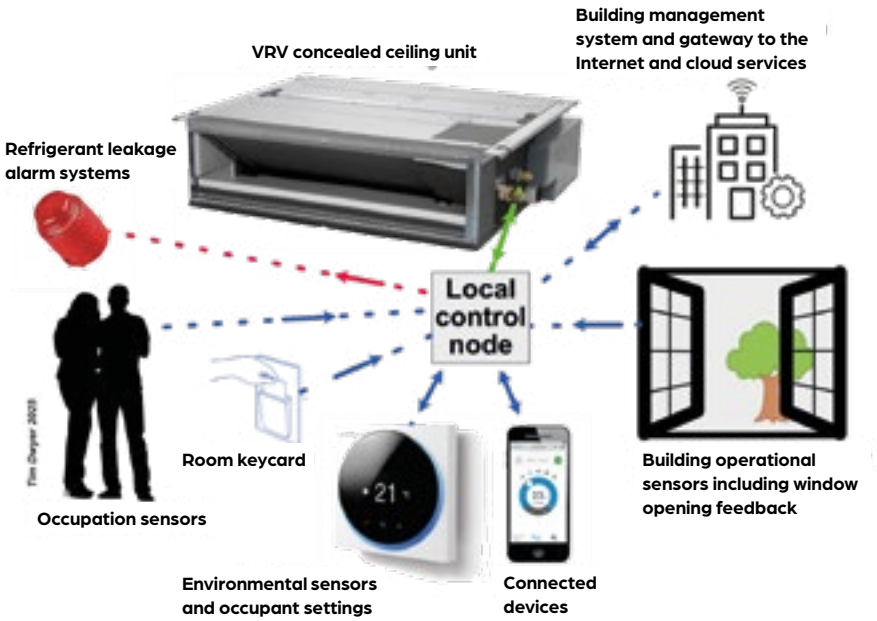

Figure 1: An example of a VRF room unit with integrated refrigerant leak sensor. Detection of a leak automatically isolates the connected refrigerant circuit and activates a local alarm. The environmental monitoring and control of the unit can be linked to a suitable selection of inputs and outputs – both local and cloud-based

Figure 2: A Daikin Round Flow FXFA-A ceiling-mounted air conditioning unit, optimised for R-32 refrigerant

building management system (BMS), achieving better operational energy performance and enhanced comfort without the disruption of a full plantroom rebuild.

R32 systems can offer improved volumetric efficiency over R410A models, typically reducing refrigerant charge by around 10% and increasing seasonal efficiency by more than 10% in some cases, though actual performance depends on system design and application. R32 is classified as mildly flammable (A2L), which means safety provisions such as leak detection, ventilation and system charge limits must be considered in design. (See *CIBSE Journal*, October 2024, CPD module 237 for more discussion on this.)

The use of refrigerants in VRF systems is subject to the UK's retained F-gas Regulation, which implements a phasedown in hydrofluorocarbon (HFC) supply. While there is no immediate ban on R410A in existing systems, from 2029 new split systems with a cooling capacity greater than 12kW must contain a refrigerant with a GWP less than 750. In response, most manufacturers are now offering R32 as their main VRF refrigerant.

The so-called 'product family standard' BS EN IEC 60335-2-40:2024[7] includes requirements for leak detection, ventilation and system design by dividing spaces into leak hazard areas to assess the risk if a refrigerant escapes. Area 1 is the high-risk zone immediately around parts of the system – such as an indoor fan coil – where a leak could cause refrigerant levels to exceed the lower flammability limit (LFL).

In these locations, the standard may require additional measures, such as leak detectors, automatic shut-off valves or enhanced ventilation. Units, such as the example in Figure 1, have specific features to meet these requirements. Area 2 covers the remainder of the occupied space, where refrigerant is likely to disperse and remain below the LFL, so fewer safety measures are normally needed. This zoning approach helps designers target protective measures where they are most critical, while avoiding unnecessary interventions elsewhere.

VRF installations must also comply with BS EN 378 – the horizontal refrigerant safety standard – that covers toxicity and flammability risks across all refrigerant classes and system types. By contrast, BS EN IEC 60335-2-40:2024 – as a vertical product-family standard – specifically addresses the safe use of flammable A2L refrigerants, such as R32, in larger systems, introducing detailed provisions on leak hazard areas, ventilation and ignition control.

If a replacement VRF system uses a different refrigerant classification from the original – for example, switching from a non-flammable refrigerant to R32 – it will be necessary to replace both indoor and outdoor units and the existing pipework. (See *CIBSE Journal,* June 2022, CPD module 198.)

Replacement systems must also meet Ecodesign requirements. Lot 21[8] of the EU Ecodesign Directive, retained in UK law, sets minimum seasonal performance standards for heating and cooling products. These include seasonal energy efficiency ratio (SEER) for cooling and seasonal coefficient of performance (SCOP) for heating, as measured under EN 14825 part-load and full-load conditions. In the EU, the development of the Ecodesign for Sustainable Products Regulation (ESPR[9]) will probably extend the areas that need to be considered beyond those of Lot 21, as outlined in the boxout 'From Lot 21 to ESPR'.

