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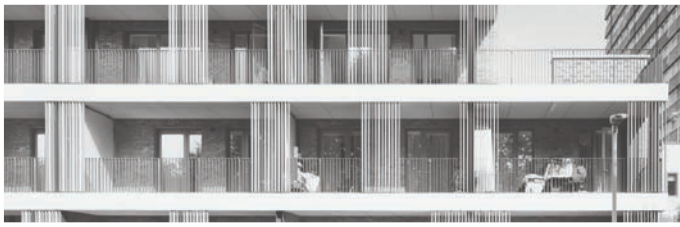

MEASURES OF SUCCESS

Making the most of energy data to benchmark building performance

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CIBSE Journal is written and produced by CPL (Cambridge Publishers Ltd) Tel: +44 (0)1223 378000.
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Editorial copy deadline: First day of the month preceding the publication month

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On the same page

President Joe Biden's pledge to cut America's greenhouse gas emissions in half by 2030 was a significant moment. Having spent four years under President Trump walking away from international climate negotiations, the US has once again put itself at the forefront of the fight against climate change.

At a climate summit organised by the US, other countries – such as the UK, Japan and South Korea – also announced ambitious carbon-reduction targets. Appearing at the conference, too, were Chinese President Xi Jinping, who hinted that China would phase down coal consumption in the five years from 2025, and Russian President Vladimir Putin, who expressed a desire to cut methane and develop carbon-capture technology.

The sight of three superpowers putting their political differences aside to pledge support for carbon-cutting ventures was compelling, and it suggests significant agreements on cutting emissions could be signed at COP26 in Glasgow.

While governments set the targets, it's industry and individuals that have to make reality happen. With heating in buildings responsible for 40% of the UK's carbon emissions, building services engineers have an urgent responsibility to minimise energy loads in building designs, and devise creative ways of cutting emissions in existing buildings. Our profile of CIBSE Award winner Lawler Consulting, on page 20, shows how engineering knowledge, coupled with guaranteed energy savings, can unlock investment in low carbon projects.

Managing director Daniel Ring says engineers can find savings others cannot, putting them in an ideal position to be involved in energy performance contracting. As Lawler benefits financially from energy savings, it is in their interest to fine-tune the building to optimise performance, and to feedback knowledge to improve future designs. Being able to measure building performance accurately, and benchmark against similar buildings, is essential to identify what designs and interventions have the biggest impact on energy savings.

CIBSE is consulting on a new entry form for the CIBSE Building Performance Awards, which aims to standardise building data across submissions. According to CIBSE technical manager Julie Godefroy, it will streamline the entry process and allow judges to compare entries and the validity of performance claims more easily.

The data can also be placed on the CIBSE benchmark database being developed with University College London. This will help build a picture of which projects are contributing the most to the decarbonisation of the building stock. The deadline to respond to the consultation is 6 May. It can be accessed at **bit.ly/CJMay21Data1**

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CONTRIBUTORS

Hywel Davies
Investment in skills will be necessary for industry to achieve net-zero carbon and improve building safety

Julie Godefroy
Why standardising energy-use data will help compare buildings and understand good performance

Carl Collins
CIBSE's new Software Verification Assessment service gives confidence to calculations

Tim Dwyer
CPD Module 179 is on predicting domestic hot-water use in large buildings and apartments

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CIBSE JOURNAL

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The official magazine of the Chartered Institution of Building Services Engineers

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 ISSN 1759-846X

SUBSCRIPTION ENQUIRIES

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

CIBSE Journal, ISSN 1759-846X (USPS 4070) is published monthly by CPL, 1 Cambridge Technopark, Newmarket Road, Cambridge CB5 8PB, UK.

The US annual subscription price is £100. Airfreight and mailing in the USA by agent named WN Shipping USA, 156-15, 146th Avenue, 2nd Floor, Jamaica, NY 11434, USA. Periodicals postage paid at Jamaica NY 11431.

US Postmaster: Send address changes to *CIBSE Journal*, WN Shipping USA, 156-15, 146th Avenue, 2nd Floor, Jamaica, NY 11434, USA. Subscription records are maintained at CIBSE, 222 Balham High Road, London, SW12 9BS, UK.

CREDITS

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ABC audited circulation:
17,944 January to December 2020
Printed by: Warners Midlands PLC

IN BRIEF

FMs optimistic despite clients cutting down on space

Most FM professionals believe the market for their services will improve in the next 12 months, despite concerns over how the pandemic has changed the way commercial buildings spaces will be used in the future, according to the Institute of Workplace and Facilities Management (IWFM).

Its Market Outlook 2021 report revealed that many organisations are radically changing the way they use their premises in the wake of the Covid-19 crisis, but this could to lead to greater demand for FM expertise with specialists playing a key role as 'agents of change'.

Most clients (84%) who responded to the IWFM survey said their organisation had changed its flexible working strategy in the past year and 58% said they were reducing the space they occupied.

Smaller firms key to solving housing crisis

A new report from the Centre for Policy Studies (CPS) has urged the government to take advantage of a proposed new Planning Bill to help small and medium-sized builders solve the country's housing-supply problems.

Trying to fix the crisis by increasing the number of planning permissions had failed repeatedly, the report said, and had simply boosted the value of the land without forcing developers to build. It added that the UK's biggest housebuilders had created a huge bottleneck by sitting on around one million plots in their 'landbanks'.

The CPS report advises government to give priority in planning to smaller firms when public sector land is sold.

Second year for lift award

The annual Alex MacDonald award for MSc lift engineering students at the University of Northampton is now in its second year.

Launched in 2020 by LECS (UK), in memory of a highly respected former colleague, the award recognises the highest-quality and most innovative dissertation produced by the university's lift engineering students. For more details, visit **www.lecsuk.co.uk** or **www.northampton.ac.uk**

New target requires switch from fossil-fuel heating

Electric systems offer the largest emissions savings, says CCC

The UK government has committed to reducing carbon emissions by 78% by 2035, compared with 1990 levels, as it prepares to host the UN's COP26 climate summit later this year.

The new target contained in the sixth Carbon Budget is in line with the recommendations made by the Climate Change Committee (CCC). It a significant increase on the government's previous position of a 68% reduction by 2030. The target will be enshrined in law by the end of June 2021.

The sixth Carbon Budget limits the volume of greenhouse gases emitted over a five-year period from 2033 to 2037. For the first time, this Carbon Budget will incorporate the UK's share of international aviation and shipping emissions.

Hitting the target will require significant changes to the way buildings are heated and insulated and is expected to see the government launch a major building retrofit strategy in order to decarbonise the existing building stock.

In the buildings sector, the CCC said opportunities to reduce emissions exist in four main areas: behaviour change, fabric energy efficiency, energy efficiency of lighting and appliances and switching away from fossil-fuel based heat. The CCC said switching to efficient electric systems now delivers the largest readily available emissions savings, which it said would 'grow steadily' as the power sector continues to rapidly decarbonise.

The UK has committed to net-zero emissions by 2050. CIBSE said the government needs to be more ambitious with its Future Buildings Standard plans for the UK to hit this target.

Wind power made up 39% of the UK's energy mix on Easter Monday

'Greenest ever' Grid over sunny and windy Easter bank holiday

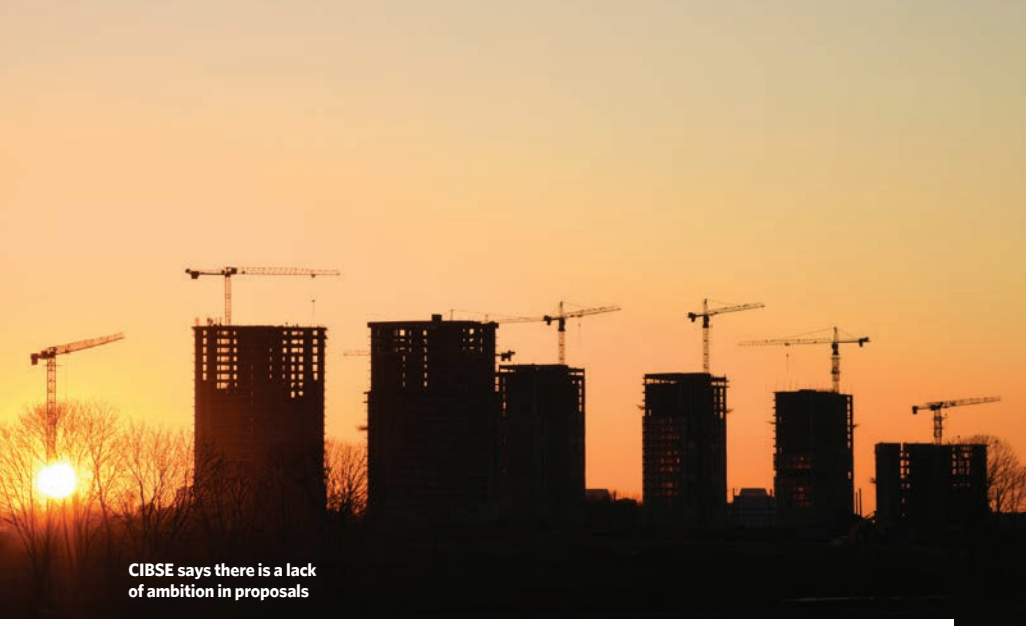
The UK electricity system was the greenest it has ever been at lunchtime on Easter Monday (5 April), according to the National Grid Electricity System Operator.

Sunny and windy weather, coupled with low demand for power, meant low carbon energy sources made up almost 80% of the country's power for several hours. There was no coal generation on the Grid and just 10% of power was from gas plants, the operator added.

The level of carbon fell to just 39 grams per unit of electricity - the lowest ever recorded for the Grid – at 1pm on Monday of the bank holiday weekend. Wind power made up 39% of the energy mix, with solar at 21% and nuclear at 16%. The following day, the mix was 24.8% from fossil fuels, most of which was gas (combined cycle), while 45.2% came from renewables.

The new Easter record was the culmination of a steady drop in dependence on fossil fuels, which has been gathering pace since last year. In March, just 37% of Grid power was generated by gas and, last year, the UK operated without coal-generated electricity for 68 days continuously.

Christmas Day was coal free for the first time since the Industrial Revolution. The previous record for the UK's greenest day was set on 24 May 2020, under lockdown conditions.



CIBSE says there is a lack of ambition in proposals

Industry bodies slam Future Buildings Standard

Lack of ambition in proposals condemned by CIBSE and others

CIBSE and 20 other industry bodies have joined forces to condemn the 'lack of ambition' in the government's proposals for the Future Buildings Standard.

In an open letter to Jeremy Pocklington, permanent secretary at the Ministry of Housing Communities and Local Government, they highlighted 'significant shortcomings' in the plans for tackling energy efficiency and improving ventilation in commercial buildings and existing homes.

The bodies, led by RIBA, criticised the failure to allow for regulation of total energy consumption of buildings, or to set targets for actual energy performance and embodied carbon. They also urged the government to introduce a national retrofit strategy.

Alongside CIBSE and RIBA, signatories included Greenpeace, the UK Green Building Council, and the Chartered Institute of Building, all of whom pointed out that carbon emissions from a building's operational energy use make up only a portion of the carbon emitted across its entire life-cycle. They added that current retrofit standards lacked 'vision and ambition'.

'We need government to set a National Retrofit Strategy with adequate funding and a clear roadmap for action. This must include a whole-building retrofit approach and a commitment to reviewing the Building Regulations for existing buildings in 2025,' the letter said.

It added that using primary energy as the 'principal energy metric', as planned in the standard, was a mistake, as it would become less relevant as the Grid is decarbonised. The standard also favours gas over electricity, which works against heat decarbonisation objectives, it said.

The Institution also called for better methods of assessing building performance, to close the building performance gap.

Morrell leads products-testing review

Former government adviser and construction expert Paul Morrell has been appointed by Housing Secretary Robert Jenrick to lead an independent review of the system for testing construction products.

The review, announced earlier this year, will examine how to strengthen the current system for testing construction products to provide confidence that these materials are safe and perform as marketed.

The review is intended to identify systemic issues with how construction products are tested, whether on a standalone basis or in assemblies, and how test results are used to manage the safety risks that those products pose, and recommend ways to address those issues.

The independent review follows evidence from the Grenfell Tower Public Inquiry, which shone a light on cases where construction products that were tested did not represent those placed on the market, and where the combination of products tested was inaccurately described in the test report.

The review panel will submit a report to the Secretary of State for Housing, Communities and Local Government this summer.

Paul Morrell

Disabled Grenfell residents had no escape route

The Grenfell Tower public inquiry has heard that disabled residents living in the 24-storey building who could not use the stairs had no escape route with disabled access in the fire when the lifts were out of action.

The inquiry heard from disabled residents that they had not been given instructions about what to do in the event of a fire.

Lawyers for residents have called the fire in June 2017 'a landmark act of discrimination' against disabled people.

Current statutory guidance in England (Approved Document B, 2019 edition incorporating 2020 amendments) is that designs should enable all persons to 'escape to a place of safety without external assistance' and should 'take account of the needs of everyone who may access the building'.

There is long-standing UK guidance on the design and management of lifts for the evacuation of persons with disability and persons requiring assistance. The guidance covers building design measures to protect lifts and refuges, and the features of evacuation lifts. Such evacuation lifts are intended to be controlled by trained and authorised lift drivers.

There have been calls for specially designed and protected automatic evacuation lifts to allow self-evacuation by those needing lifts to escape. However, there is currently no guidance for the specification of self-evacuation or 'automatic' evacuation lifts for lift providers to follow.

The regulatory framework for fire safety is currently undergoing a process of unprecedented scrutiny and change, which some in the industry say should be an opportunity to make design for building fire safety more inclusive.

Government urged to launch retrofit plan

The Chartered Institute of Building (CIOB) has called on the government to make a national retrofit plan a key part of its industrial strategy, following the launch of the Climate Change Committee's Sixth Carbon Budget.

'Upgrading the UK's existing building stock through retrofitting is vital to achieving the net-zero target,' the CIOB said in a statement.

It added that the carbon budget was right to propose a £55bn household energy efficiency programme, with 15 million households to receive main insulation measures and a further eight million to benefit from draught-proofing.

A national retrofit plan would provide a 'clear direction of travel for the construction industry' and the certainty the private sector needs to invest in improving energy efficiency, according to the CIOB.

IN BRIEF

Flywheel cuts crane energy costs

Flywheel energy-saving technology developed by Formula 1 motor-racing engineers has cut the energy consumption of a tower crane by 40% in a live trial.

Construction firm Kier is using the flywheel as an energy-storage system to power a tower crane on a project in Liverpool. The Punch Flybrid system reduced the size of the generator needed by the crane during a trial at the Shakespeare North site.

Flybrid managing director Tobias Knichel said it was the first time a flywheel energy-storage system had been used on a live construction site. 'Such forward-thinking leadership deserves the very positive results achieved during this trial,' he said.

Batterbee to lead Atkins' applied technology practice

Atkins has appointed John Batterbee, formerly technology solutions director at Costain, to lead its new applied technology practice, which has been formed in response to a growing demand for digital services.

Batterbee will bring together and expand Atkins' digital services and data analytics to create a service that will 'help clients unlock the benefits of digital transformation'.

At Costain, Batterbee was responsible for helping clients with digital disruption and to realise the value of technology transformation. He has delivered solutions across a diverse range of sectors, including defence, energy, transport and water.

CIBSE Awards proposal to raise profile of energy data

New quantative entry form will more closely reflect building performance

CIBSE has proposed a series of changes to the entry process for its annual Building Performance Awards (BPA) that would increase the visibility of energy-performance data.

It plans to introduce a separate entry form for quantitative data on energy performance, alongside the qualitative form already in use, to maximise the value gained from the data for applicants and the industry. The Institution says this should make the entry process simpler and help improve the sector's understanding of building performance.

CIBSE is asking for feedback from members and the wider industry on proposals that it believes will create a clearer and fairer process, while also making it easier for the judges to assess the performance claimed in entries.

By having a separate form for energy performance, the data will also be ready for processing by CIBSE's partner University College London, which is compiling a benchmark database. Projects can be showcased on the benchmark curves, adding profile to their achievements, according to the BPA organisers.

Eventually, this should create a more streamlined process and can be combined with other awards, such as those organised by RIBA, with which CIBSE has been working to align criteria and share data. In-use energy data entered for the RIBA awards could also be added to the CIBSE database.

'We are trying to balance the need for clarity and useful information with the desire to make it as easy as possible for entrants,' said CIBSE's technical manager, Julie Godefroy. 'The very fact of having monitored energy use is an achievement, so the new form tries to recognise this, while offering options for gathering more granular information where possible.'

Read more on page 16. The consultation is open until 6 May at **bit.ly/CJMay21Data1**

Max Fordham's Passivhaus home won a 2021 CIBSE Building Performance Award

Construction sector 'full of the joys of spring'

Commercial pipeline 'spectacular', according to new data

The construction industry grew at its fastest rate since September 2014 during March, according to a survey by IHS Markit and the Chartered Institute of Procurement & Supply (CIPS).