In hotel retrofits, DHW production is a major part of energy demand and integrating it efficiently with the VRF plant can improve the overall performance. Options include manufacturer-specific hydro-modules that recover waste heat from the VRF circuit, dedicated air-to-water heat pumps installed in parallel with the VRF system, or electric immersion and boiler systems as backup or supplementary heat sources. In all cases, hot-water storage helps manage peak loads.

Effective controls are critical in maximising efficiency and comfort in a VRF retrofit. In-room controllers should be simple to operate and use symbols to overcome language barriers. Integration with occupancy sensors, key-card systems and window contacts can enable automated energy-saving adjustments. Wireless connections between these devices and the controllers can reduce installation complexity. Centralised control systems allow FM staff to manage VRF units from a single platform, often with web-based access. They enable building-wide settings such as temperature setbacks, setpoint limits and mode restrictions to be applied remotely.

Integration with the BMS via Modbus, KNX, HTTP, or BACnet/IP allows the VRF plant to operate as part of the wider building services strategy. Cloud-based platforms can also support multi-site monitoring, energy logging and predictive fault detection.

Hotels generally have higher energy use intensity than many other commercial building types, and guest expectations around comfort remain high. Without ongoing investment in efficiency and decarbonisation, hotels risk operational cost increases, reduced competitiveness and reputational impacts.

Including HVAC upgrades – such as replacing older VRF systems with more efficient, lower-GWP alternatives – as part of planned refurbishment cycles can help to manage these risks and contribute to long-term sustainability goals. ●

VRF: a quick refresher

Variable refrigerant flow (VRF) technology is a modular HVAC solution that uses refrigerant as the primary heating and cooling medium. A single outdoor condensing unit serves multiple indoor units via a network of refrigerant piping, with each indoor unit delivering heating or cooling by evaporating or condensing the refrigerant.

In 2-pipe VRF systems, all indoor units operate in the same mode – either heating or cooling – at any given time. Three-pipe VRF systems add a third line for hot gas, alongside liquid and vapour lines, and use a refrigerant distribution unit to direct refrigerant where it is needed. This arrangement enables simultaneous heating and cooling in different zones, making it well suited to buildings with varied load profiles.

Module 253

October 2025

1. What are the approximate average carbon emissions per occupied hotel room per night in London, as given in the article?

- ☐ A 9.8kgCO_2e
- ☐ B 10.4kgCO_2e
- ☐ C 11.0kgCO_2e
- ☐ D 11.5kgCO_2e
- ☐ E 12.6kgCO_2e

2. Why is R32 generally considered a lower-impact refrigerant than R410A in VRF applications?

- ☐ A Because it has a lower GWP under IPCC AR4 (regulatory) methodology
- ☐ B Because it is a natural refrigerant
- ☐ C Because it is non-flammable (A1)
- ☐ D Because it has zero GWP
- ☐ E Because it operates at substantially lower pressures

3. The main technical advantage of a 3-pipe VRF system over a 2-pipe arrangement is:

- ☐ A Ability to provide simultaneous heating and cooling in different zones
- ☐ B Complete elimination of defrost cycles
- ☐ C Lower installed cost in all cases
- ☐ D No requirement for refrigerant leak detection
- ☐ E Reduced need for branch selector components

4. Lot 21 of the Ecodesign framework primarily addresses:

- ☐ A Building energy performance certification (EPC) procedures
- ☐ B Leak hazard area definitions for A2L refrigerants
- ☐ C Maximum refrigerant GWP thresholds for HVAC products
- ☐ D Minimum seasonal efficiency (SEER/SCOP) based on EN 14825 testing
- ☐ E Whole life embodied carbon disclosure and recycled content quotas

5. Which DHW option can integrate directly with a VRF system to recover waste heat for hot-water preheating?

- ☐ A Electric immersion heaters
- ☐ B Gas-fired condensing boilers
- ☐ C Solar thermal collectors
- ☐ D Standalone air-to-water heat pumps operating in parallel
- ☐ E VRF hydro-modules (manufacturer-integrated)

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Removing the blind spots

Hybridised construction products, such as polyethylene pre-insulated MLCP pipes, are slipping through the regulatory gaps. **Chris Ridge**, from the Thermal Insulation Contractors Association, believes informed specification and rigorous scrutiny may be the only safeguard against performance shortfalls and hidden compliance risks

The construction industry is entering a period of heightened scrutiny. With publication earlier this year of the Construction Products Reform Green Paper, and a new construction products code of practice (*PAS 2000:2026 Construction Products – Bringing Safe Products to Market*) under development, questions are being asked about how products are designed, tested and specified.

The Green Paper states, 'the anecdotal evidence suggests that two-thirds of construction products are unregulated'.

Thermal insulation for pipework, for example, is subject to harmonised testing standards and can usually be specified against clear parameters. When thermal insulation products are hybridised with other products, however, a new product is created, for which no harmonised standard yet exists.

The Office for Product Safety and Standards has confirmed that drawing up a Declaration of Performance (DoP) for polyethylene pre-insulated multilayer composite pipes (MLCP) products is not possible using the existing standards, and they must not be accompanied by a DoP and should not have a CE mark affixed.

A polyethylene pre-insulated MLCP pipework installation

In the case of polyethylene pre-insulated MLCP products, lack of an established means of verification has resulted in major variation in manufacturer product information – a significant challenge for clients wishing to confirm compliance with specifications and standards.