Rises in housebuilding, commercial work and civil engineering helped drive the sector, with the UK Construction Total Activity Index recording a reading of 61.7 in March, up from 53.3 in February. Anything above 50 indicates growth. The positive figures also reflect the resurrection of delayed projects, particularly in the hospitality, leisure, and office-development sectors.

'Construction was full of the joys of spring in March, with a sudden leap into solid growth fuelled by across-the-board rises in workloads. The commercial pipeline was particularly spectacular, giving its best performance since late-2014,' said CIPS group director Duncan Brock.

Housebuilding was the best-performing category, at a reading of 64, showing its fastest growth since July 2020. Commercial construction was at 62.7 and civil engineering 58. As a result, job creation was the strongest for more than two years.

This surge in activity put supply pressure on products and materials, leading to longer wait times for deliveries, especially for imported items. As a result, prices rose steeply and at their fastest pace since August 2008, with many survey respondents blaming Brexit and the pandemic.

'Improving confidence among clients in the commercial segment was a key driver of growth, with development activity rebounding in sectors of the economy set to benefit the most from the improving pandemic situation,' said Tim Moore, economics director at IHS Markit.

'Continued pressures on supply chains are expected in the near term, but these concerns did little to dampen confidence about the business outlook. The survey pointed to the strongest growth projections across the UK construction sector since those reported during a post-election bounce in June 2015.'

Home work fuels data-centre boom

Demand for data-centre projects is at an all-time high, according to market analyst Glenigan. It says the Covid-19 'stay at home' rule and resultant changes to working practices – along with huge increases in home streaming and online shopping – have put enormous pressure on existing data centres and is driving significant investment in new construction.

Before the pandemic, users were typically calling on 75-80% of their capacity outside peak times, but that has risen to very close to 100% for extended periods, according to Matt Pullen from data-centre provider CyrusOne.

Almost 24 million people – about 60% of the UK's workforce – have been working from home, and more than 25% expect to continue doing so full time or for part of the week, Glenigan said. Before the Covid-19 crisis, just 1.54 million people were based at home.

There are 23 'high-value' data-centre projects due to start on site in the next 12 months, Glenigan says, with a total value of £1,337bn. The Republic of Ireland continues to dominate new construction, with seven projects worth £860m in total due to start in the next 12 months.

New fire risk façade assessment proposed

The draft of a new publicly available specification, PAS 9980 *Fire risk appraisal and assessment of external wall construction and cladding of existing blocks of flats – Code of practice*, has been published for comment.

It gives recommendations and guidance on undertaking a fire risk appraisal and assessment (FRAA) of the external wall construction of existing multi-storey, multi-occupied residential buildings.

The purpose of such an FRAA is to assess the risk to occupants from a fire spreading externally over – or within – the walls of the building and whether remediation is considered necessary. It is applicable where the risk is known or suspected from the presence of combustible materials within the external wall build-up.

CIBSE technical director Hywel Davies said it was a significant draft document. He said: 'It is really important that those with practical experience in the façade engineering field give this draft PAS thorough scrutiny.

'It is likely to replace the EWS1 form, so its essential that it is scrutinised at this public comment stage. We have a responsibility to respond and provide constructive engineering comment to improve the draft prior to publication and adoption.'

The SFE Fire/Technical Committee will be sending a response and invites contributions from members before 12 May, to give the committee time to collate responses before the consultation closes on 20 May. The proposal can be downloaded from **www.cibse.org/pas9980** Comments should be sent to **sfe@cibse.org**

New mindset needed to fix safety issues

Contractors and design professionals must rethink their approach to supports and fixings to reduce the number of unsafe building services installations, says BESA.

BESA has produced a new guide to good practice, which addresses historic problems caused by inadequate fixings and seeks to plug gaps in the sector's knowledge about the safest ways to support mechanical and electrical systems.

Will Pitt, chair of BESA's technical committee, said: 'Recent high-profile failures have highlighted the importance of ensuring these issues are properly considered at design, procurement, installation and testing.'

He told a BESA webinar that the industry's tendency to leave critical decisions to onsite teams undermined the safety of installations.

Ideally, the weight of the services needs to be considered at RIBA Stage 2, and the details of brackets and other fixings should be included in installation drawings, added Pitt, who is divisional mechanical engineering manager at NG Bailey.

The BESA Guide to Supports & Fixings for Building Services (TR50) can be downloaded from **www.theBESA.com/knowledge**

Stephen Matthews formally retires from CIBSE

Past presidents pay tribute to CIBSE chief executive's 15 years leading the Institution

CIBSE's chief executive Stephen Matthews DL FRSA CEng FCIBSE FIMeche will formally step down this month, after 15 years as the head of the Institution.

He will hand over to Ruth Carter, who was previously managing director of Telegraph Media, at the CIBSE AGM on 6 May.

Current CIBSE President Stuart Macpherson said: 'Stephen rose to the challenge of the last year with the energy and determination of a man who had just taken on the CEO role.'

Past CIBSE Presidents also paid tribute. Terry Wyatt said: 'Stephen has enabled nothing short of a complete transformation of our industry in every aspect, from training to delivery, setting standards for performance and targets towards the environmental and energy performances that are so crucially required.'

While David Hughes said: 'Stephen has proven to be a friend and wise advocate to everyone, not only to staff and members within our organisation.'

Matthews joined CIBSE as chief executive in 2006 after a military career in which he attained the rank of brigadier and was troop leader with command of Chieftain tanks. In May 2013, he was appointed a deputy lieutenant for the Royal County of Berkshire. A qualified mechanical engineer, he brought to CIBSE a passion to develop the Institution and make an informed contribution to the climate-change debate.

Matthews has been a huge asset to CIBSE throughout his tenure as CEO, growing the Institution and building its reputation over the 15 years he has served.

He has been instrumental in forming alliances with key organisations and institutions across the building engineering industry, helping to raise the profile of the profession and provide wider support for Members. This has included: signing a memorandum of understanding with the Institute of Refrigeration in 2016; building a relationship with the Royal Academy of Engineers; signing a refreshed strategic partnership agreement with ASHRAE in 2020, to enhance collaboration and communication; and, most recently, seeing the launch of Actuate UK, a new alliance for the UK engineering services sector.

Matthews has supported the Institution's growth from a membership body with around 17,000 Members to nearly 21,000, as well as establishing the Young Engineers Network.

Other notable achievements during his tenure include the:

- Acquisition of Mid-Career College, now CIBSE Training – last year more than 1,400 individuals attended a course
- *CIBSE Journal* launch in 2009, following the previous CIBSE magazine being moved away from UBM
- Establishment of the CIBSE Knowledge Portal
- Establishment of the UAE Region, and development of the relationship with Hong Kong Region
- Introduction of a new CIBSE website and IT infrastructure to position CIBSE for growth and resilience.

Although not exhaustive, this list illustrates perfectly Matthews' commitment to ensuring that members remain at

IN BRIEF

Annual Report shows progress in hard year

The 2020 CIBSE Annual Report is now available to view on the CIBSE website. Providing a concise report of the activities of the Institution and the wider CIBSE community of Groups, Divisions and Regions, it illustrates the range of achievements and outputs in a challenging year.

These achievements include: welcoming 1,726 new members; 3.5 million page views to the CIBSE website; and 62,000 downloads of the *Emerging from Lockdown* guidance.

Acknowledging the exceptional circumstances of 2020, the annual report includes a timeline showing CIBSE's response to the Covid-19 pandemic.

The report can be found at: **www.cibse.org/about-cibse/cibse-annual-report**

CIBSE members make shortlist for construction and engineering awards

Jennifer Cox

The European Women in Construction & Engineering Awards celebrate the achievements of women in the sectors – and eight CIBSE members have made the 2021 shortlist in the following categories:

- Best Woman Electrical and Mechanical Engineer: **Emilia Targonska**, senior mechanical engineer, Foster + Partners; **Victoria Stephens**, engineering associate, BDP; **Mary-Ann Clarke**, regional director, Aecom.
- Best Woman in Environment and Sustainability: **Gemma Taylor**, sustainability adviser, Department for Education.
- Best Woman in Digital Innovation: **Janine Gibson**, digital engineering lead, BDP.
- Best Young Woman Engineer: **Jennifer Cox**, electrical engineer, Aecom.
- Best Woman Consultant: **Zara Edwards**, associate director, Aecom.
- Best Male Mentor: **Mike Burton**, director, Aecom.

Three of those shortlisted have been recognised in the CIBSE Young Engineers Awards, with Cox named CIBSE Graduate of the Year in 2020 and Targonska in 2014, and Taylor taking third place in 2018. Congratulations to everyone who has been shortlisted – and the best of luck.

- For the full shortlist, visit: **wiceawards.com/2021-finalists.html**

Winners will be announced at an awards dinner, which is expected to take place in May.


Stephen Matthews

the heart of everything CIBSE does.

Over the past year, he has been the linchpin in supporting CIBSE staff through the pandemic, heading weekly staff meetings and ensuring everyone feels supported. Notably, there were no staff furloughed through the pandemic.

He will be greatly missed, and we wish him all the very best for his retirement.

'STEPHEN HAS STEERED US FROM STRENGTH TO STRENGTH'

CIBSE Presidents past and present remember Stephen Matthews' term of office

Stuart MacPherson, CIBSE President:
The test of a CEO comes when times are difficult. We have had our testing times during his tenure, not least a global financial crisis in 2008 – and what a year 2020/21 turned out to be as his last year in the post.

Rather than a gradual segue into retirement, Stephen has had to manage the Institution through probably the toughest year in its existence. He rose to that challenge with the energy and determination of a man who had just taken on the CEO role anew. He can look back with satisfaction on a year in which the Institution operated as close to normally as possible, and which returned a balanced budget in spite of financial challenges. All this while remaining characteristically polite, considerate, calm and helpful to his staff and the Board.

Peter Y Wong, CIBSE President 2017-18:
Stephen once teased me that, on his first visit to Hong Kong, I accused CIBSE of not doing enough for the Hong Kong Region. In fact, Stephen has never stopped supporting CIBSE's Regions, and has steered us from strength to strength – something for which we are all grateful.

David Hughes, CIBSE President 2006-07:
Stephen has provided sound counsel to me, together with advice where appropriate. He has proven to be a friend and wise advocate to everyone, not only to staff and members within our organisation, but also to the wider landscape of professional bodies and industry representatives.

A significant part of my tenure as incoming president was to help appoint a new chief executive. Stephen's credentials matched our selection criteria admirably. Today, we are in a better position than we have ever been. We must congratulate Stephen on his significant contribution to this success.

Terry Wyatt. President 2003-04:
Stephen has enabled nothing short of a complete transformation of our industry in every aspect, from training to delivery, setting standards for performance and targets towards the environmental and energy performances that are so crucially required. We should be immensely grateful for Stephen leading us to the position we are in today globally. His departure will leave a mighty place for another to fill.

CIBSE mourns Honorary Fellow HRH Prince Philip

CIBSE has paid tribute to HRH Prince Philip, the Duke of Edinburgh, who was an Honorary Fellow of the Institution from 1978, and sent its condolences to the royal family on news of his death. CIBSE President Stuart MacPherson said: 'The Duke of Edinburgh was noted for his deep interest in engineering and the built environment, and was campaigning for a better natural environment long before it became fashionable to do so.'

Remembering the Duke of Edinburgh
by Terry Wyatt

I wonder how many fellow CIBSE members are aware that Prince Philip was 'one of us'. In 1978, the Duke of Edinburgh accepted an Honorary Fellowship of CIBSE at a ceremony in London, which I was fortunate to attend.

As a naval officer, the Duke had been engineer in charge of his ship's heating and ventilation systems, among others. In his acceptance speech, I recall him telling of, what he called, the curse of the adjustable room thermostat, which frequently ensured that a room's temperature was other than it should be. So often, someone entering would decide it was too cold and yank the lever up high; the room then overheated and the next person did the reverse, ensuring it was never set correctly.

Prince Philip told us this was not the case on his ships, because he introduced a mechanism whereby a clockwork function would return the thermostat to its set position after adjustment by any shipmate. He wished they were fitted in his home and could not understand why our industry did not use them. Amazingly, it is only relatively recently that this has become commonplace.

The Duke memorably said that, unlike structural and civil engineers, with their harbours and bridges, the less people are aware – by 'see, feel, smell or touch' – of what we do, the better we've done our job. As a consequence, he said, you are invisible. I do not doubt that he was glad to see we have emerged from the shadows to take our place at the forefront of building design, construction and operation.

Prince Philip graced our Institution as a uniquely worthy member, and will be missed and remembered with gratitude.


HRH Prince Philip, the Duke of Edinburgh, died on 9 April, aged 99

IN BRIEF

CIBSE AGM welcomes new President

The CIBSE Annual General Meeting will be held at 5pm on Thursday 6 May, as an online meeting. After the AGM, at 5.30pm, the incoming President, Kevin Kelly CEng FCIBSE FSLL, will deliver his Presidential Address. Please register for the event at: **www.cibse.org/agm**

For those unable to join, a recording of the Presidential Address will be made available after the event on the website at **www.cibse.org/president**

Members of all grades are entitled to attend the AGM, but only Corporate Members (Fellows, Members, Associates and Licentiates) are entitled to vote.

Calling all apprentices, graduates and employers

The CIBSE Young Engineers Awards 2021 are open for entries. The awards bring together the Graduate of the Year, Employer of the Year and Apprentice of the Year awards – the latter being launched last year to allow the CIBSE community to recognise more of our early career contributors.

The awards recognise excellence and showcase diverse, hard-working graduate engineers, as well as celebrating those employers who help support, nurture and mentor them.

Entry is free and open to all, and the closing date is 30 July 2021. For full details, see **www.cibse.org/yea**

New members, fellows and associates

FELLOWS

Tse, Kit Shing
Hung Hom, Hong Kong

MEMBER

Al Abbar, Saeed
Dubai, United Arab Emirates

Busayong, Anthony
Olongapo City, Philippines

Chay, Joon Ying
Selangor D E, Malaysia

Christie, Sean
Dubai, United Arab Emirates

Combes, Richard
Redditch, United Kingdom

Dempsey, Ruairí
Antrim, United Kingdom

Frazer, Tristan
Sutton, United Kingdom

Garforth, Ross
Doha, Qatar

Garma, Glenn
Doha, Qatar

Gibson, Paul
Crook, United Kingdom

Haddad, Mohammad
Riyadh, Saudi Arabia

Ho, Wah Cheong
Hong Kong, Hong Kong

Htet, Hein
Chatswood, Australia

Kam, Hung Pong
Toronto, Canada

Kesidis, Alexandros
Birmingham, United Kingdom

Koufakis, Alexis
London, United Kingdom

Lau, Fan Yiu
Hong Kong, Hong Kong

Lawson, Sam
Dartford, United Kingdom

Lazell, Joseph Oliver
Manchester, United Kingdom

Leitao, Trevor Joseph
Maidenhead, United Kingdom

Leung, Pak Wai
Sai Kung, Hong Kong

Leung, Wai Hung
Cheung Sha Wan, Hong Kong

Li, Zhi Ran
Kowloon, Hong Kong

Liu, Pik Ki
Kowloon, Hong Kong

Lo Vuolo, Nicol
London, United Kingdom

Lung, Chi Wai
Kowloon Bay, Hong Kong

Mak, Wai Ho
Tuen Mun, Hong Kong

Marcinczak, Alicja
Godalming, United Kingdom

Ng, Wing Yin
Sheung Shui, Hong Kong

Omar, Tarek
Cairo, Egypt

Papasifaki, Alkyoni
Finchley, United Kingdom

Ramsdale, David Paul
Blackburn, United Kingdom

Rivas Gonzalez, Cristian Brais
Staines-upon-Thames, United Kingdom

Robertson, Lee David
Coatbridge, United Kingdom

Runton, Howard
Broadford Bridge, United Kingdom

Syed, Iqbal Ahmed
Jeddah, Saudi Arabia

Tam, Chi On
Hong Kong, Hong Kong

Tetlow, David
Nottingham, United Kingdom

Wong, Wai Kin Thomas
Tsing Yi, Hong Kong

Yau, Yiu Wai
Kowloon, Hong Kong

ASSOCIATE

Anastasakis, Konstantinos
Solihull, United Kingdom

Baron, Jonathan
Darwen, United Kingdom

Birch, Harry
Redditch, United Kingdom

Collins, Jacob
Leamington Spa, United Kingdom

Davies, Kyle
Manchester, United Kingdom

Duffy, Sean
Bolton, United Kingdom

Evans, Conner
Liverpool, United Kingdom

Faraday, Ben
Blackburn, United Kingdom

Galbally, Jake Marcus
London, United Kingdom

Hitchman, Neil
Manchester, United Kingdom

Lawton, Zak
Newton Abbot, United Kingdom

Limon, Prince
Leeds, United Kingdom

Lingard, Joe
Accrington, United Kingdom

Mobsby, Zak
Camberley, United Kingdom

Noman, Cameron
Hull, United Kingdom

Priyatharsan, Sachchithanantham
Singapore, Republic of Singapore

Pullen, Adam
Bristol, United Kingdom

Richardson, Nicholas
Liverpool, United Kingdom

Wolstenholme, Ben
Oxford, United Kingdom

LICENTIATE

Bancroft, Jordan
Nottingham, United Kingdom

Bruce, James
Lowton, United Kingdom

Clack, Joshua
Gloucestershire, United Kingdom

Crawforth, Gary William
Hull, United Kingdom

Cummings, Martin
London, United Kingdom

Gwaze, Munyaradzi Webster
Birmingham, United Kingdom

Horan, Paul
Manchester, United Kingdom

Hughes, Jack
London, United Kingdom

Jackson, Miles
Birmingham, United Kingdom

Jeffery, Richard
Maidstone, United Kingdom

Kantounas, Callum
London, United Kingdom

Lawson, Sam
Chesterfield, United Kingdom

Lehal, Rajun
Birmingham, United Kingdom

Malone, Gemma
Bridgwater, United Kingdom

McAndrew, Charlotte
Newcastle upon Tyne, United Kingdom

Morgan-Heath, Jonathan William
Brecon, United Kingdom

Murray, Adam
Colchester, United Kingdom

Nakitto, Jackline
Kampala, Uganda

Nolan, Jordan
Liverpool, United Kingdom

Potter, Jack
Liverpool, United Kingdom

Sinden, Nathan
Langford, United Kingdom

Watkins, Brogan James
Bridgend, United Kingdom

Ward, Kenzie
London, United Kingdom

Zhu, Yuting
Bristol, United Kingdom

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The skills challenge

There is currently a clear focus on building safety and net-zero carbon buildings. Hywel Davies suggests that serious investment in skills, right across the industry, is needed to deliver these effectively

Safety, sustainability and digitalisation are driving real change in our industry.

With the Fire Safety Bill in its final parliamentary stages, the Building Safety Bill due to be introduced soon, a new Chief Inspector of Buildings, and development of new competence frameworks by BSI, there is gathering momentum to building-safety reform. We also have a new Product Safety Regulator and an independent review of product testing.

Government has just consulted on the Future Building Standard,[1] setting out proposals for new buildings to be net-zero ready without significant refurbishment or retrofit measures. There is a consultation on a performance-based framework to assess energy use in larger commercial buildings,[1] and a Construction Leadership Council framework for the retrofitting of existing buildings to be net-zero carbon ready.

The UK BIM Framework and Digital Built Britain initiatives are embedded in government's Construction Playbook, bringing digital information management and exchange to an ever wider circle of activities. The digital agenda meets the building safety programme in the development of the Golden Thread. This digital record of a building is intended to address concerns over ineffective operation of current rules for the creation, maintenance, handover and accessibility of building and fire-safety information and building logbooks, already required by Building Regulations. Recommendations from the Grenfell Tower Inquiry Phase 1 report, relating to better provision of information about high-rise residential buildings, need a government response.

Nothing here is exceptional or unreasonable, but it is extremely challenging, because it requires the whole industry to adopt new technologies and ways of working. It requires an approach to building focused on achieving safe and sustainable outcomes, not just doing what is required by parts of the Building Regulations that are enforced. It demands increasing adoption of digital information management processes and standards – not just for design and construction, but throughout the building life-cycle and supply chain.

The challenge here is that each of these initiatives – be it building safety, sustainability and net zero, or digitalisation – require significant enhancement to, and investment in, skills if they are to be delivered effectively.

"All these changes demand new skills and knowledge across the supply chain"

The Building Safety Bill will introduce new gateways and competences for planning, design, completion and handover of buildings. There will be requirements to demonstrate that outcomes are achieved and buildings are safe to occupy, not just compliant with those minimum legal standards that are checked. The Future Buildings Standard will require more challenging levels of fabric efficiency and installation of low carbon energy-using systems. Switching to LED lighting is a relatively simple transition; replacing gas-fired boilers with heat pumps requires a different design approach. Heat pumps use refrigerants, which come under a different statutory licensing regime than the Gas Safe Register.

All these changes demand new skills and knowledge across the supply chain. Every business is affected, whether providing design expertise, delivering safe low carbon products, or installing or maintaining them in buildings. Building owners face new duties to know what those installations are, and how they are operated and maintained to be safe and energy efficient.

The Covid-19 pandemic shows the need for better knowledge and operation of ventilation systems to both the Building Regulations and workplace health and safety regulations. With greater corporate focus on net-zero targets and sustainability commitments, more building operators will demand effective ventilation and better energy performance from their buildings, especially if they must disclose them.

Regulators are not exempt. They must embrace digital technology to assess building projects effectively in construction, to review building-safety cases, and to enforce new requirements where needed.

As a sector, we design, install, maintain and operate many of the energy-using systems in buildings, and make most of the penetrations that need firestopping and fire dampers. We must invest in the skills to design, install and operate buildings to match new regulations, technologies and digitalisation. CIBSE must also invest in new technical guidance to support them.

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

References:

1 CIBSE response to Future Buildings Standard: Building Regulations Part L and F, and overheating **bit.ly/CJMay21HD1**

Designing for feedback

Incorporating in-use feedback into design is key to building performance. **Julie Godefroy** says a new book shows how this can be achieved

There are already a multitude of design guides for low-energy buildings, and many reports on lessons from post-occupany evaluation (POE). This new book does something different and really valuable: it closely relates design advice with in-use feedback making it clear why the advice is useful.

The advice is provided along themes: building context, fabric, systems, and controls and user experience. There are chapters on how to design for feedback, with early stage considerations such as setting targets, modelling, and PI insurance.

The section dedicated to controls and user experience quotes research by UCL, which estimates the impact that complexity has on buildings energy use, and has a clear recommendation: echoing repeated POE studies such as PROBE: simpler is better, especially where complexity is not sufficiently planned and budgeted from the start.

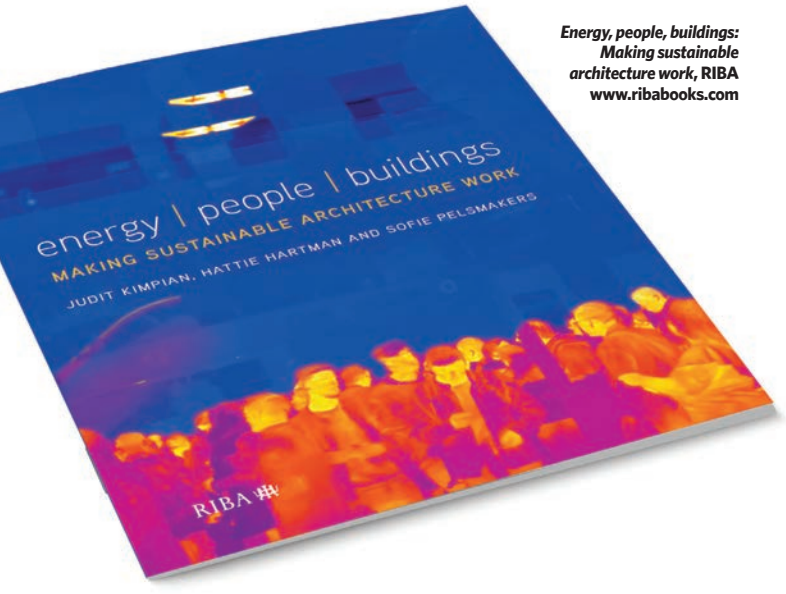
The book concludes with a chapter on contracting for performance, an approach that can be a gamechanger because it aligns incentives for raising the game across a project team. This reflects the approach in several CIBSE award winners, for example the Keynsham civic centre and Leicester Centre for Medicine, which had contractual performance targets.

It advocates the creation of a Building Performance Register to record performance objectives, risks, the methods to deliver them, and responsibilities across the team, with prompts for issues such as scopes of services.

The register can be used in the project stages and integrated into the contract; at the in-use stage, the team can record performance against objectives, and lessons for future projects.

With this book, project teams are provided not only with good reasons to design with building performance in mind, but also advice on how to do it and, importantly, integrate it into processes and contracts.

● **By Judit Kimpian, Hattie Hartman and Sofie Pelsmakers**



***Energy, people, buildings: Making sustainable architecture work*, RIBA www.ribabooks.com**

The safe choice for smoke control

Choosing accredited experts when specifying smoke-control solutions is crucial, says the Smoke Control Association's chair **David Mowatt**

If you have ever specified a smoke-control system, you will no doubt be aware that there are a number of elements that require careful consideration. To understand smoke control fully you need a detailed knowledge of the building design and function, a clear grasp of building regulations, standards and responsibilities, as well as in-depth appreciation of the smoke-control solutions currently available.

It's been well documented that the smoke generated by a building fire often proves more deadly than the fire itself. Smoke-control systems, therefore, play a critical role in the fire-protection design of a building, preventing the spread of smoke through it and protecting the common circulation areas and staircases. In the event of a fire, extracting heat and smoke away from escape routes is vital for evacuating the building of occupants and for safe firefighting operations – keeping these areas clear can ultimately save lives.

The Smoke Control Association (SCA) is committed to promoting the highest possible standards in the design, manufacture, installation and maintenance of life safety smoke-ventilation systems. As an established industry voice, the association works closely with government authorities and other relevant parties to raise awareness and improve technical understanding at every available opportunity.

Every SCA member has agreed to stringent membership requirements, stipulating all products installed as part of life safety smoke-ventilation systems should be independently tested and certified to the EN12101 series of standards and UKCA/CE marked.

Members that install smoke-control systems are required to apply for, and receive, the UKAS-accredited SDI 19 Certification Scheme, guaranteeing that they have the necessary skill and experience in fire-safety verification, system design, installation and commissioning in accordance with industry standards and guidelines. All SCA members carrying out smoke-control design are also required to have PI insurance with a minimum cover of £5m.

When specifying smoke-control systems, SCA members can be relied upon to provide the expert advice and guidance needed, guaranteeing best practice at all times. Further information and a full list of SCA members can be found at **www.smokecontrol.org.uk**

● **David Mowatt** is chair at the Smoke Control Association

SMOKE CONTROL ASSOCIATION

MAKING DATA COUNT

Standardising energy data is essential to accurately assess relative building performance. **Julie Godefroy** compares data from previous CIBSE award winners with the latest energy use targets and introduces a new awards submission form that aims to maximise the value of data

Since their creation in 2012, the CIBSE Building Performance Awards have been based on monitored energy use data. With contractual and regulatory performance rising up the agenda, CIBSE has been looking at the past six years of entries to see what we can learn from building performance and data collection.

There has been an increasing number of resources and research on building performance data including CIBSE's *TM61-64 suite on Operational performance*,[1] the *RIBA Plan for Use Guide 2021*,[2] and a new book on the lessons to be learnt from post-occupancy evaluations (see 'Book review: *Energy, people and buildings*' on page 15.)

We are looking to maximise the value gained from the awards data for applicants and industry and to identify whether projects could contribute to the CIBSE benchmarks database,[3] especially at the low energy end of the scale. Ideally, we would like to showcase the projects on the platform (subject to agreement by applicants).

As well as making use of the data for the good of the industry, we would like to make the awards process simpler for applicants and are proposing a new data colletion form for those entering.[4]

For the moment, the exercise has focused on UK buildings and we have found 85 projects with good-quality data suitable for analysis. It could be expanded to other countries or regions.

> "We are looking to maximise the value gained from the awards data for applicants and industry"

The Enterprise Centre

What the review has told us about building performance

One of the aims of the data review was to identify best-performing CIBSE award submissions from 2016 to 2021 projects and compare them with industry targets from the RIBA 2030 Challenge[5] target and LETI's Net Zero Operational Carbon[6] paper. The results are summarised as follows. The energy use intensity (EUI) targets include all energy used by the building, from the grid and on-site supplies, normalised to floor area.

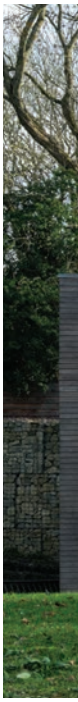
Housing CIBSE award submissions

- LETI EUI target: 35kWh·m^{-2} GIA per year
- RIBA 2030 target: 35kWh·m^{-2} per year.

Three individual homes met the LETI EUI (or almost, at 37 or 38kWh·m^{-2} per year). They included 2019 winner Lark Rise (it did have a wood burner fitted, but according to the architect has hardly been used).

All have Passivhaus certification and a heat pump – also the design strategy modelled when creating the LETI EUI. While energy use is undeniably low, they are also relatively large dwellings (above 150m^2 GIA), which can make energy use benchmarked per m^2 look better than it would per dwelling or per occupant.

The 2020 award winner, Agar Grove, scheme, is also Passivhaus certified and achieved exemplar electricity consumption and space heating demand, which is remarkable as it has much more 'average' dwelling sizes. However, it is served by block heating (gas boiler fed), which takes it well




Agar Grove

above the LETI EUI despite substantial work by the team which spent a lot of attention on reducing distribution losses; simple calculations indicate that with a heat pump system of average seasonal efficiency, it would likely have achieved the LETI EUI target.

Offices

- LETI target: 55kWh·m^{-2} GIA per year or 70kWh·m^{-2} NLA per year and/or DEC B (40) rating
- RIBA target: 55kWh·m^{-2} per year and/or DEC A rating.

No office building among the award submissions met the LETI EUI, but 2018 award winner the Enterprise Centre came very close. It is Passivhaus certified and achieved exemplar electricity consumption and heating demand. However, it is served by district heating, and total energy use to meet that heat demand is not known to CIBSE at this stage. Simple calculations indicate that with an onsite heat pump system instead, it would likely have achieved the LETI EUI.

A number met the alternative LETI targets of DEC (B) rating. Energy use across the projects spans the CIBSE benchmark curve for offices (see Figure 1). High-rise, deep-plan commercial offices clearly tend to have higher energy use; this is sometimes accompanied by higher occupancy density, which could partly, but not always, explain it.

Inversely, some offices at the better energy use end of the scale have lower-than-average densities (around 8.5m² GIA per occupant), but several also have average ones (around 10m² GIA per occupant). Higher energy »


Lark Rise

TYPICAL ISSUES WITH DATA

- Floor area provided without stating whether it is gross internal area or net internal area, or sometimes not declared at all, which prevents good benchmarking and evaluation of performance
- Buildings served by district heating without indication of whether generation and distribution losses are accounted for in the declared 'heating energy' (a very ambiguous term), or with only space heating demand declared, which prevents an evaluation of actual overall energy use
- Unclear language. For example, 'heat demand' or 'heat consumption' used interchangeably, sometimes to mean demand and other times to mean energy use to meet that demand
- Only thermal or electrical energy use reported, not both
- Energy performance reported in terms of carbon emissions or primary energy, without conversion factors, or as a total without fuel breakdown
- For buildings with onsite PVs, lack of clarity on whether the PV output used by the building (rather than exported) is included in the declared 'building's energy use', or not. In some cases, because of the size of PV systems, this could significantly change the assessment of the building's energy performance. Similar issues were found with other onsite systems such as CHP and solar thermal panels.

HOW TO SUPPORT BUILDING PERFORMANCE

- Comment on the draft awards data collection form by 6 May
- Submit in-use energy data
- Sign the Building Performance Network joint position statement on in-use performance: **bit.ly/CJMay21JG1**
- Look out for the BSI consultation on a new BPE standard, expected this summer.

» users overall often displayed high energy use for heating, which tends to further indicate that occupant density is not the main 'culprit' for high energy use, and points to a large potential for energy savings.

Schools

- LETI target: 65kWh·m^{-2} GIA per year
- RIBA target: 55kWh·m^{-2} per year.

There was only a small number of schools in recent years of submissions, but two of the three with good data met the LETI EUI.

Other sectors

- LETI target: n/a currently
- RIBA target: n/a currently.

From the awards submission data, higher education is probably a sector 'ready' for EUI targets, with much data available and several exemplar projects.

There are also many useful examples of office retrofits and energy savings, from operations and maintenance measures through to plant replacement and full façade upgrades, which can support an ambitious energy-use trajectory for existing office stock.

What the review says about data

Despite these findings, the review was limited by the quality or completeness of data, particularly in the early years. Quality of data has improved markedly in the past two years, and many more projects have gone through an overall post-occupancy evaluation exercise including gathering of user feedback.

Typical issues with the data collected included no indication of whether internal floor area is net or gross, unclear language, and inconsistent energy units quoted. (See panel 'Typical issues with data'.)

Proposed changes to entry form

CIBSE is proposing a change to the award submission forms, with a separate data entry form for quantitative data on energy performance, alongside the qualitative form. This should have a number of benefits including more clarity on the essential information needed and in quicker data entry, and a clearer and fairer basis for judges to assess the respective performance of entries.