The role of trade associations

Trade associations have been tasked with taking a lead on installer competence, and the Thermal Insulation Contractors Association (TICA) was among the first to complete a competence framework for the industry.

There is also a perception at policy level that trade associations will push construction product reform – but when it comes to hybridised products, it's not that simple. A pre-insulated pipe is both a pipe and a thermal insulation product. If a product crosses trade boundaries, no single association can police it fully, leaving potential blind spots.

Competence

With two key exceptions – domestic plumbing and commercial refrigeration applications – all pipe insulation should be installed by a thermal insulation specialist.

Domestic plumbing and refrigeration, such as direct expansion, typically incorporate flexible foams that are relatively straightforward to install. Other HVAC applications usually require low-emissivity rigid insulation products that need specialist skills to install. Swapping out these products for

What can you do to help close the gaps?

- **Be precise about the insulation material you wish to specify, confirming both reactions to fire performance and thermal performance.**
- **Consider dwelling vs non-dwelling applications, as standards differ.**
- **Specify that a suitably competent thermal insulation specialist carry out the work (excluding commercial refrigeration and domestic plumbing).**
- **Specify a particular table in BS 5422, rather than 'insulate as per BS 5422'.**
- **Ask the manufacturer of the pre-insulated pipework product for a copy of the fire test report and seek further advice regarding suitability.**
- **Ask for manufacturer specific heat-loss calculations based on the specific parameters of the project and product.**

TICA is training the thermal insulators of the future

an easily installed polyethylene product is likely to compromise both the thermal performance specification and the minimum reaction to fire specification.

Pre-insulated pipework is often marketed as 'requiring no follow-on trades' and is typically installed by non-specialists without adequate knowledge. Heating and plumbing contractors proposing these as a 'value engineering solution' risk putting themselves in the position of 'unintended designer'.

Further, pre-insulated pipework products are typically marketed by manufacturers and distributors in the pipe and fitting market – rather than to specialists in the thermal insulation market – and the insulation element often appears to be a secondary consideration. By marketing these products, pipework manufacturers are unwittingly placing themselves in the position of 'accidental manufacturer' of an insulation product.

Reaction to fire

Polyethylene is combustible. It can be used safely in certain applications, but only if tested and certified appropriately. This is possible for standard polyethylene 'pipe lagging' because it is covered by the harmonised thermal insulation testing standards. However, polyethylene pre-insulated MLCP products are not.

The declared Euroclass reaction to fire for these products can vary anywhere between 'B' and 'E', suggesting there is a range of approaches to product testing. If a manufacturer is declaring a Euroclass B reaction to fire without an applicable testing standard as reference, its important to understand what that Euroclass B actually means and how the product is being tested.

Polyethylene pre-insulated MLCP products are treated with an additional polyethylene protective sheathing. It is often unclear whether the declared reaction to fire for the product is based on a test including the sheathing, or if it has been based on the existing polyethylene foam performance prior to alteration during the secondary manufacturing process.

When standard pipe insulation is tested to the harmonised standards, a minimum thickness of 25mm is required in a pipe insulation-specific 'single burning item' test rig. There appears to be no polyethylene pre-insulated MLCP systems on the market with an insulation thickness as high as 25mm and it is unclear how these products are being tested.

This is important, because many of these products are being marketed as having an equal reaction-to-fire value as traditional thermal insulation products, without evidence that they have been tested to the same standards.

Pre-insulated pipework products are manufactured with limited insulation thickness options.

There is a wide range of thermal insulation specifications, and a one-size-fits-all approach does not always allow for a diverse range of specification requirements to be met.

The thickness of insulation required to comply with maximum heat loss/heat gain depends on the thermal conductivity of the insulation.

Therefore, pipe insulation products with higher thermal conductivity (for example, polyethylene with a lambda value of around 0.038W·m^{-1}·K^{-1} at 10°C mean) must be installed at greater thicknesses than pipe insulation products with a lower thermal conductivity (phenolic foam with a lambda value of around 0.025W·m^{-1}·K^{-1} at 10°C mean, for example). In many cases, this makes polyethylene pre-insulated MLCP pipework unsuitable for anything other than small-bore domestic pipework.

Conclusion

Hybridisation can drive innovation, but if innovation outpaces testing standards, the resulting grey area is a very real liability for everyone involved in the supply chain.

Products spanning multiple trades are particularly at risk of falling into regulatory blind spots. Industry must collaborate to find these blind spots, and the chain between 'accidental manufacturer' and 'unintended designer' must be broken.

We need to ensure we stop non-compliant products making their way into our projects. Construction product-related regulations will help close the gaps, but this will take time. In the meantime, well-informed specifiers and consultants may be our best defence. ●

● **Chris Ridge is technical director at the Thermal Insulation Contractors Association**

Thermal insulation products have unique characteristics, with differing thermal conductivities (W·m^{-1}·K^{-1}) and emissivity (ε). *Typical values at 10°C mean

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Grundfos claims TPE3 inline pumps are most efficient yet

Pumps connect with the Grundfos GO app, providing real-time data insights

Grundfos claims its new generation of TPE3 inline pumps delivers the company's highest energy efficiency offering yet, across motor outputs from 0.25 to 22kW.

The updated series features MGE motors with IE5 efficiency, optimised hydraulics, and intelligent functions that reduce energy use, CO_2 emissions and life-cycle costs.