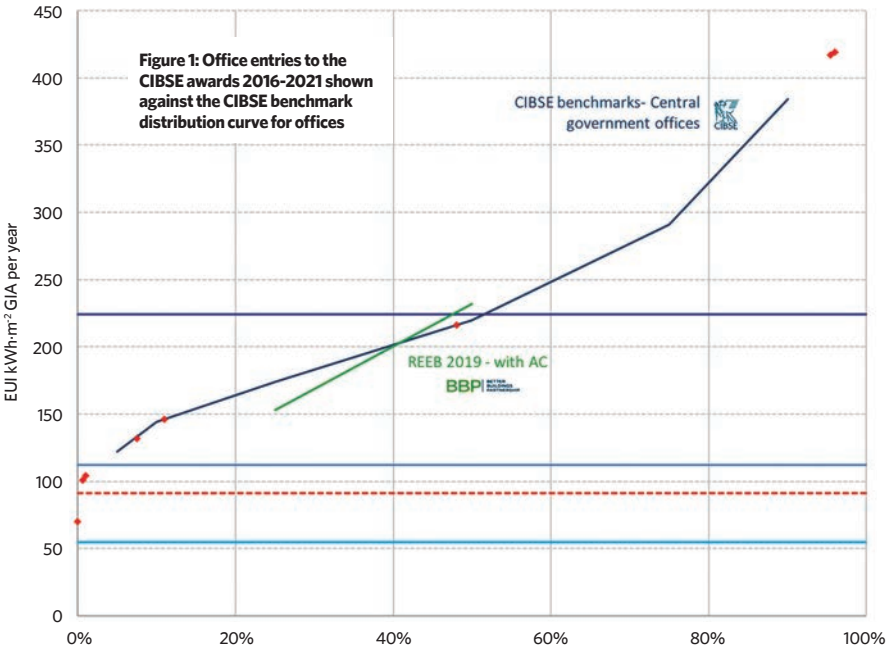
We believe the awards submissions will have more value to industry, as the data will be ready to be processed by CIBSE's partner UCL to contribute to the benchmark database (subject to agreement from entrants).

Project team members will also have the option to be showcased on the benchmark curves, adding profile to their achievements.

Hopefully in the near future, there will be a streamlined co-ordinated process with other awards, in particular RIBA's with whom CIBSE has been working for a few years to align criteria and share data. The aim is for in-use energy data entered for the RIBA awards also contributing to the CIBSE database.

We have drafted new data-collection forms for homes and non-domestic projects. The aim is to balance the need for clarity and useful information, while addressing the common issues mentioned above. We realise the very fact of having monitored energy use is an achievement, so the new form recognises this, highlighting the essential asks while offering options for more granular information.

The deadline to comment on the draft awards data collection form is May 6.[4] To contribute to other industry efforts on building performance see panel 'How to support building performance'. CJ



Energy use across the office award entries covers the whole range of the CIBSE office benchmark distribution curve, from very high down to exemplar low-energy use.

Densities ranged from around 8.5 to 14m^2 per occupant, with no strong link to energy-use intensity (at least, as seen from the data available).

The 'central government office' benchmark sub-category has been used as probably the most relevant category to compare large, relatively dense commercial offices. This is supported by the fact that the Better Buildings Partnership REEB benchmarks, also included on the figure and typically covering commercial stock, show reasonably good alignment with the CIBSE curve.

- Office building entered in CIBSE awards
- CIBSE 'typical; nat vent office and RIBA 'current practice'
- Building Mission 'Having energy use' and RIBA 2030 Challenge – 2025
- Average across green construction board building mission in-use case studies
- LETI and UK GBC 'Paris Proof' and RIBA 2030 Challenge – 2030

RESOURCES ON BUILDING PERFORMANCE EVALUATION

Energy, People, Buildings **by J. Kimpian, H. Hartman and S. Pelsmakers bit.ly/CJMay21JG**
Housing Fit for Purpose**, F. Stevenson, 2019 bit.ly/CJMay21LG2**
Woodknowledge Wales Building Performance Evaluation Guide and toolkit for housing, 2021 bit.ly/CJMay21JG4

References:

1 TM61-64 suite on Operational performance, 2020 **bit.ly/CJMay21JG3**
2 RIBA *Plan for Use guide*, 2021 **bit.ly/CJMay21JG5**
3 CIBSE Energy Benchmarking tool (beta version) **bit.ly/CJMay21Data2**
4 CIBSE awards – New data collection form for consultation **bit.ly/CJMay21Data1**
5 RIBA 2030 Climate Challenge, **bit.ly/CJMay21Data3**
6 LETI Net-Zero 1-pager, **bit.ly/CJMay21Data4**

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When recession hit Ireland in 2008, Lawler Consulting turned to energy-performance contracting to engineer efficiency savings for its grateful clients. Since then, it has enjoyed growth in Ireland and the rest of the world, and this year retained its Consultant of the Year (0-50 employees) crown at the CIBSE Building Performance Awards. **Andy Pearson** reports

MEANING BUSINESS

'Engineers are the architects of energy consumption; we are the only ones who really understand it.' So says Daniel Ring, managing director at Lawler Consulting, the Kilkenny-based multidisciplinary consulting engineers.

'We are uniquely positioned to reverse engineer and overlay today's technology on yesterday's buildings,' he adds. 'This is different from traditional construction engineering, and an area where the building services engineer must lead.'

Ring says his company has taken a lead on sustainability and energy consumption by adding energy-performance contracting (EPC) to the services it offers. Sustainability consulting – and EPC in particular – are fast-growing elements of this innovative engineer's business, and a sector in which it has had considerable success in recent years. The practice, Ring says, has had to be innovative to thrive in difficult times.

Lawler Consulting was founded as Noel Lawler Consulting Engineers in 1980, by Noel Lawler. Back then, the services it offered were conventional mechanical and electrical engineering design for projects mostly based in Ireland.

Noel retired in 2005, but the business continued in his name after a management buyout, which resulted in co-directors Jason Smith and Jonathan Culleton joining the company. Business was good until 2008, when recession hit Ireland hard. 'We went from 26 staff to six, three of whom owned the business,' Ring recalls.

To survive, a decision was taken to diversify the markets in which Lawler Consulting worked and the nature of the work. 'It got us into the mindset that we needed to be more resilient. An overdependency on a sector and a market creates vulnerability' says Ring. Under the new philosophy, the practice took on work in the UK and the Middle East, and branched out into the insurance sector, where it undertook technical investigations for claims involving flooding and fires.

The big driver of change, however, came when Lawler Consulting started doing energy surveys for the Sustainable Energy Authority of Ireland. 'We were finding that the great ideas we were proposing in

Lawler Consulting with the first of its two CIBSE Building Performance Awards in 2020

Daniel Ring says EPC makes sense because engineers can find energy savings that other disciplines cannot

the audits to save energy were not being realised because businesses were reluctant to act,' says Ring. It became obvious that any initiative to unlock these potential energy savings would have to come from the engineer. 'If we believe in it, we have to be able to demonstrate it can be delivered,' says Ring. So began Lawler Consulting's move into EPC.

Ring admits it is unusual for a consultancy to be involved in EPC, but he believes it makes sense because consultants can find savings that other disciplines cannot: 'We can go right back to design fundamentals and say, "that doesn't need to run that way"; or, "if we take out those pumps and put in these pumps, we can save this amount of energy".'

To sell its EPC services, the company had to adopt a different approach to selling. 'We had to start thinking as businesspeople and not as engineers, because we had to be able to talk to non-technical people about their balance sheet, and about cutting operating costs and improving their profit,' says Ring.

> "We're nimble and agile enough to ensure that any learning isn't contained in a silo, but gets fed back to the entire business" – Daniel Ring

Looking for opportunities

The practice's first EPC project was a swimming pool that had been open for about five years. 'We looked at it and said "we think there's an opportunity to save energy here",' recalls Ring. The EPC proposition is that the investment required for energy upgrades is funded from the energy savings generated by the upgrade.

'[The memorandum of understanding] said we'd come in at our risk and at our cost to make a number of energy upgrades to the building's mechanics and electrics, and carry out strategic building tuning, to achieve an agreed minimum energy saving,' explains Ring.

The agreement also stipulated that, should Lawler Consulting save more energy than the agreed minimum, the cost savings would be shared equally for a set period, after which all savings would belong to the client.

» Changes implemented by the engineer included the installation of variable speed drives on the pool's air handling units. A simple energy intervention, achieved though deck-side wireless switching, also brought operational improvements, as swimming instructors previously had to shout above water features.

After the success of its initial EPC, Lawler Consulting's next venture was an eight-year contract with Dublin City Council across three leisure centres. For this project, the firm had to invest in new combined heat and power plant, boilers, pumps and heat-recovery air conditioning systems, and in upgrades to the lighting and pool plant.

The modifications were anticipated to result in a 30% annual cost saving for the leisure centre, based on €170,000 (£148,000) energy savings and €70,000 (£61,000) annual maintenance savings. Impressively, Lawler Consulting achieved savings of 42%. Unsurprisingly, it won a second EPC with the council and is in discussion with two other local authorities.

A major benefit of focusing on the operation of a facility to save energy is that it provides a feedback loop from the site to the designers. 'We're nimble and agile enough to ensure that any learning isn't contained in a silo, but gets fed back to the entire business,' says Ring.

EPC also presented the company with an opportunity to diversify further through European Union (EU) research. 'We've just finished a three-year EU project, where we looked at the revenue stream generated from energy-efficiency initiatives and coupled that with a demand-response revenue stream, to help reduce paybacks on energy-efficiency projects for supermarkets and high energy users,' Ring explains.

The practice's next project is looking at the 'locked-in opportunity' for energy-efficiency improvements for landlords and tenants, when a tenant will not pay for improvements that have a payback longer than the length of their lease.

Alongside the benefits of EPC, there is a financial challenge, because the energy-efficiency modifications need to be paid for up front. 'When we do energy contracting, we have to go to the bank to raise the funds; that sends our balance sheet south, so we need to offload that debt by wrapping it into a contract with a financier,' says Ring, who adds that it is not difficult.

'There is a market for this, because it is seen as a very sound investment for pension funds because of the ethical and sustainability aspects of EPC.'

The EPC team is based within Lawler Consulting's sustainability arm, which also includes energy monitoring, targeting and reporting services. 'Our business is currently 30% energy and sustainability and 70% traditional consulting, but I do see the pendulum swinging the other way really quickly because of the amount of enquiries from clients that want to establish a pathway to net-zero carbon,' Ring says.

EPC also appeals to investors looking for something more responsive than standard Leed and Breeam. The in-use versions of the ratings offer evidence that gives ongoing certainty about their assets' environmental performance, and this is an increasingly important metric. 'They want dynamic and ongoing monitoring, which is what we can do with EPC,' says Ring.

The company is also talking to investors about preventing stranded assets or buildings where the yield or value is falling. 'Picking the decision-makers and pitching

Lawler Consulting has carried out low carbon retrofits for Lidl in the UK and Ireland

"Engineers are the architects of energy consumption. We are the only ones who really understand it" – Daniel Ring

GOING TO GREAT LENGTHS IN SWIMMING POOLS

Leisure centres – characterised by long run hours, and high internal air and water heating loads in the pool hall – are a great opportunity to unlock significant energy-efficient revenue streams, according to Lawler Consulting's Daniel Ring.

He says his company has come to understand their DNA through the design and delivery of many leisure projects. 'It's given us a unique insight and understanding of the "reverse engineering" required to extract energy wastage from these sites.

'The introduction of responsive controls that work dynamically with building use and loadings is fundamental,' adds Ring, who says recommissioning and seasonal commissioning are also important in tuning an engineering system and creating efficiency.

User behaviour can have a significant bearing on energy use, and making occupiers energy aware can yield large savings. Typical initiatives that Lawler Consulting introduced included: lighting and lighting control upgrades; AHU and air conditioning upgrades, with demand-based control; heat recovery in DHW pre-heat and swimming pool heat exchangers; performance and integrity testing of existing engineering systems; behavioural assessment; and grid services integration.

'Our understanding of the environmental interaction between the pool water, environment, air movement and the fabric, and achieving optimal control of these conditions, is integral to the successful performance of these facilities,' says Ring.

He would like to see fabric and air leakage addressed in more retrofits, but the 25-year payback of such interventions are beyond the 5-15 years in which investors currently expect to see a return.

Ring thinks this may change in future, with building performance and digital twins being a very important part of this progression.

Lawler Consulting was the building services engineer on the refurbishment of offices at 78 James Street, London. Amenities include an auditorium and roof-top bar

to them in the language they understand is very important,' says Ring. 'If you go to them and say "do you want to save money off your operational costs and improve the net value of your building?", not many are going to say "I don't want that".'

Another major benefit of talking directly to the investment community is that a proposition will often be judged solely on its financial merits. 'With the traditional M&E consulting business, somebody would probably go to three or four consultants [to pitch a project], whereas – in energy performance consulting – if you put forward a business case, you are seen as the delivery partner. It's a different landscape,' says Ring.

Strangely, Ring would welcome more competition in the EPC market because, to some clients, the benefits of EPC sound too good to be true. 'For a landlord, energy performance contracting is risk-free – they don't have to find the money for energy savings and, if we get it wrong, it's our problem, so it should be easy to sell,' he says.

'One of the problems we have in marketing this is, because it sounds so good, landlords won't move, because they want another price, or they feel there is a catch.'

Lawler Consulting's move into energy performance contracting has been a big part of the practice's transformation, not least because it ensures a recurring income stream over the duration of a contract. More importantly, it's recession-proof. 'Even in the worst of times, you can approach a business and say "do you want me to take some pain away in terms of financial pressure? Here's what we can do",' says Ring.

With new offices in Dublin, Cork and London, Lawler Consulting won Consultancy of the Year (up to 50 employees) for the second year in a row at the CIBSE Building Performance Awards.

The judges, impressed by its delivery of energy performance as a standalone service, said: 'The transfer of risk to the consultant to provide assurance around building performance to its clients is a significant innovation'. Worthy winners indeed. CJ

Better ambient lighting design must be our focus

The authors of the *Ambient Lighting Manifesto* insist that a change in methods of designing interior lighting is necessary and urgent. They explain why new metrics need to be adopted in codes and standards

Our *Ambient Lighting Manifesto* was published in the *CIBSE Journal* in December 2020, and a response from eight leading members of the profession was published in the March 2021 edition. We welcome the feedback from these highly respected lighters, and continue the dialogue with our response to their comments below, in no particular order.

First, it is important for us to reiterate that changing workplaces, changing visual needs, the growing realisation that lighting affects health and wellbeing, and the demand to use energy wisely, mean that a change in our methods of designing interior lighting is necessary and urgent.

This will never happen, however, unless we lift our eyes from the horizontal plane and develop better ways of designing lighting that respond to these changing needs. Continuing to design lighting using illuminance on a plane as the central metric is inappropriate and will not allow us, as a lighting and engineering community, to move forward.

Our manifesto has set out our beliefs. If you put the four of us in a room, we would probably not agree on very much. However, we do agree on this manifesto, because there is growing evidence – based on multiple PhD theses and published papers – that the ambient lighting metrics originally proposed by Kit Cuttle are valid, robust and reliable enough to justify their widespread use.

It is argued that lighting designers already consider ambient lighting; maybe it is true that some do, but a lot of 'design' in the industry is still based around a 100-year-old metric for working-plane illuminance.

Even if lighting designers already do consider ambient lighting in practice, the new metrics – mean room surface exitance (MRSE) and task/ambient illuminance ratio (TAIR) – coupled to the Lighting Design Objectives Procedure (LiDOs), offer new tools for design and to prove compliance when codes and standards include these metrics. This is already beginning to happen. In this way, we do indeed support what leading lighting designers are already doing.

A very good point was made about closing the gap between research and design, and this is what our manifesto set out to do. This continuing dialogue, and the engagement of practitioners, furthers this aim.

As researchers and academics, we are aware of the research published and the research coming through for publication. Without this research, there would be no evidence to support the change to the new paradigm represented by LiDOs. And it is a new paradigm – a whole new way of doing things.

It starts with listing the lighting design objectives in descriptive terms that everyone can understand, and this can be as simple or as complex as circumstances demand. Then, the practitioner specifies those objectives relating to illumination quantity and spatial distribution in terms of the metrics, and the procedure guides the user towards a specification of the required lighting performance.

This specification enables an informed selection of light sources, luminaires, and layout, with confidence that the chosen objectives will be achieved. If LiDOs shifts standards towards what advanced lighting designers are already doing, that can only be a good thing.

Another question raised was, is this moving from design to auto design? No, is the answer. There may be moves

LIGHTING | CALCULATION METHODS

AMBIENT LIGHTING MANIFESTO: THE RESPONSE

In December, *CIBSE Journal* published an 'ambient lighting manifesto', written by four highly respected lighting academics who are calling for a paradigm shift in lighting practice. Here, we print a summary of reactions to the document from leading members of the profession, whose responses can be read in full on our website

The ambient lighting manifesto

Heatherwick Studio, Matzie's, Leeds | Left: The manifesto is published in the December edition of the *Journal*

Barrie Wilde, retired lighting consultant, teacher, and former Society of Light and Lighting (SLL) president:
Having retired recently, after 60 years as a lighting designer, these claims do not register with my own experience, or with that of the profession. Quite the reverse.

The considerable number of highly successful, independent lighting-design consultancies – including specialist lighting units in building services, design and architectural practices – already operate an enlightened design ethos of 'ambient, task, display'. Of course, there are still lighting designs based on spraying a horizontal surface with an abundance of luminous flux, but surely this is a case for education, not a wholesale change in the metrics?

The SLL president's address of 2005, by lighting academic and researcher Geoff Cook, was titled *Mind the gap*, and addressed the widening gap between research and design. This manifesto perhaps indicates that there is still a disconnect between the two and, if a paradigm shift is really necessary, it should be to close this gap, not to produce yet another set of metrics.

36 March 2021 www.cibsejournal.com

The response to the manifesto of eight leading lighting professionals, in the *Journal* in March 2021

towards automating application of standards anyway, but LiDOs opens up opportunities for practitioners at all levels to select design objectives specific to applications, and to incorporate these into their lighting solutions. That cannot be automated.

The new metrics allow designers to focus on what is important to building users and what is relevant in this changing internal environment. It is not intended that the metrics are the focus, or that good lighting is summed up by them.

The metrics are merely tools. They are intended to be flexible and allow legislators to specify minimum levels of ambient illumination. However, this is less about compliance and more about allowing designers flexibility to design for different objectives – even uniform illuminance on the working plane if that is what is required.

A question was also raised about whether clients can understand these metrics. Do they need to? Surely the role of the designer/engineer is to communicate the intentions of the design in lay terms and provide assurance that standards will be adhered to.

We wholeheartedly agree about the importance of vertical illuminance. Our point is that, too often, too little regard is paid to it, and that the introduction of the new TAIR metric allows a more concentrated focus on areas of the room that require emphasis. In practice this will often be vertical surfaces and features.

Vertical illuminance is also important with respect to circadian lighting, but it requires careful handling to avoid visual discomfort. Advantages of focusing on ambient lighting as the means to provide the light exposure necessary for circadian entrainment are that the occupants may receive circadian stimulation wherever they look, with minimal glare.

> "Without research, there would be no evidence to support the change to the new paradigm represented by LiDOs – a whole new way of doing things"

Clockwise from top left: Kevin Kelly, Kit Cuttle, Dr Peter Boyce and Professor Peter Raynham

Despite the existence of new metrics and a new design procedure, there is still some work required to achieve the paradigm shift needed for interior lighting. Specifically, we need evidence that focusing on ambient lighting of interiors produces a more positive response from clients and occupants.

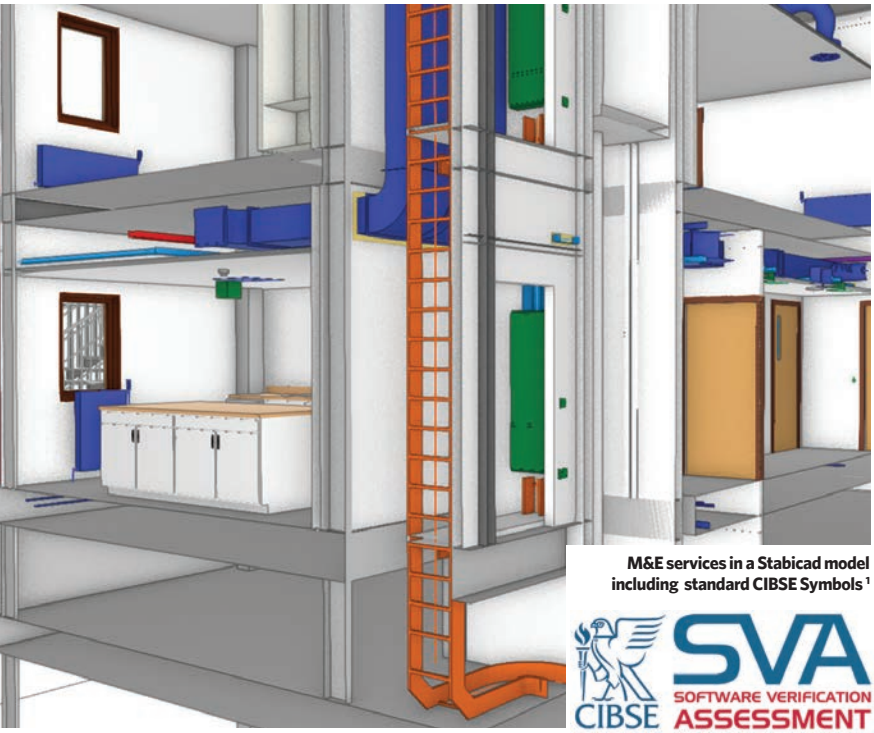
We need more investigation of the financial and energy costs associated with ambient lighting design – and while there are signs that the writers of codes and standards are looking at these ideas, we believe it is clear that better ambient lighting should be the focus of their efforts.

So, there is still much to do, but it is our earnest hope that our manifesto can set the direction of travel for interior lighting design in the immediate future.

KEVIN KELLY FCIBSE FSLL, professor emeritus at Technological University Dublin;
KIT CUTTLE FCIBSE FSLL, lighting consultant;
DR PETER BOYCE FSLL, editor of *LR&T*;
PETER RAYNHAM MCIBSE FSLL professor of the Lit Environment at UCL

TAKING THE RISK OUT OF CALCULATION

CIBSE has launched a Software Verification Assessment service that verifies design software is carrying out design calculations accurately. CIBSE's **Carl Collins** explains how it works with the first software to be verified



M&E services in a Stabicad model including standard CIBSE Symbols [1]

Over the course of their careers, building services engineers will have to get to grips with new software packages that will enable them to perform everyday tasks more quickly and efficiently.

But how do they know the software is actually doing the sums as we would expect? Most organisations run tests on the software and compare them with other calculations that they know to be trustworthy. This may be a familiar spreadsheet that has been used for years, an old piece of software or even a handheld calculator.

Every organisation will have an equivalent validation system and this will be on top of the checks carried out by software providers as part of the software development process – they need to be sure that their product is the best it can be, as mistakes can ruin reputations.

To avoid wasting time and resources, CIBSE has launched an independent Software Verification Assessment (SVA) that will save companies having to carry out their own series of test calculations.

What CIBSE is not doing is providing testing for the whole software platform; that would take too long and be overly complex – it would be difficult to demonstrate what works and what does not. So, instead, CIBSE is setting out a series of tests on specific calculation sets, such as ductwork and pipework calculations.

As CIBSE is the provider of accepted calculation practices – through its guides and other knowledge products – it can test a series of calculations in any given software package against these principles and processes.

Any software that has passed one of its tests can display the SVA logo (see left), which tells users it has been tested rigorously and can be trusted. The aim is that organisations will use the SVA to save time and money by not having to test the software themselves.

Deciding what to test first turned out to be an easy decision. The CIBSE SVA team focused on what members do most frequently – ductwork and pipework were the obvious candidates, with domestic water close behind.

To test a software calculation, the SVA team first has to run the CIBSE-recommended calculation 'long hand'. To do this, a simple spreadsheet is used to replicate the contents of Guide C for ductwork and pipework – such as pressure loss in a straight duct.

Having established the baseline calculation, a CIBSE engineer and technician skilled in the use of the software replicates the calculations in the test set. After successful completion of the tests, the software vendor is issued a CIBSE SVA certificate, the SVA logo and the test results.

First results

The first software vendor to request testing for SVA verification was Trimble, for its Stabicad platform for Revit. Exyte Hargreaves was selected to perform the analysis.

Trimble wanted to prove the accuracy of Stabicad calculations in mechanical, electrical and public health services design. With CIBSE, it developed computer-aided calculation tests to reflect the processes that are important to an engineer.

Trimble worked with rival design software providers as part of CIBSE's Digital Engineering Steering Group. They were aware that SVA verification would carry more weight if all parties were assessed in the same, rigorous way.

As a result of SVA, Stabicad's ventilation and heating and cooling water systems calculations are

> "As CIBSE is the provider of accepted calculation practices, it can test calculations in any given software package"

now verified as being compliant with CIBSE methods.

'Trimble is committed to the digital transformation of the construction industry,' said Lawrence Smith, general manager of Trimble's MEP division. 'Independent verifications around the quality of data add to our customers' confidence and business result.'

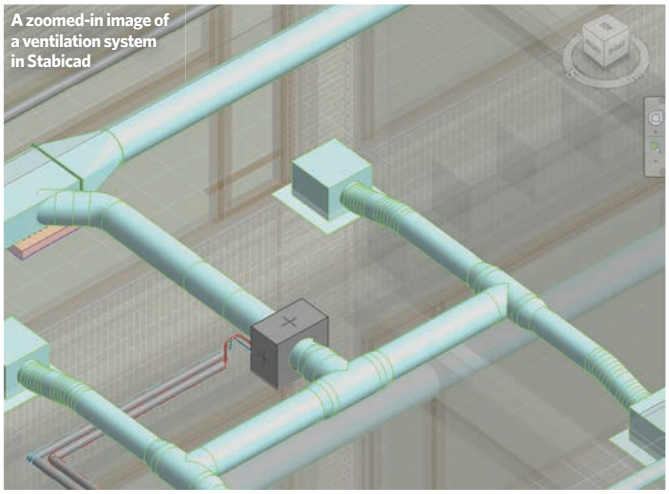
In the past, Exyte Hargreaves had a process that was manual, heavily paper-based, and required a specialist staff member or contractor to complete.

As part of its digital transformation, Exyte Hargreaves moved from this traditional method to implementing Revit in its project and manufacturing design teams. This transformation meant finding a way for the team to work in a 3D environment rather than relying on manual calculations on spreadsheets, or standalone external solutions.

For Exyte Hargreaves' involvement in the SVA project, one of its principal mechanical chartered engineers – with the help of its BIM manager – ran the SVA tests as follows.

After selecting a maximum velocity for each type of duct and inserting a zeta value, the flowrates were inserted as input data. Stabicad was then able to deliver all the calculations of every item, such as pressure drop in straight runs and fittings and a continuous duct run. The results were recorded and returned to CIBSE.

Assessing the results, Exyte Hargreaves was reassured



A zoomed-in image of a ventilation system in Stabicad

Stabicad had passed the tests and, soon after, Trimble was issued with its SVA certificate of verification for Stabicad for ductwork systems. CJ

CARL COLLINS, head of digital engineering at CIBSE

- For more information on the Software Verification Assessment, to request an assessment, or to volunteer as a testing organisation, contact **SDE@cibse.org** and visit **cibse.org/SVA**
- CIBSE would like to thank **Trimble** and **MagiCAD** for helping formulate these tests.

References:

1 CIBSE Standard Symbols **bit.ly/CJMay21SAV**

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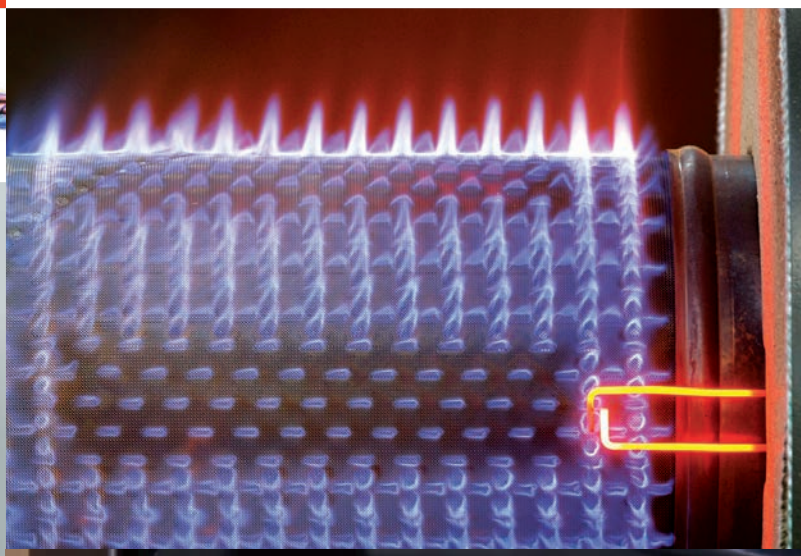

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CIBSE JOURNAL

COMMERCIAL HEATING SPECIAL

HEATING'S NEW HORIZON

What the energy transition means for heating in building services engineering

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

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

Changemakers

The UK government may not yet have published its Heat in Buildings Strategy, but the industry knows the direction of travel – rapid decarbonisation of new and existing buildings.

With heat in buildings making up 40% of the UK's carbon emissions, there is a genuine opportunity for engineers to design building services that have a positive impact on the health of the planet.

In this heating special, we look at industry's response to the transition away from gas-fired appliances. Stephen Livermore and Paul Needley report on what's being done to convert commercial gas appliances to hydrogen, while a project to install a heat pump at Pembroke College, Cambridge, will serve new and historic buildings with low carbon heat (page 42). FairHeat's Michael Ridge (page 36) explains how the switch from gas-fired CHPs to heat pumps is affecting the design of heat networks – while Karen Boswell OBE, MD of Baxi Heating, says hydrogen and heat pumps will both be part of the low carbon equation (page 40). As well as developing appliances, her challenge will be to train the installers and specifiers, too.

Liza Young, deputy editor of *CIBSE Journal*

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A multistrand approach

In the past 14 months, the impact of the pandemic has brought unprecedented, unforeseeable change to every sector of society. Yet, when it comes to heat decarbonisation, it appears that the huge challenge is still very much ahead of us.

What should be evident to us all is that action is needed now. What might not be quite so clear, without definitive government guidance, is how to proceed. At Baxi Heating, we believe that using a mix of technologies and approaches will offer a combined solution to the challenge: heat networks in dense urban environments, and electrification and decarbonisation of the gas grid.

So, we have committed to a portfolio of cleaner, greener products that will work directly with low carbon fuels by 2025, such as heat pumps, smart electric water-heating and heat-network equipment, and hydrogen-ready boilers that can be converted after installation. Providing all the relevant products, backed by our specialist product and technical knowledge, we are well placed to support designers in producing appropriate solutions to meet individual needs.

Energy efficiency will also be key, as the most cost-effective resource available to meet our energy needs. Where technically and financially viable options are limited, taking phased steps – from 'fabric first' measures to improved system efficiency – is far preferable to total inaction.

By adopting this multistrand approach, we believe we can effect positive change and, working together, make real progress towards net zero.

James Galloway is head of commercial product marketing at Baxi Heating.

For more information, visit **www.baxiheating.co.uk**

Golf club retrofit slashes energy demand by 93%

A golf hotel and spa that installed four water source heat pumps in 2020 has recorded a dramatic 93% fall in its energy use.

Energy demand at The Oxfordshire Golf Hotel fell from 1,410kWh to 100kWh after a major retrofit of its 1994 buildings.

Heat pumps were connected to a lake on the course, and water from it is used in two 2,000-litre thermal heating and cooling stores in the upgraded plantroom (see Energy drive, *CIBSE Journal Hotel and Leisure Special*, October 2019). The redesign, by Geyser Thermal Energy, also included a new BMS that integrated separate systems.

Replacing water softeners with Next Scale Stop reduced water waste by 20% and resulted in less brine being discharged, said Geyser. Cleaner water also meant pumps were 15% more efficient because they didn't have to pump solid particles.

Oil use for the boilers has also been reduced by 75%.

New direct-drive fans in the air handling units (replacing old belt-driven units) are 20% more efficient, and the new heat pumps are able to provide cooling.

Lolli Olafsson, from Geyser, said: 'The heating is switched on all the time, but with set-back temperatures of 16-17°C. Yet, the venue's heating and cooling demand is a whopping 93% less than it used to be.'

CIBSE's commercial kitchen guide

CIBSE has published TM50: *Energy efficiency in commercial kitchens*.

The guide provides updated advice for designers, installers and operators of these facilities, in all areas of business and industry, on how to minimise their energy consumption.

TM50 includes sections on agreeing an energy strategy, use of recovered heat, and ventilation heat recovery. There is also a chapter on connectivity and energy optimisation systems.

The PDF can be downloaded now and print copies are available from this month. Members have free access to the digital version. Visit **www.cibse.org/knowledge**

Major update of CIBSE heating guidance planned

New heat-pump guidance among publications due out this year

CIBSE is to publish a range of guidance on low carbon heating solutions this year, after the Knowledge Management Committee highlighted that net-zero carbon was one of our key priorities for CIBSE Knowledge and Research in 2021.

Simon Wyatt, chair of the CIBSE Knowledge Generation Panel, said: 'We recognise that fundamental to achieving this [net zero] will be transition to low carbon heating solutions.'

Publications will include design guidance for heat pumps and insights into the potential role of hydrogen for heating in the UK (see panel, below).