The new range aims to simplify selection, installation and commissioning, with fewer models, a standardised setup wizard and enhanced connectivity. Integrated frequency converters, differential pressure, and temperature sensors, previously limited to 2.2kW, are now available up to 22kW, enabling uniform TPE3 models to cover higher motor outputs without switching configurations.

The pumps connect with the Grundfos GO app, providing real-time commissioning, access to intelligent functions such as AutoAdapt and FlowAdapt, and interface activation via Bluetooth. Future updates will support BACnet, while existing ethernet and CIM interfaces ensure compatibility with diverse applications and cloud solutions.

The redesigned hydraulics reduce the number of types needed, covering DN32 to DN200 with just 12 models, with an Environmental Product Declaration and IE5 efficiency across the range.

Manchester City aims for smart water-saving win

Manchester City's Football Academy has adopted digital water platform Xylem Vue to see where and when water is being used across its 16.5-pitch campus.

Using sensors and smart meters, the system helps the club optimise irrigation and reduce reliance on public water sources, says Xylem.

Natural grass pitches use up to 23,000 litres of water per day in the summer, and the club's reuse strategy has saved more than 50 million litres of water. It says it's on the way to cutting use in half by the end of this year.

'Our goal is to capture and reuse 100% of stormwater run-off on site by mid-2026, and we're well on our way,' said Pete Bradshaw, director of sustainability at Manchester City.

The club also works with Xylem to raise awareness of water challenges among fans, encouraging them to adopt smart, water-saving behaviours at home through its 'Play Smart' campaign.

Xylem has a number of solutions installed at the club, including the Wedeco LBX90e UV disinfection system. The club has also implemented an energy-efficient borehole pumping solution from Xylem, to draw non-potable water from an underground source.

Albion expands embodied carbon assessment to more product ranges

Embodied carbon life-cycle assessment data is now available for Albion's brass, DZR brass and bronze products, widening the scope beyond the cast and ductile iron ranges covered in data released in December.

Using CIBSE's TM65 methodology, Albion calculated the carbon impact of manufacturing, transport and use, presenting figures in $kgCO_2e$ to allow easy comparison across products.

Albion said the data gives contractors a clearer view of embodied emissions and helps estimate whole-project carbon over a building's lifetime.

The company says that stainless steel valves and fittings are next in line, with more ranges to follow.

For more information visit: bit.ly/CJAlVal25

Armstrong 4380 pumps now available with express delivery

Fourteen best-selling models from Armstrong Fluid Technology's 4380 Vertical In-Line Pumps range can now be shipped in just two weeks at no extra cost.

Covering power outputs from 0.37kW to 7.5kW, the pumps can be quickly configured on site with Armstrong's adaptable control methodology and self-commissioning features.

The faster turnaround is aimed at projects under time pressure, particularly urgent, high-demand or retrofit schemes.

All 4380 pumps are BEP tested as standard and feature Armstrong's Design Envelope platform, which seeks to combine energy efficiency, smart pump connectivity and the space-saving benefits of vertical inline design.

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CPD programme
Data centres

Liquid cooling in data centre applications

This module explores how, as power demands in data centres continue to accelerate, liquid cooling applications are increasingly being used to offer more effective cooling solutions

Whether you are streaming a film, using cloud storage or even reading this CPD online, your data is being stored, processed and delivered by a data centre. There are estimated to be around 12,000 data centres currently located around the globe, worth an estimated £180bn, but that value is projected to more than double to £433bn by 2032.[1] Driving this surge is the rise of artificial intelligence (AI), which demands far more computing power than traditional applications.

As the global appetite for AI continues to grow, a new era of power-intensive data centres is transforming the industry. Increasing performance demands across central processing units (CPUs), graphics processing units (GPUs), and field-programmable gate arrays (FPGAs) has resulted in substantial increases in device power consumption – commonly referred to as socket power.

While a modern CPU might draw more than 300W, a high-end GPU used in AI and HPC can draw more than 700W, with future models expected to exceed 1,000W within the next year,[2] all leading to higher thermal power densities in server racks and a corresponding increase in cooling requirements.

Cooling is estimated to account for somewhere between 20% and 50% of a data centre's total energy use.[3] As the global appetite for digital technologies continues to grow, data centres are under increasing pressure to deliver more computing power with less environmental impact. One advancement supporting this evolution is liquid cooling – a technology that, while not new, has emerged as a solution that offers several efficiency advantages over air cooling.

Limitations of air cooling for racks

The effectiveness of a cooling solution is quantified by thermal resistance, defined as the temperature difference between the processor case and the cooling medium, divided by device power (°C/W). Lower thermal resistance values correspond to more efficient heat removal.[4]

According to ASHRAE, analysis of manufacturer data shows that maximum socket power has steadily risen, while the thermal resistance necessary to maintain safe device temperatures has declined, so the demand for more effective cooling is increasing. This inverse relationship highlights the escalating demand for advanced cooling strategies either through reduced inlet fluid temperatures or adoption of new technologies.

Air cooling has long served as the standard for data centre thermal management. However, it is increasingly constrained by physical, economic and operational limits. Conventional air systems can support rack densities up to approximately 25–30kW,[5] but emerging workloads frequently exceed 100kW per rack.