One of the key focuses of the Knowledge Management Committee and Knowledge Generation Panel is bringing CIBSE guidance into the digital era, said Wyatt. He added that CIBSE was reviewing how it categorised and updated its guidance: 'As low carbon is so important, we are starting this exciting process with a review of *Guide B1: Heating* this year.'

Wyatt believes the greatest challenge facing the industry is retrofitting millions of existing private homes, offices, schools, hospitals and shops to reach the government's 2050 net-zero carbon requirement. He said: 'This will require guidance on how to improve energy efficiency and replace fossil fuel-based heating systems with a low carbon alternative, so we can transition to a zero carbon economy supplied with 100% renewable energy. For this we need the support of our members – you!'

Heat-related CIBSE guides coming soon:

- Guidance on heat pumps for multi-unit residential buildings.
- Insights into the embodied carbon of heating systems – off the back of the release, earlier this year, of TM65: *Embodied carbon in building services: a calculation methodology*.
- A focus on fabric first; collating our guidance on building physics.
- Design guide on heat networks.
- A revision of TM54: *Evaluating operational energy performance of buildings at the design stage* to help achieve the emerging net-zero carbon-intensity targets.

HEAT PUMPS SET FOR MANCHESTER'S POWER HALL

The industrial museum where the term 'Northern Powerhouse' was coined is to have a major retrofit that will include the installation of water and air source heat pumps.

The Science and Industry Museum, in Manchester, has been awarded £4.3m from the government's Public Sector Decarbonisation Scheme to improve energy efficiency and lower carbon.

Installation of water source heat pumps will help to heat and power the Power Hall and the 1830 Station and Warehouse, while the New Warehouse will have an air source heat pump. Improved roof insulation and glazing, and a new a BMS to monitor and control energy use, are expected to cut the museum's carbon footprint by 515 tonnes per year.

Viessmann gears up for energy transition

Heating systems manufacturer focuses on hydrogen, heat pumps and digital services

Viessmann has announced gas boilers that can operate with up to a 20% hydrogen mix with natural gas.

Viessmann said its gas-condensing boilers in the Vitodens 200 and 100 range could also convert a 30% blend into heat.

The heating manufacturer said it was focusing on the development of hydrogen- and electricity-powered buildings as it disclosed that a 6% growth in sales in 2020 was underpinned by rising demand for renewables and digital services.

It added to its renewable portfolio in 2020 by buying ThermoWise, a South African commercial heat pump specialist, and Kospel, a Polish manufacturer of instantaneous water heaters, electric boilers and domestic hot water cylinders. Viessmann said green solutions accounted for almost 50% of turnover.

From mid-2021, Viessmann said the Vitocrossal 100 gas-condensing boiler (type CIB) would be able run on a proportion of up to 20% hydrogen and that its Vitomax hot-water and steam boilers can now be operated with pure hydrogen.

It also announced a new controls systems that networks Viessmann energy systems – including heat pumps, ventilation and electricity storage – with digital services.

The firm has also announced it is unveiling new CHP units later this year: the Vitobloc 300 NG 15 and Vitobloc 300 NG 20 models.

Brighton development opts for heat pumps

Planning approval has been given to a new mixed-use student accommodation development in central Brighton that includes air source heat pumps as its primary heat source.

Part of the New England Quarter and London Road Development Area, the new scheme will see the former Marks & Spencer site transformed into retail units and student apartments.

McLaren Property said the five-storey building would feature 156 student bedrooms and communal interior and exterior spaces. Vector is the services engineer and HWA the engineering consultant.

The building will aim for a Breeam 'Excellent' rating and will feature solar panels on a green roof, air source heat pumps and planted outdoor spaces, which will be maintained using recycled rainwater.

Air source heat pump for retail and student flats

Making hydrogen work for commercial buildings

Any conversion from natural gas to hydrogen in the grid must cater for commercial and industrial heating. Enertek International's Paul Needley and Frazer-Nash Consultancy's Stephen Livermore explore the challenges

There is significant interest in the decarbonisation of heat by converting the UK natural gas grid to hydrogen. Of the 23 million homes connected to the network, around 90% have boilers for space and water heating, and about half have gas hobs and fires.

Although domestic heat makes up more than half of the UK heat demand, the provision of space heating, hot water and cooking for commercial and industrial properties accounts for more than 25%.

Any network conversion to hydrogen will need to cater for larger-scale commercial and industrial heating, too.

Overall provision of heat for space heating, hot water and cooking in our homes and businesses accounts for more than 35% of UK energy consumption, according to BEIS. The government has signalled its intention for affordable, low carbon energy through the Clean Growth Strategy, and achieving this is likely to require almost full decarbonisation of heat in buildings.

There has been increasing interest in the potential conversion of the UK gas grid to hydrogen. As intimated in the Prime Minister's 10-point plan, any conversion of the network is likely to start by blending natural gas with up to 20% hydrogen.

Hydrogen has a high energy density per unit mass, but a low volumetric energy density, so a 20% blend only equates to around 7% decarbonisation. There are advantages to this approach, however. It will enable the hydrogen supply chain to be ramped up and it has a minimal effect on appliance performance – domestic and most commercial appliances are already tested for ignition performance with 23% hydrogen as part of certification for use on natural gas. In practice, 20% is likely to be a limit for blending because of certification and technical issues. After that, it will be a jump up to 100% hydrogen.

For the past four years, the government – through the Hy4Heat programme – has been exploring the feasibility of developing appliances that can run on 100% hydrogen, and a number are undergoing trials. Recently, commercial appliances have also been developed.


Stephen Livermore


Paul Needley

"It is estimated that there are around 1.5 million commercial gas appliances"

For a given delivery pressure, hydrogen and natural gas provide a similar energy flux when injected through a burner. This is characterised by the Wobbe Index and means that – from an energy production metric, at least – natural gas and hydrogen are relatively comparable. The key benefit of hydrogen over natural gas is that, at the point of combustion, there are no carbon emissions. Initial findings from the Hy4Heat programme also suggest that NOx emissions – a major air pollutant – are lower for hydrogen than natural gas.

Technical hurdles

There are technical hurdles to deal with. Hydrogen has a greater flammability range and this poses a risk of ignition before the point of combustion. It also has a greater flame speed and is more prone to light-back, where the flame can propagate back upstream.

These challenges can be overcome by: changing the gas and air mixing point and method; smaller burner port diameters; multiple ports; and specifying UV flame detection, except in open spaces, where fast-acting thermocouples suffice. Hydrogen flames are less visible and produce more water vapour (see panel, 'How hydrogen and natural gas differ').

The engineering challenges for developing commercial hydrogen appliances are similar to those faced with domestic appliances, except on a larger scale. On some commercial catering appliances, ignition is manual and requires opening the appliance door, but this is likely to be acceptable for hydrogen appliances, as the gas tends to disperse quickly.

It is estimated that there are around 1.5 million commercial gas appliances in the 2 million or so non-domestic premises in the UK[1] – less than 5% of the number of domestic appliances. As with homes, space-heating appliances are the most prevalent, with around 500,000 boilers in the range 30kW to 1MW. It is estimated that 80% of these boilers are <150kW,[1] so commercial hydrogen boiler development has focused on

PAUL NEEDLEY is managing director at Enertek International and **STEPHEN LIVERMORE** is senior consultant at Frazer-Nash Consultancy

delivering heat through a cascade of domestic boilers.

This provides a relatively cost-effective and low-risk method of demonstrating that hydrogen boilers can deliver heat at commercial scale. Cascade systems have resilience benefits in the event that one boiler fails, although they may need higher down-turn rates than single units in homes. In the long term, it may prove necessary to develop single hydrogen boilers at commercial scale.

The commercial sector also has appliances that are rarely found in homes – including warm air and radiant heaters. Enertek has developed hydrogen variants that are all being certified for use in commercial premises.

Across all hydrogen-appliance development, it is now generally agreed that 'hydrogen-ready' appliances could lessen significantly the burden of a nationwide conversion.

These would be developed with hydrogen in mind, but back-fitted in the factory to run on natural gas up to the point of changeover. If a switchover occurred, a standardised conversion kit could be used to convert them in situ, rather than having to remove the natural gas appliances and replace them with hydrogen versions.

Under the Hy4 Heat programme, domestic boilers are being piloted in unoccupied test homes. An occupied trial is expected to go live at the end of 2022 and last until March 2027. Parallel work carried out under the Ofgem-funded H21 project will verify the gas-distribution network aspects. Commercial and industrial end users are likely to be brought into the trial programme before 2025.

References:

1 *Hy4Heat WP5: Understanding commercial appliances for UK Hydrogen for Heat demonstration*, ERM, Oct 2020 **bit.ly/CJMay21**

HOW HYDROGEN AND NATURAL GAS DIFFER

- **Hydrogen flames are much less visible than natural gas flames (especially when the appliance is cold) and they have an orange tinge (rather than blue with natural gas) as the appliance becomes warm. In most modern appliances this is irrelevant, because flames cannot be seen by the user. Where flames are seen, such as in catering appliances, visibility is improved by a flickering effect and ignition is noticeable by the sound of flames cross-lighting between ports, confirming ignition has occurred.**
- **Hydrogen produces 60% more water vapour for the same amount of energy delivered than natural gas. Most existing condensate drains are oversized, so should cope without difficulty, and flue duct materials are resistant to water vapour. During cooking, the extra moisture content may or may not benefit the food in an oven, but water vapour emitted from the gas burner is deemed insignificant when compared with steam from a boiling pan on the hob.**
- **Compared with natural gas, hydrogen is more prone to leakage, although it is significantly more buoyant, so any leak will tend to disperse more rapidly. The intention is to use the same odorant as natural gas.**
- **Natural gas appliances tend to use ionisation sensors to detect the presence of ignition. In the absence of hydrocarbons in the exhaust, these will not work, so alternative mechanisms – such as UV or infrared detection – will need to be used.**

Over the past 18 months, heat pumps have replaced CHPs on heat networks, according to FairHeat's Michael Ridge. The challenge now, he says, is to integrate the technology successfully, while still providing reliable and affordable heat for customers and residents

Designing for large-scale heat pumps

Working in the construction sector as a heat-networks specialist, I have seen my fair share of policy changes and new technology trends. However, none has been as significant as the transition we are currently navigating: the heat pump has arrived, and it is here to stay. Heat-pump technology is our best bet to aggressively decarbonise the UK's heat sector, as we move from fossil fuel-based systems and take advantage of the falling carbon intensity of the Grid.

Only 18 months ago, the projects I was supporting were gas-based combined heat and power (CHP), but this era feels well and truly behind us now. The new challenge is to integrate heat-pump technology into heating systems effectively, while still providing the resident with an affordable and reliable service.

It is now common for a development to supply both residential and commercial spaces with heating and hot water, and a communal system is often the most cost-effective way to achieve this, rather than commercial units having to install standalone systems.

This article is focused on optimising the design of low temperature heat networks (LTHN) to enable efficient integration of centralised heat-pump technology. The LTHN system in question can be considered to comprise of:

- A site-wide heat network that supplies heating and hot water to end users through heat interface units (HIUs) that separate the network from the resident's dwelling-level heating and instantaneous hot-water systems
- A centralised energy centre containing the generation and distribution plant that serves the site-wide heat network
- Low flow temperatures of 55-60°C
- Low return temperatures of 25-30°C.

It's all about the temperature

Even in CHP-led systems, FairHeat has been preparing developers of heat networks for low temperature design and operation. This is to combat the excessive heat losses and overheating risks that have plagued the industry from systems operating at, or above, 70°C. A heat network can supply heating and hot water to meet the demands of residents at flow temperatures of 55-60°C, but this requires joined-up thinking between the dwelling and heat-network design.

With the introduction of heat pumps, it is doubly important for the operating temperatures to be as low as possible. Heat pumps operate more efficiently at low output temperatures. Perhaps even more challenging, most models on the market have not been optimised for operating in heating mode, but are really chillers operated in reverse. For the few 'high temperature' heat pumps available, their coefficient of performance (COP) generally starts to be compromised at output temperatures above 60°C, which puts an upper limit on the operating temperature of heat networks.

Effect of lower operating temperature on radiator size

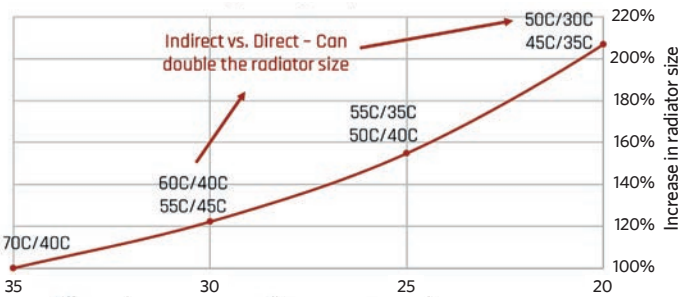

Figure 1: Impact of radiator operating temperatures on unit size

FairHeat Engineers checking the plantroom heat meters to inspect flow and return temperature performance from a central plant

"With heat pumps, it is doubly important for the operating temperatures to be as low as possible"

To make a 60°C network flow temperature work for accommodation, a forward approach temperature (the difference between the incoming and outgoing hot water) across the HIU will be required to transfer heat from the network to the dwelling. If this temperature difference is too low, the plate heat exchangers become too big, and the control stability can be compromised.

For domestic hot-water (DHW) generation, we recommend that a forward approach temperature of 5°C is used. For space heating, this will probably need to be between 7°C and 10°C depending on the HIU selected.

The HIU will need to deliver DHW at sufficient temperatures to meet the HSG 274 requirements for legionella control. Historically, there has been confusion in the industry about how this is applied to HIUs supplying instantaneous hot water, as opposed to hot-water cylinders, for which the risk is much greater because of the presence of stored water.

This has been clarified through the work of the CIBSE DHW Working Group, with the Health and Safety Executive confirming that HIUs delivering instantaneous hot water are to be considered 'low risk' systems, required to deliver a minimum temperature of 50°C at the outlet or immediately upstream of any TMV. This is now reflected in the updated *ADE CIBSE Heat Networks Code of Practice, CP1 (2020)*, which permits network flow temperatures as low as 55°C. »

» Lastly, the HIU will need to deliver sufficient space-heating temperatures to the dwelling-level heat emitters to achieve their design outputs. Underfloor heating (UFH) systems, because of the large surface area of loops, operate at very low temperatures of 40-45°C. This makes them ideal technologies for LTHNs, as they no longer influence the minimum operating temperature of the main network, which is, instead, determined by the DHW set point. This allows LTHNs supplying UFH to operate at network flow temperatures as low as 55°C, as dictated by the DHW requirements.

For radiator systems, the solution has become a trade-off between low temperatures and increased radiator sizes. Traditional radiators have operated with flow temperatures of 60-70°C, whereas this will need to drop to nearer 50°C for LTHNs. The increase in radiator size this necessitates can be problematic for the dwelling design, leading to aesthetically unpleasing wide or deep radiators.

As can be seen, the dwelling design is intrinsically linked to the viability of a heat pump-led heat network. This requires early consideration in the design process and alignment between the responsible design parties. We have seen a significant shift to UFH systems by developers in recent years because of the benefits they provide to LTHN operating temperatures, and the simplicity of commissioning compared to radiators.

Thermal storage: heat pumps' best friend

Heating and hot-water demands have a frustrating characteristic for heat-network designers: the peak demand that the system must be capable of providing occurs infrequently and for short durations.

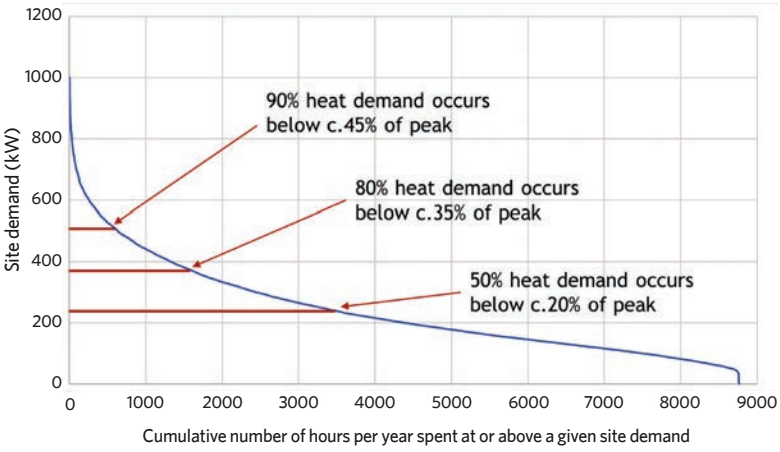

Figure 2: Hourly demand profile for a c.500-unit scheme

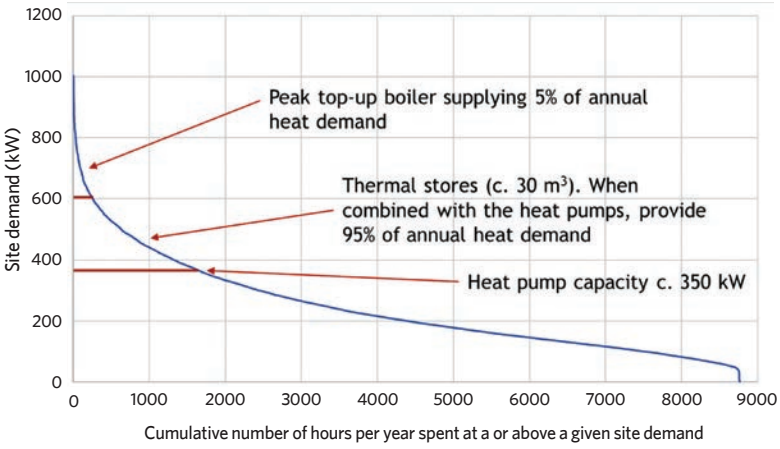

Figure 3: Hybrid system design using large thermal stores to provide 95% of annual heat from heat pumps sized for only 35% of peak demand

> "Heat pumps are an expensive technology; an ASHP is likely to cost £500-800/kW of capacity"

Most of the time, the load is significantly lower than its absolute peak. This is illustrated by Figure 2, which shows the hourly load profile for an example, high-density, 500-unit residential scheme; 50% of the annual heat demand is occurring below 20% of peak demand.

Heat pumps are an expensive technology; an air source heat pump (ASHP) is likely to cost £500-800 per kW of capacity. As a result, shifting a network's peak demand entirely on to heat pumps will result in significantly more expensive systems. For a 1MW system, this is a £500k-800k expenditure on the heat pumps alone.

An alternative approach is to combine large thermal stores and 'peak top-up' boilers to limit the required heat-pump capacity. Large thermal stores are essential for extracting the maximum kWh contribution for each kW of heat-pump capacity. Because of this impact, they are a key driver for reducing the total system cost, so should be considered as early as possible in the design to ensure sufficient space is provided for their installation.

Figure 3 shows how, for the same 500-unit scheme, a 350kW heat pump, combined with a 30m^3 thermal store, can provide 95% of the annual heat demand. The remaining 5% is provided by boilers, which can be gas or electric depending on the requirements of the site.

From a decarbonisation perspective, the result is comparable to an all-heat-pump system, but with several advantages. The system has a capital cost about 50% less than an all-heat-pump solution. Further, it is future-proofed, as the carbon intensity of the heat will decarbonise with the Grid and, when appropriate, the boilers can be replaced with lower-carbon technology. The system could also connect to a nearby heat network and deploy a controls strategy that determines whether to run the onsite heat pumps or use the heat-network supply, based on carbon, cost or combination of the two.

An exciting time to be in heat networks

Decarbonising heat is a massive challenge, and heat networks will play an important role in this journey. Engineering optimal solutions that are cost-effective for all stakeholders in the life-cycle is critical to their success.

Their unique position as a technology agnostic infrastructure for decarbonising heat at scale, and over a long period, is, arguably, unrivalled, and is proven to work. Scandinavia shows us that this challenge, while daunting, does not require us to reinvent the wheel.

Heat pumps are a new engineering problem to solve. To navigate this successfully will require pragmatism, consideration for the end user, and a risk-based approach, to arrive at designs that deliver for all stakeholders. CJ

MICHAEL RIDGE is principal engineer at FairHeat

To read more on heat-pump selection and air source v ground source heat pumps, read this article at **cibsejournal.com**

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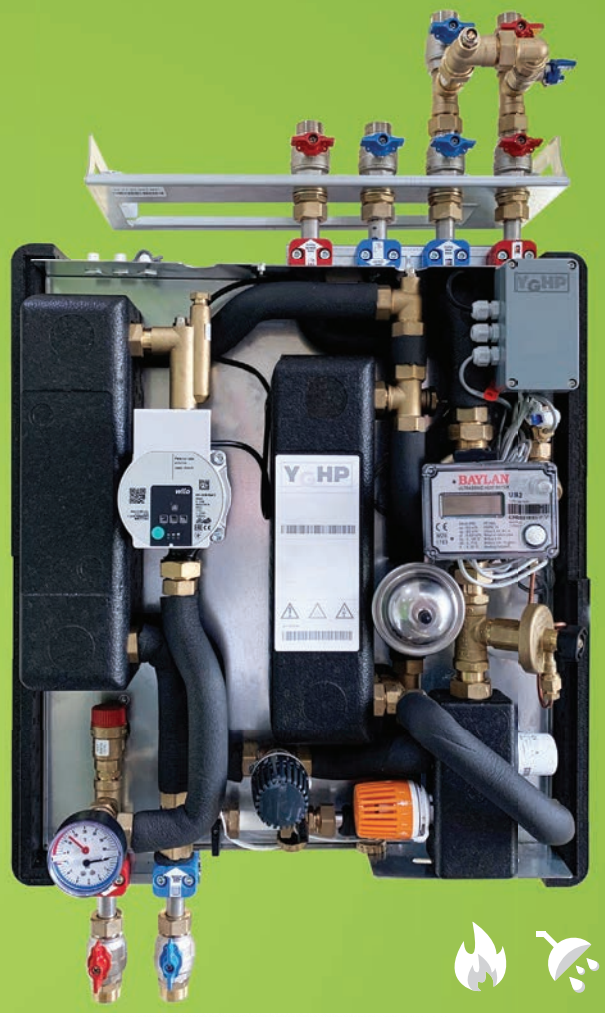

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Baylan or Sharky 774 MBUS Heat Meter	Y - Pattern Strainer
CIMM Water Shock Arrestor	Thermal Actuator
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Leading the revolution

Karen Boswell OBE joined Baxi Heating as managing director during a time of significant change for the heating industry. She tells Alex Smith how the boiler manufacturer plans to lead the transition to low carbon heating and become carbon neutral by 2030

'The heat revolution is coming and we've got to be prepared.' Baxi Heating's managing director Kate Boswell OBE is in no doubt that the government's pledge to decarbonise buildings will lead to a radical change in how heat and hot water is delivered to them.

Heating accounts for around 40% of the UK's greenhouse gas emissions, predominantly through the burning of natural gas. For the UK to meet its target of net-zero carbon emissions by 2050, boiler manufacturers such as Baxi will have to develop alternatives to traditional boilers – and fast. As part of the roadmap to 2050, the government is proposing to ban gas boilers in all new homes by 2025.

'We are committed to a portfolio of cleaner products that work with low carbon fuels by 2025,' says Boswell. 'Change is coming, whatever way you look at it, and we have to be ready to offer people what they require to take advantage of the heat revolution.' Baxi, she adds, is changing the way it works, too: it is committing to be carbon neutral in all operations by 2030.

Leading change is not new to Boswell. Before joining Baxi last September, she was a managing director at Hitachi Rail Europe, which also faces a major energy transition – from diesel to electric and hydrogen.

The solutions proposed by Boswell are around heat pumps, heat networks in dense urban environments, and hydrogen-ready boilers. 'We have a multistrand approach using a mix of technologies to offer solutions to the challenge,' she says.

Boswell advocates air source heat pumps for well-insulated new buildings, and Baxi markets them as part of its Assure range. For heating existing properties, she believes that hydrogen can replace natural gas. 'We see the repurposing of the gas grid to support hydrogen as a non-disruptive solution, particularly in poorly insulated buildings. It can capitalise on the existing infrastructure and transition us to a cleaner fuel source,' she says.

Baxi has been working with the UK government on hydrogen trials. It is involved in the HyDeploy energy demonstration at Keele University, where up to 20% of hydrogen is being injected into a natural gas network serving 100 homes and 30 faculty buildings. Alongside Worcester Bosch, Baxi is also showcasing hydrogen boilers at a 100% hydrogen housing demonstration project near Gateshead. 'It's important to work with gas providers to understand their requirements and see the part you play,' Boswell says.

Results from the trials will be published by Baxi soon, but Boswell is confident that hydrogen boilers will work – in part because of the work done on hydrogen appliances by its Remeha brand in The Netherlands. 'Technically, we're doing well, and I know we'll be able to make great products and the controls that manage it,' she says.

Baxi has called on the government to mandate hydrogen-ready boilers for new installations in 2025, and she says there will be commercial hydrogen-ready boilers on the market from 2024. 'The installation of hydrogen boilers could begin a long way before 100% hydrogen networks are available. If you have a boiler that is ready and adaptable, it can be adjusted for hydrogen in a simple, non-intrusive way,' says Boswell, who believes the big challenge is around public understanding of what hydrogen will do.

'We have a lot of work to do to support consumer understanding. Affordability, consumer choice and acceptance is a big part of the journey, and we have to be careful to avoid fuel poverty,' she says.

Preparing engineers for the energy transition is also a big focus. 'Engineers are

"Engineers are a precious commodity – you need to nurture them and encourage them to adopt new technologies. The onus is on us"

a precious commodity – you need to nurture them and encourage them to adopt new technologies,' says Boswell, who sits on the board of Enginuity (**enginuity.org**) an organisation supporting skills development in UK engineering.

'The onus is on us to help them succeed. There won't be a cliff edge; it's something we are working towards over time.'

To prepare its staff, Baxi is investing in a new training academy in the Midlands, which will also be available to specifiers, installers and contractors to learn about new domestic and commercial products. It is also creating hubs of skills in its internal teams, and has created a roadmap of the training and development opportunities on offer.

CAREER CV

September 2020: Joins Baxi Heating as managing director UK and Ireland
2019: Joins Enginuity as board member
2015-19: Managing director at Hitachi Rail Europe
2016 Made an OBE for services to the railway industry
2009-15 Managing director at East Coast Mainline
2006-09 Deputy managing director, First Capital Connect

Karen Boswell OBE joined Baxi Heating as managing director in September 2020

Baxi Heating's hydrogen appliances are currently being trialled

Boswell is also keen to encourage the next generation of engineers, so Baxi has partnered with 10 schools near its manufacturing site in Preston. 'It's brilliant. It's a really great way of also educating the teachers and parents,' she says.

In addition, she wants to encourage people from a diverse range of backgrounds to come into the industry, and an aspiration to create an inclusive culture that supports equal opportunities was included in Baxi's Sustainability Pledge.

'There's not enough diversity. We need to make environments feel right, culturally. We want an organisation that's committed to enriching diversity in all its forms,' she says. 'You have to run a company that looks like the customers you serve – otherwise, how can you possibly understand and come up with the right solution? It starts with demonstrating how interesting our industry is, showing the potential career paths and thinking about how we communicate with people.'

Another part of Baxi's Sustainability Pledge is aiming to be carbon neutral in all operations by 2030. It recently consolidated its UK manufacturing operations into one factory in Preston, which Boswell says has resulted in 'considerable energy benefits'. The company is also focusing on removing waste in packaging and promoting responsible energy consumption and recycling, and a new BMS at Preston has enabled energy use to be monitored closely. Vehicle emissions are also under the microscope; by 2025, Baxi aims to phase out non-electric vehicles and, this year, is trialling an electric van.

Boswell says Baxi is looking at the efficiency of materials all the way through its production stages, and at the embodied carbon of its products. 'Embodied energy is a massive issue. It affects the whole supply chain and, as an organisation, we want to influence this – but it's not a quick fix,' she says.

Baxi now insists that key suppliers achieve a minimum bronze EcoVadis certificate of sustainability. While this doesn't guarantee low embodied energy, it indicates a direction of travel, says Boswell. 'We're driving harder on embodied energy. It's something we want to get to grips with. It's on the agenda,' she adds.

Despite the Covid-19 pandemic and Brexit uncertainty, Boswell reports a strong commercial start to the year. Q3 and Q4 were also strong last year and Baxi did not stop production. The big unanswered question, she says, is whether people will return to their workplaces,and how empty offices will be repurposed. Even before the pandemic, Baxi had been looking at how its staff might work more flexibly and at more collaborative spaces.

'A positive that has happened is people's confidence in their use of technology, and the realisation that some people can work from home very effectively,' Boswell says. Increased awareness about mental health and wellbeing has also been a really good thing, she adds, as has the chance to think differently about work. 'It's not about working harder; it's about working smarter. We're trying to encourage people to take regular breaks – go for a walk for an hour. It takes confidence for people to do that and not feel they have to be chained to a desk all the time.'

An opportunity to reset in a post-pandemic world will give Boswell the chance to double-down on her sustainability goals. She understands the role heating companies such as Baxi have in determining whether we hit our net-zero goals. 'I'm passionate about living in a sustainable world and taking some responsibility for that,' she says. 'Future generations will judge us by our actions.' **CJ**

Fuel for thought

Use of a community heat pump at Pembroke College's mixed-use project in Mill Lane, Cambridge, is the latest in a long line of energy transitions on the university site. Andy Pearson looks at plans for the connection of both new and historic buildings

Electricity is replacing gas as a cleaner source of heat. The phase-out of coal-fired power stations and the growth in renewables, such as wind and solar, have made grid electricity a low carbon, cost-effective replacement for gas in heating.

Energy transitions are not new; decades earlier, natural gas was used widely as a ready replacement for coal and the sulphurous smog it made. Centuries before, the concentrated heat in coal meant it replaced wood, which had been burned to provide heat for thousands of years.

All of these historic energy transitions have featured on the site of a new development in Cambridge, where Pembroke College is undertaking a significant expansion in the historic city centre, on a site bordering the River Cam.

Designed by architect Haworth Tompkins, the proposals for the Mill Lane redevelopment include: demolition of a number of unremarkable buildings and their replacement with a new student residential court; the restoration of a number of historic and significant buildings to provide new teaching, meeting and seminar rooms; and the creation of a new gallery and performance venue in the listed Emmanuel Reformed Church.

If this scheme had been designed a decade ago, gas would have been the obvious choice of fuel for heat. What makes it significant is that it is one of the first of a new wave of large-scale projects where heating (and cooling) for the entire development is to be supplied by electricity-powered air source heat pumps (ASHPs). 'The transition to low carbon electricity for heating and cooling in buildings is happening, and it's happening now,' says Joel Gustafsson, director of Joel Gustafsson Consulting, the project's building services engineer.[1]

Fabric energy performance is fundamental to the success of the scheme. New-build areas, such as the accommodation block, Dolby Court, will have high fabric-performance standards from the outset, while the fabric performance of the retained elements will be upgraded significantly.

'Working with the architect, we undertook a full sustainability audit, which resulted in increasing the airtightness of the buildings, enhancing the amount of PVs on roofs, increasing insulation levels, and even a reduction in the embodied carbon,' Gustafsson explains.

To develop the façade design and to prevent the students' rooms from overheating in the main accommodation block, Gustafsson has used a combination of

CIBSE TM59 and CIBSE TM52 to arrive at a comfort strategy. Both documents (available at **cibse.org/knowledge**) address the risk of overheating in buildings; TM52 can be used to assess any type of commercial building, whereas TM59 has been tailored to target overheating risk in homes specifically.

'We have used a composite of CIBSE TM59 and TM52 for the overheating strategy because student rooms are simultaneously domestic and commercial work spaces,' he says.

Unfortunately, Dolby Court is positioned on busy Mill Lane. Noise from the street prevented windows in rooms fronting the thoroughfare from being opened for ventilation to achieve acceptable levels of comfort. So, in addition to heating, the rooms incorporate cooling and mechanical ventilation with heat recovery.

Heating is in the form of an underfloor system, with pipes embedded in the floor screed; cooling is provided by pipes embedded in the concrete soffit, in what Gustafsson describes as 'an augmented passive strategy'. He says the cooling system temperatures – designed to run at 14°C flow, 18°C return – will be 'allowed to creep up' if it is very warm outside.

Both heat and coolth are supplied by the site's electric ASHPs through a heating and cooling network. These are housed in the ground-floor plantroom, beneath Dolby Court. 'Electric heat pumps are the new norm,' says Gustafsson. 'Pembroke College subscribed to that view because it knew it was the right thing to do, environmentally, and it could see the longer-term trend – so it has taken the longer-term view'.

The scheme's design is still being finalised. 'Right now, we're investigating the option of using natural refrigerant-based heat pumps, of the type established in the European market, because the client is keen to understand the possible efficiency gains and environmental benefits,' says Gustafsson.

Initially, a ground source heat pump solution was considered alongside the air source units. However, site spatial constraints meant the ground source system would have been confined to a single pair of abstraction and injection boreholes, with an estimated output of around 100kW – about 20% of peak heat demand. It was concluded that the cost and complexity of operating two concurrent systems was not warranted, so the idea was abandoned.