Fundamentally, air is less effective than liquids at transferring heat. Liquids have significantly higher specific heat capacities and densities than air, which makes them far superior at heat transfer. For example, water's volumetric heat capacity is more than 3,400 times greater than that of air. This inherent inefficiency means that air cooling is struggling to keep pace with the increasing heat generated by modern IT equipment

Where air is used, more space is needed for air circulation and increased numbers of air cooling systems, such as computer room air conditioning (CRAC) and computer room air handlers (CRAH).

To compensate for higher heat loads, servers relying on air cooling need more airflow, causing fan power to rise, potentially reaching 10% to 20% of server power for denser servers, accompanied by a significant increase in noise.[4] Additional constraints from using air for cooling include increased water consumption in evaporative cooling systems, decreased uninterruptible power supply (UPS) capacity as a result of the increased fan power, and limited potential for heat recovery and reuse.

Collectively, these challenges demonstrate that air cooling may no longer be the best option for high-density, high-power IT equipment, accelerating the transition toward liquid-based thermal management solutions in data centres.

The rise of liquid cooling for racks

Liquid cooling, previously reserved for niche applications such as mainframes and supercomputers, is now emerging as an efficient solution for modern data centres. There are three primary scalable approaches to liquid cooling: direct-to-chip, immersion, and rear-door heat exchangers.

Direct-to-chip cooling

Also known as cold-plate or direct-liquid cooling, this method attaches cold plates directly to high-heat components such as CPUs. A coolant – typically water, a refrigerant, or a water/propylene glycol mix – flows through micro-tubes in the plates, absorbing heat at source. The warmed liquid is then circulated to a coolant distribution unit (CDU), where it is cooled and recirculated via a closed loop. Single-phase and two-phase direct-to-chip cooling solutions are available, with two-phase solutions using a refrigerant that is boiled by the heat-generating component, turning it into vapour, leveraging the latent heat of evaporation and offering higher efficiency but increased complexity.

Direct-to-chip cooling allows for highly efficient and targeted heat transfer from specific high-power components. It uses smaller volumes of coolant

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compared with immersion cooling and offers easier accessibility to components for maintenance. However, it may still require some traditional air cooling for non-liquid-cooled components such as power supplies and hard drives.

- **Immersion cooling**

In this approach, entire servers – including processors, GPUs, and other components – are submerged directly into a non-conductive dielectric fluid, eliminating reliance on air for heat transfer. The fluid directly surrounds and contacts the components, allowing for rapid and efficient heat transfer from the hardware to the liquid coolant. The components and fluid are typically encased in a sealed container to prevent leakage.

In single-phase immersion, the coolant is maintained in liquid form, pumping it through external heat exchangers before returning it to the tank. Two-phase immersion employs low-boiling-point coolants that boil and vaporise upon contact with hot components. The vapour condenses on coils within the chamber, releasing heat to secondary cooling systems before cycling back.

Immersion cooling provides highly uniform and efficient thermal performance, reduces fan and heating, ventilation and air conditioning (HVAC) requirements, and isolates equipment from environmental contaminants. Two-phase designs can achieve two to three times the efficiency of single-phase approaches but raise costs, maintenance demands, and require environmental consideration where fluorinated refrigerants are used.

- **Rear-door heat exchangers**

A more incremental approach to liquid cooling involves replacing a server rack's rear door with a liquid-cooled heat exchanger. Warm exhaust air from server fans passes through the exchanger, where circulating coolant absorbs and transfers the heat away. While less direct than chip or immersion cooling, this method integrates readily into existing air-cooled environments, offering a pathway for gradual upgrades of existing data centres.

Hybrid approach

While liquid cooling represents a transformative leap in thermal management, it is not a wholesale replacement for air-based systems... yet. Instead, a hybrid approach is becoming common. Many data centre operators are deploying a mix of cooling strategies based on workload demands, with liquid cooling handling high-density or GPU-intensive racks and air cooling supporting more conventional equipment. This approach balances performance, efficiency, and cost.

These integrated systems can be dynamically controlled via smart building management systems (BMSs) and software platforms, enabling real-time adjustment of CDU flowrates (see below), chiller output, and airflow. This level of orchestration can be efficient and help operators to reduce their power usage effectiveness (PUE) to around 1.2, with some aiming for even more ambitious figures.[6]

Coolant distribution units

There are two main fluid loops in a data centre liquid-cooling system: the technology cooling system (TCS), sometimes called the secondary flow network, and the facility water supply (FWS), or primary coolant loop.

The FWS is connected to the condensed water system, where heat is rejected to the environment through cooling towers or dry coolers, for example.

Figure 1: A coolant distribution unit (CDU) from manufacturer Carrier

The TCS is the secondary loop that circulates coolant to the IT equipment. A 75% water, 25% propylene glycol (PG25) mixture is commonly used (or sometimes ethylene glycol) for the SFN coolant. Heat from the TCS is transferred to the FWS via a coolant distribution unit (CDU).

CDUs are critical components that manage the flow of liquid coolant; they provide cool fluid to server manifolds, receive warmed fluid, and cool this fluid using internal heat exchangers, which usually reject heat to the FWS.

Rack-mounted CDUs are typically used to provide a TCS loop for a single rack. Free-standing CDUs generally provide the TCS loop for clusters of racks, and are usually located near the racks or immersion tanks.

The performance of heat exchangers or coils determines the CDU's ability to dissipate heat from the TCS. An important metric is approach temperature, which is the temperature difference between the TCS and the supply fluid provided by the FWS. The lower the approach temperature at a given heat load, the better the cooling efficiency of a CDU.

CDUs must also ensure coolant temperature remains above the dew point to prevent condensation, and serve to hydraulically decouple the FWS from the TCS, which is essential where water quality requirements are different for each loop – see boxout, 'ASHRAE environmental classes for data centre cooling'.

Benefits of liquid cooling for data centre design

Liquid cooling eliminates the need for large air cooling units and fans, resulting in a smaller physical footprint. This, coupled with the ability of liquid cooling to support higher densities, allows for a reduced data centre footprint for the same IT equipment load, improving space utilisation and potentially lowering building costs. The absence of cooling fans and reduced airflow can also significantly reduce noise levels both inside and outside the facility.

ASHRAE environmental classes for data centre cooling

ASHRAE Technical Committee (TC) 9.9 defines three complementary classification systems that guide the design and operation of liquid- and air-cooled data centres: water quality classes, water temperature classes, and surface temperature classes. Together, these classes provide a unified envelope for safe, efficient and reliable data centre cooling.

Water quality classes (W1–W4) specify the chemical purity required for liquid cooling loops. W1 demands ultra-pure water for direct-to-chip applications, while W2 allows controlled impurities. W3 and W4 correspond to facility water loops with less stringent treatment, typically separated from IT by heat exchangers.

Water temperature classes (W17, W27, W32, W40, W45, W+) define supply temperatures for facility water. The numbers in the class names (for example, '17' in W17) actually refer to the maximum allowable supply fluid temperature in degrees Celsius. For example, the W27 class specifies that the fluid supplied to the IT equipment must be at or below 27°C. The warmer the temperature the less mechanical cooling required, and the greater the potential for free-cooling and opportunities for waste-heat reuse in district heating, for example.

Surface temperature classes (S1–S3) address condensation risk. They define the permissible relationship between surface temperature and local dew point to prevent moisture accumulation on IT equipment. S1 enforces strict margins, while S3 allows operation in more humid conditions with tolerant equipment.

Liquid cooling also minimises the facility's reliance on energy-intensive air conditioning. Designing for higher facility water temperatures enabled by liquid cooling means less reliance on energy-intensive chillers for mechanical cooling, allowing for more efficient heat rejection using dry coolers or cooling towers.

Rather than rejecting the heat to atmosphere, another option is to recover it. The warm liquid exiting chipsets at, for example, 30°C can be further heated (possibly with a heat pump) and used for district heating networks, industrial applications, or absorption chillers. Research indicates that more than 97% of data centre waste heat is theoretically utilisable. Designs that incorporate this can significantly reduce overall energy waste and improve PUE (see boxout).[7]

Liquid cooling also uses less water than many air cooling systems and contributes to lower carbon emissions – aligning with sustainability initiatives and stringent environmental regulations, particularly in Europe. The EU currently has mandatory EU-wide reporting for data centres with an IT load greater than 500kW, which includes water use effectiveness (WUE) to measure how efficiently a facility uses water in delivering IT services. Minimum performance standards are expected by the end of 2026, as part of a broader water-resilience package.[8]

The UK currently has no specific restriction on data centre water use, but operators are regulated through general regimes that effectively limit water use in water-stressed areas. Broader UK water-resource reforms and drought-resilience measures will probably raise the bar, increasing the need for water-free or closed-loop cooling.

For the electrical installation, rack density increases facilitated by liquid cooling will enable new designs to benefit from higher voltage distribution, such as 480V to server cabinets. This will reduce conductor sizes and numbers of power distribution units, potentially leading to a reduction in electrical installation costs.

Retrofitting

Liquid cooling can be retrofitted into an existing data centre. To do so, however, designers must address a unique set of challenges and considerations that go beyond those for a new build, because many older data centres were designed to keep water away from IT racks to avoid damage from potential leaks. This may require changes to service level agreements (SLAs) where these might explicitly exclude water from the proximity of racks in environments such as colocation facilities.

Adaptations revolve around the need to integrate new liquid-cooling infrastructure with existing power, space, and cooling systems, while also managing costs, operational changes, and maintaining reliability and sustainability.

A hybrid approach, perhaps using rear-door heat exchangers and/or direct-to-chip, is often regarded as a practical strategy for existing facilities. This enables liquid cooling to be used for high-density, GPU-intensive racks, while existing air cooling is used for more conventional equipment to help balance upfront costs with efficiency gains.

While a major benefit of liquid cooling is a reduction in the need for bulky air handling units (AHUs), retrofits will require space for coolant distribution units, manifolds, and piping close to the servers. Coolant quality, too, may need to be upgraded for the TCS circuits, the quality of which may differ from that of the existing FWS.

Finally, new skill sets will be required for those operating and maintaining the upgraded facility, because liquid cooling will demand a new mindset and new ways of working.

Cost considerations

Liquid-cooling systems often have a higher upfront cost because of specialised infrastructure such as CDUs, cold plates and immersion tanks. However, studies suggest that for high-density racks, the initial capital investment (capex) can be comparable with advanced air-cooling solutions.

However, liquid cooling can significantly reduce operational costs (opex) by lowering energy consumption compared with air cooling. It also reduces fan power consumption, and can lead to longer hardware lifespan as the result of lower thermal stress.

There are also longer-term savings: the increased rack density enabled by liquid cooling allows for better space utilisation, potentially reducing the required building footprint and associated costs. Waste heat can be more easily reused, which can further enhance long-term savings.

Current and future take-up

Direct-to-chip cooling has gained traction faster and is more prominent currently than immersion cooling. This is because direct-to-chip systems can be retrofitted into existing air-cooled data centres with relatively modest infrastructure changes. They can operate alongside traditional CRAC/CRAH units and do not require wholesale redesign of facilities.

Direct-to-chip can provide some operational familiarity. Only targeted components (CPUs, GPUs, and so on) are liquid-cooled, while the rest of the system remains accessible to technicians. In addition, major hardware vendors, such as Dell, HPE, Lenovo and so on, now offer servers with built-in cold-plate solutions.

This standardisation makes procurement and servicing straightforward, whereas immersion cooling often requires custom-designed hardware and tanks.

Direct-to-chip is also considered less risky because coolant is confined to controlled loops within cold plates and CDUs, reducing concerns about leaks. Immersion, by contrast, involves higher capital costs, fluid management complexities, and uncertain long-term vendor ecosystems.

Rear-door heat exchangers do not cool components as directly or efficiently as direct-to-chip or immersion, but they are ideal for legacy facilities seeking incremental improvements. In many deployments, rear-door heat exchangers are combined with direct-to-chip to achieve balanced efficiency.

A recent survey indicates that 22% of data centres currently utilise direct liquid cooling, with an additional 61% considering its adoption.[9]

Over the next five to 10 years, direct-to-chip cooling is expected to remain the dominant technology for new deployments because of its maturity, manufacturer support, and balance of efficiency and serviceability. While rear-door heat exchangers will continue to play a complementary role in retrofits, to extend the life of legacy air-cooled data centres, and hybrid environments.

Longer term, with rack power densities expected to push beyond 100kW, immersion cooling will become increasingly attractive, particularly two-phase immersion with its unmatched efficiency – although challenges around cost, standardisation, maintainability, operator familiarity and coolant sustainability will need to be addressed. ●

What are PUE and WUE?

Power usage effectiveness (PUE) is a widely used metric for measuring the energy efficiency of a data centre. It is calculated as the ratio of the total facility energy use to the energy used directly by the IT equipment. The theoretical ideal is 1.0, where all energy goes directly to computing. Most traditional data centres operate with PUE values around 1.6, while advanced liquid-cooled facilities are now hitting values in the 1.05 to 1.15 range.

Water usage effectiveness (WUE) is the metric used to measure how effectively a data centre uses water in its operations. It is the ratio annual water consumption to the total annual energy used by IT equipment. Typical WUE for historic data centres is around 1.5litres/kWh, while modern liquid-cooled data centres can have a WUE of 0.1litres/kWh or less.

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Module 254

October 2025

1. Which of the following is a key reason liquid cooling is becoming increasingly necessary in modern data centres?

- ☐ A The growing use of renewable energy in data centres
- ☐ B Rising socket power consumption of CPUs and GPUs
- ☐ C Limited availability of CRAC and CRAH units
- ☐ D Stricter regulations on noise levels inside facilities
- ☐ E The reduced physical size of IT hardware

2. Conventional air-cooling systems typically support rack power densities up to what range before becoming impractical for emerging workloads?

- ☐ A 10–15kW
- ☐ B 20–25kW
- ☐ C 25–30kW
- ☐ D 50–60kW
- ☐ E 100–120kW

3. Which statement best explains why liquids are more effective than air for data centre cooling?

- ☐ A Liquids have higher electrical conductivity than air
- ☐ B Liquids have lower density than air, enabling faster flowrates
- ☐ C Liquids have higher specific heat capacity and density than air
- ☐ D Liquids allow servers to operate at higher inlet air temperatures
- ☐ E Liquids prevent condensation without additional safeguards

4. According to ASHRAE classifications, the W27 water temperature class specifies:

- ☐ A Maximum allowable supply temperature of 17°C
- ☐ B Maximum allowable supply temperature of 27°C
- ☐ C Supply water must be ultra-pure
- ☐ D Surface temperatures must remain above dew point by 27°C
- ☐ E Maximum relative humidity of 27%

5. Which liquid-cooling method provides the most uniform thermal performance across all server components?

- ☐ A Rear-door heat exchangers
- ☐ B Direct-to-chip cooling
- ☐ C Air-assisted liquid cooling
- ☐ D Immersion cooling
- ☐ E Hybrid liquid-air cooling

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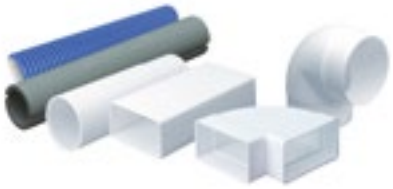

Domus Ventilation joins ADCAS to champion higher industry standards

Domus Ventilation has become a corporate member of the Association of Ductwork Contractors and Allied Services (ADCAS).

ADCAS represents contractors, suppliers and manufacturers in the sector, promoting higher standards in design, specification and installation. Product manager Paul Williams said the move reflects a commitment to improving IAQ and efficiency.

● **Visit www.domusventilation.co.uk or www.adcas.co.uk**

CIBSE-approved CPD course explores heat-recovery ventilation

Vent-Axia has launched a new CIBSE-approved CPD course to help construction professionals deepen their understanding of heat-recovery ventilation in commercial applications.

The course explains how the technology works, its benefits for energy efficiency and IAQ, and key design considerations. It also explores drivers behind adoption, such as regulation.

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Connect Housing has equipped 14 new homes in Halifax with Panasonic Aquarea J-Series air-to-water heat pumps, supplied by Logicool and installed by Air Distribution.

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A Lo-Carbon Revive 7 Switchee-enabled fan has been launched to support social housing landlords ahead of Awaab's Law, which comes into force on 27 October. Combining Vent-Axia's energy-efficient ventilation with Switchee's smart connectivity, it delivers real-time air quality insights, early detection of condensation and mould, tamper-proof operation, and direct landlord–resident communication. It aims to improve compliance, protect housing stock and enhance tenant wellbeing.

● **Visit www.vent-axia.com/social-housing**

Fully electric plantroom powers Canary Wharf decarbonisation

ACV UK has supplied a fully electric hot-water and heating solution for a landmark high-rise in Canary Wharf, replacing its gas-fired system. The retrofit has four E-Tech W electric boilers and four Smart L 600 indirect cylinders, integrated with air source heat pumps to form a high-efficiency hybrid system. The 11th-floor plantroom added logistical challenges, making equipment size, weight and installation essential considerations. The compact, lightweight and flue-free operation of the E-Tech W boilers simplified transport and installation.

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Q&A

Chair of YEN UAE **Bushra Siddiqua** is helping to shape the next generation of engineers – from championing sustainability and digital innovation to mentoring early-career professionals

Bushra Siddiqua, chair of YEN UAE, is an electrical engineer at RED Engineering Design in Dubai, with more than three years' industry experience. She specialises in designing electrical infrastructure for mission-critical facilities across Europe, the Middle East and Africa, with a focus on data centres, helping deliver resilient, efficient and compliant MEP systems.

Q How did you become involved in YEN?

A My involvement began early in my career, when I was seeking opportunities to grow. I was drawn to the network's ability to create meaningful impact across the region by connecting professionals and supporting early-career engineers through purposeful events, outreach and knowledge sharing.

Seeing the value YEN UAE brought to the community motivated me to engage more. I wanted to contribute as someone who could help shape the journey of others.

Q What are the benefits of joining YEN?

A It's a great way to connect with other young engineers, gain exposure to the wider CIBSE network and build relationships with senior stakeholders, which I've found invaluable. Each initiative and event brings fresh opportunities, and the committee is full of people who genuinely care about the profession.

YEN offers the chance to learn, collaborate and help shape the future of our industry.

Q What project have you been most proud of?

A A standout project is a 100MW Tier III data centre in the UAE, designed as the region's first AI-ready facility. Delivering the full, detailed design within a tight timeframe added complexity, and required balancing

pressure with precision. It taught me how to navigate fast turnarounds while keeping technical quality front and centre. It also strengthened my leadership and collaboration skills.

Q Where has YEN UAE had its biggest impact in the past year?

A We have focused on supporting young engineers with targeted, career-building content and conversations. We ran sessions around chartership, to demystify the process, and introduced technical topics such as energy modelling.

A highlight was launching the Sustainability Odyssey, a LinkedIn-based initiative to share short, accessible content on building services through a sustainability lens. It has sparked industry-wide engagement and encouraged critical thinking about sustainable design.

"YEN offers the chance to learn, collaborate and help shape the future of our industry"

Q What are the current priorities for YEN in your region?

A Our key focus areas include digital innovation, mission-critical facilities such as data centres, and practical support around career development, particularly chartership. We are continuing to grow through initiatives such as the Sustainability Odyssey, which opens up accessible, sustainability-focused discussions across the building services sector.

We also engage in STEM outreach at local universities, and I am keen to carry that energy forward. Our aim is to keep young professionals connected to evolving challenges with confidence and insight.

Q What are your personal objectives as chair?

A One of my main goals is to spotlight data centres as a vital part of the industry, an area many young engineers haven't yet explored.

I'm also looking forward to continuing as a mentor, helping others on the committee grow through knowledge sharing and collaboration. Having previously served as vice-chair, I'm now focused on strengthening the quality and depth of engagement across everything we do as a team.

Q Is there anyone who has helped mentor you?

A There are so many individuals who consistently lead by example – each one contributing to a culture where experience is shared, questions are welcomed, and growth is collective. If I had to highlight one person, it would be Farah Kais, my first line manager during my internship. Her leadership style was clear, collaborative and grounded in purpose, which left a lasting impression on me. She showed me what it means to lead with intention and to support others while delivering high-quality work.

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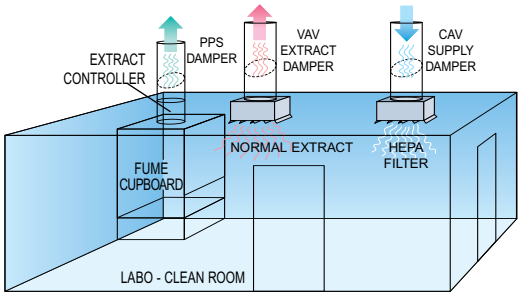

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