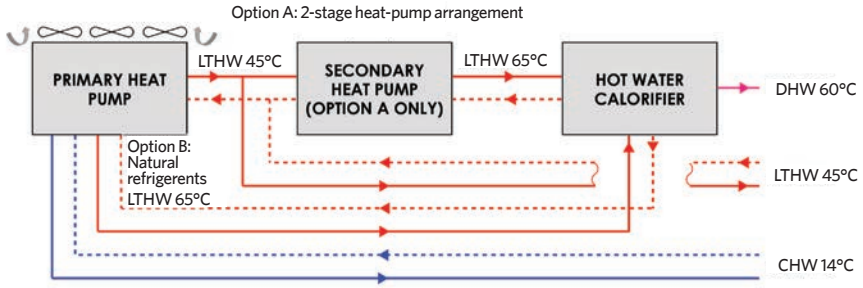
Subject to the ongoing review, the base case is that three large ASHPs, each with the capacity to supply up to 150kW of heat for space heating and 135kW of cooling,

> "To develop the façade design and prevent students' rooms from overheating, a combination of TM59 and TM52 was used"

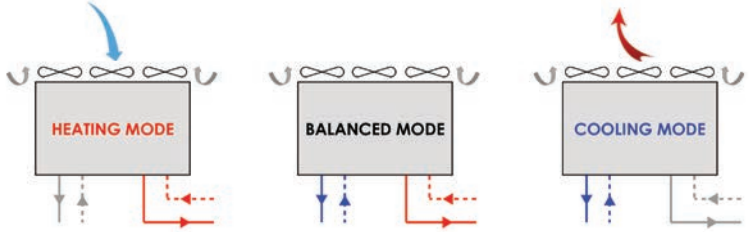
serve the site-wide network. The primary hot-water circuit is designed to operate at a temperature of 45°C flow/40°C return. A secondary heat pump will raise the water temperature to 65°C to supply domestic hot-water calorifiers, located in a basement plantroom next to the main plantroom. They serve all the new buildings, plus the catering in the refurbished 6 Mill Lane. A chilled water circuit will operate at 14°C flow/18°C return to supply cooling to Dolby Court and a basement screening room, art gallery and teaching spaces. The former United Reformed Church, however, remains passive as the Victorian natural ventilation provision still holds its own against the CIBSE TM52 standard for lecture and performance use.

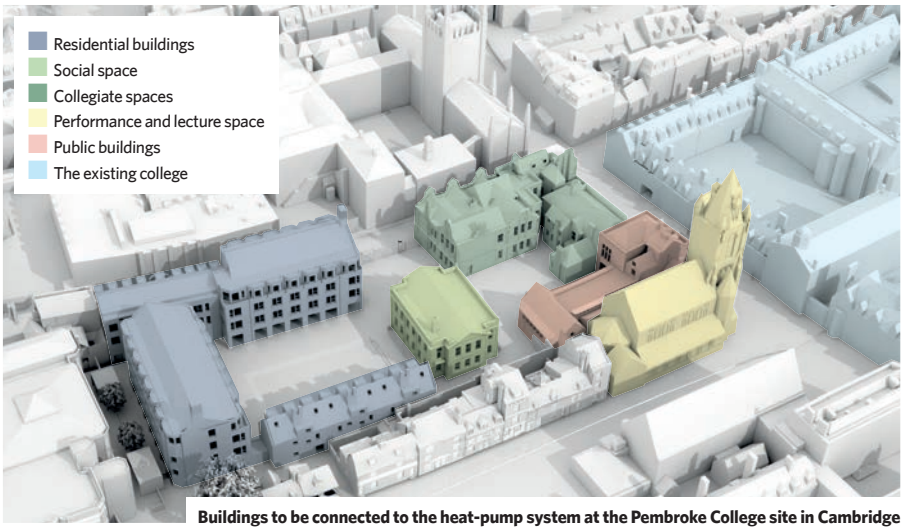
'The lower your heating temperature, and the higher your cooling temperature, the less work the heat pump has to do to provide the outcome »

1 Space heating and hot-water production
Option A: Two-stage heat-pump arrangement – primary LTHW to 45°C. Secondary LTHW to 65°C
Option B: Single-stage heat pump with natural refrigerants – LTHW to 65°C



2 Heat-recovery heat-pump system – mode of operation





Buildings to be connected to the heat-pump system at the Pembroke College site in Cambridge

» that you want,' explains Gustafsson.

The lower-temperature heating mains make it more of a challenge to deliver heat to the site's refurbished buildings. These were originally heated using traditional gas boilers with heating circuits that operated at more conventional system temperatures of about 80°C flow/71°C return. However, the new, lower-temperature heating circuits require more efficient heat emitters.

'If we take the church, for example. At the moment, there are slimline radiators behind panels; the panels are being retained, so we're[1] using highly engineered aluminium radiators, which incorporate a little fan to assist the heat transfer from them,' says Gustafsson. 'It's the same technology, it's just that the bit you don't see is better engineered.'

The three heat pumps are sized to meet the total load. There is no additional capacity because the system incorporates a level of resilience. In the event of a heat-pump failure, a maximum of one-third of peak load will be lost. 'In the majority of situations, there will still be enough capacity to sustain a reasonable level of service for a period of time, while the main plant is repaired or replaced,' says Gustafsson.

In addition, each individual heat pump has inherent resilience because it has two compressors and four fans; if a fan or a compressor fails, the heat pump is still capable of providing up to half the load.

The heat pumps have three modes of operation:

- **Heating mode, where the units extract heat from ambient air**
- **Cooling mode, where heat is rejected to the ambient air**
- **Balanced mode, where the heat demand is equivalent to the heat removed by the cooling system. Heat removed by the cooling system is added to the heating and hot-water systems.**

'We're using heat-recovery air source heat pumps so that we can take the heat from the places that have excess and put it into either space heating or domestic water – which reduces the amount of electricity needed to keep the buildings comfortable,' says Gustafsson.

'We're also incorporating buffer vessels to maximise the time the system will spend in balanced mode.'

A small additional heat pump will be installed to keep the cold-water system cold. According to Gustafsson, high temperatures are becoming an increasing issue for cold-water supplies, particularly in college buildings. As water temperatures rise, the management of legionella risk becomes more onerous and the quality of service decreases.

To overcome this, the scheme will include a heat pump to cool the water within the cold-water tank so that stored water is always below a set point of about 10°C. The small amount of heat rejected will be transferred to the hot-water calorifiers. Additionally, the temperature of the water throughout the system is monitored and low volumes are automatically discharged when the water in the pipework goes above 15°C. This will ensure low-temperature cold water is available at every outlet, regardless of usage patterns or ambient temperature. It has the additional benefit of removing the water waste associated with flushing water through the system to manage legionella risk.

As well as designing for the present, the design team is designing for the future. Pembroke College has been in existence for hundreds of years (it was founded in 1347 by Marie de St Pol, Countess of Pembroke); the new buildings are expected to be in use for many, many years to come.

To ensure Dolby Court's plantroom can accommodate the equipment it will need to meet the next energy transition – whatever that will be – the design team has provided it with additional space.

'The college understands that what it's doing here will be fit for many generations of students, so we're not just doing what's right for 2021 – we're enabling what's right for 2100 and beyond,' says Gustafsson.

He is already eyeing up the additional space to house a large storage battery, which will enable the college to buy grid electricity when it is cheap and store the energy generated by the site's PV installations. 'A battery will probably have an economic value, and will further reduce the environmental impact of the scheme, because electricity is cheap when it's low carbon,' Gustafsson says.

Work on the scheme is set to start this month, with demolition of some of the unretained buildings. Construction is expected to start in 2022. When the heat pumps are installed, the site's next energy transition will be complete. **CJ**

A HISTORY LESSON IN ENERGY SUPPLY

In the 19th century, the Pembroke College site was the industrial heart of Cambridge when it housed a large water mill for milling grain from the surrounding farmland. Later, the site was home to the Bailey Grundy Barrett Building, headquarters of the Cambridge Electric Supply Company (now being demolished to make way for Dolby Court). Bailey Grundy Barrett operated the first coal-fired power station in the city, using coal delivered by barge on the river Cam.

The power station generated electricity from 1893 until nationalisation in 1947. In addition to burning coal to generate power, coal was burned to provide heat in many of the buildings, as their numerous chimneys testify. Now, the coal fires have been replaced with cheaper and more convenient gas-fired boilers. Soon, these too will be gone, replaced by electric air source heat pumps.

To provide electricity to the development, the existing substation, which is located in the soon-to-be-demolished Bailey Grundy Barrett Building, is being relocated. In a nice touch, the building to house the substation will be built using bricks reclaimed from the demolition of the former headquarters of Cambridge's first electricity company. A 2MVA substation (incorporating two no. 1 MVA transformers) is proposed for the southwest corner of the site.

The now demolished King's Mill was powered by the river Cam

Footnote

1 Joel Gustafsson completed the design from concept to RIBA stage 3 as a partner at Max Fordham. Delivery of Dolby Court, including the technical design of the site-wide heat pumps, is being undertaken by Joel Gustafsson Consulting. Max Fordham is the services engineer on the delivery of Phase 1 buildings.

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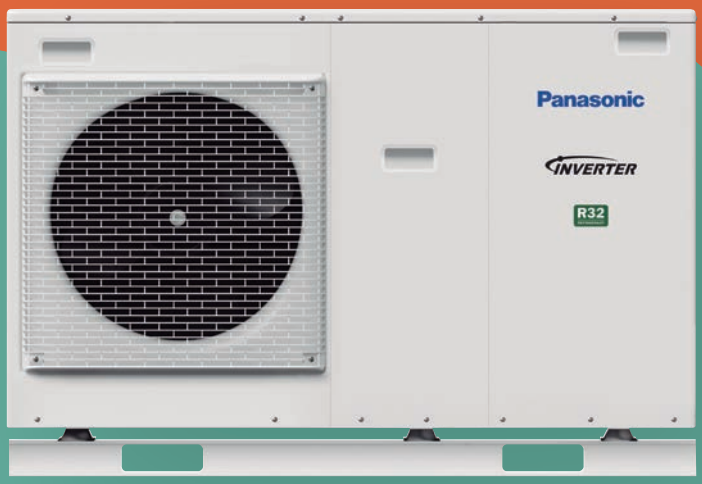

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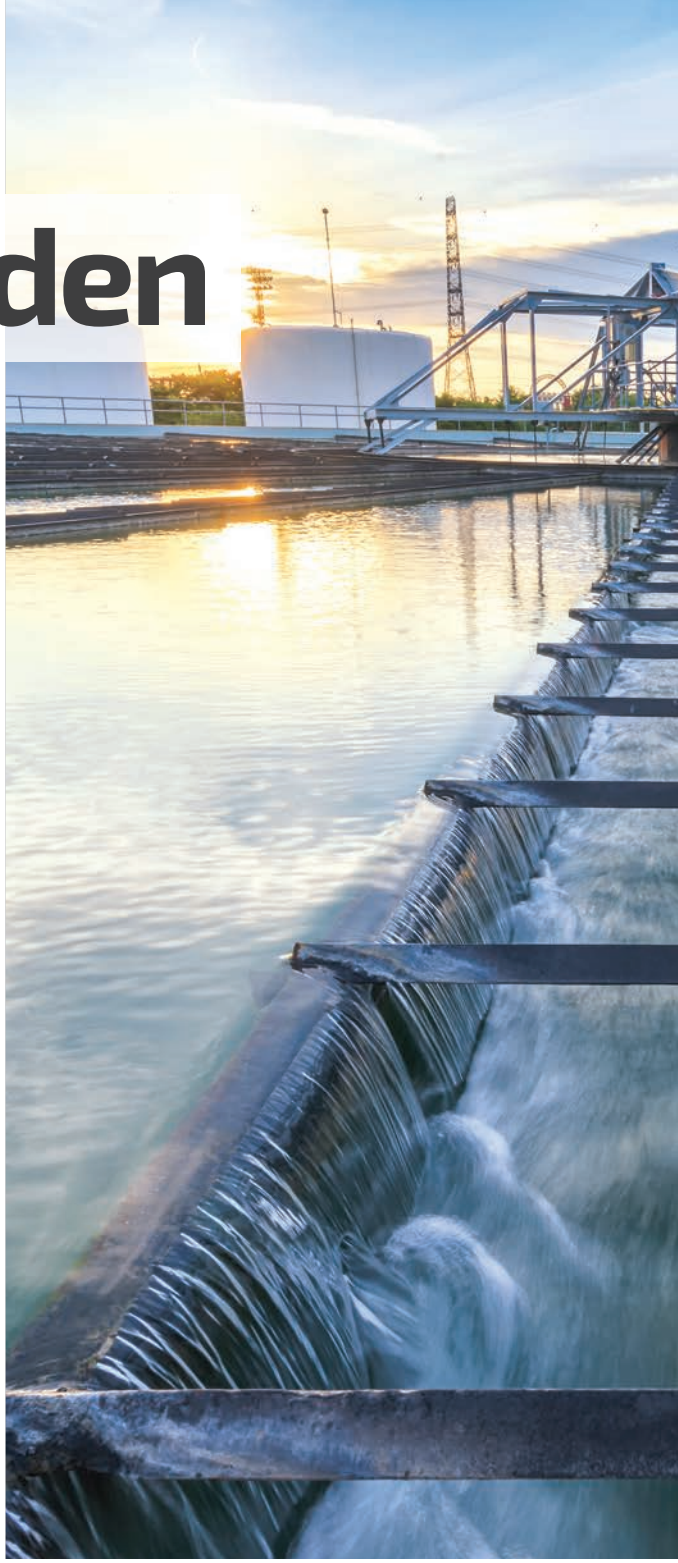
London's hidden heat source

A new wastewater heat-recovery project announced by Thames Water and Kingston Council could provide a model for future schemes in London. Andy Pearson reports



Thames Water and Kingston Council have unveiled plans to use heat recovered from a wastewater treatment plant (WWTP) in Kingston upon Thames, southwest London, to provide low carbon heating for more than 2,000 homes in the borough.

Under the partnership, heat recovered from the effluent leaving the sewage-treatment process at the WWTP will provide clean, green heat and hot water to new homes soon to be built under the regeneration of the nearby Cambridge Road Estate. If successful, up to 7GWh of low carbon heat could be supplied per year.

The scheme in Kingston is still being finalised. Currently, Thames Water flushes 69 million litres of clean warm water from Hogsmill WWTP into the Hogsmill river every day, as treated effluent. This effluent is at a temperature of between 10-15°C all year round.

Under the proposal, one-third of this effluent will be piped to a new energy centre, where heat will be extracted before it is discharged. A heat pump will concentrate the reclaimed heat, which will then be piped to the district heating system being built to serve the 2,170 new homes on the redeveloped housing estate. If successful, the scheme could be expanded to public and commercial buildings in Kingston town centre.

This is the first project of its kind in England, but similar schemes are already operating successfully in cities such as Oslo, Vancouver and Beijing, which reuse heat from the billions of litres of warmed water that end up in sewers every day.

Closer to home, in Scotland, Borders College, Galashiels, has been recovering heat from wastewater since December 2015. Here, the system is producing 1.9GWh of heat annually, which is about 95% of the heat demand of the college, with no negative impacts on the operation of the local sewer network. The value of gas saved is around £10,000 per year, while carbon savings as a result of the scheme are estimated to be 170 tonnes of CO_2 a year.

Resource

Heat in sewers is a huge global resource. The heated water from showers, dishwashers and washing machines, for example, goes down the drain, literally, and into the sewer. In Switzerland, it is estimated that 6TWh of thermal energy are lost every year through the sewage system, corresponding to around 7% of the country's total demand for space and hot-water heating. In the USA, the figure is higher, with Americans estimated to flush a massive 350TWh of energy down the drain each year – the equivalent of heating 30 million homes a year.

In the UK, energy from the 16 billion litres of sewage wastewater dumped in the sewers every day could, theoretically, provide more than 20TWh of heat energy annually. This is enough to provide space heating and hot water to 1.6 million homes, according to a paper on heat recovery presented by S Farman Ali and A Gillich at the 2020 CIBSE Technical Symposium.[1]

This paper states that the average temperature of wastewater in UK sewers varies between 10°C and 25°C, depending on the time of year and whether the sewer is combined to carry rainwater. By the time the wastewater has reached the treatment plants, which are often situated out of town, it will have cooled to approximately 10-12°C. However, treatment processes in the WWTP to clean the water can reheat the wastewater by 2-3°C, so the average temperature of water leaving the treatment plant is a consistently between 12°C and 15°C year round.

Recovery

The task of recovering heat from urban wastewater can be performed either before the WWTP – where the wastewater is

> "In the UK, the energy from the 16 billion litres of sewage wastewater dumped in the sewers every day could provide more than 20TWh of heat energy annually"

untreated – or after it has been treated in the WWTP. Upstream heat recovery has the advantage that the wastewater is at a higher temperature and the extracted heat is more likely to be close to where it is needed. However, there are limits on the amount of heat that can be extracted because the performance of the WWTP is dependent on the wastewater being maintained above a temperature of about 10°C.

The downside of this arrangement is that the heat exchanger is likely to require frequent maintenance to remove fouling and biofilm growth. In the case of combined sewers, natural events such as rainfall and snow melt could also alter the water temperature significantly, affecting the efficiency of the system.

Heat recovery downstream – after the water has been treated in the WWTP but before the effluent is discharged – has several advantages. Perhaps the »

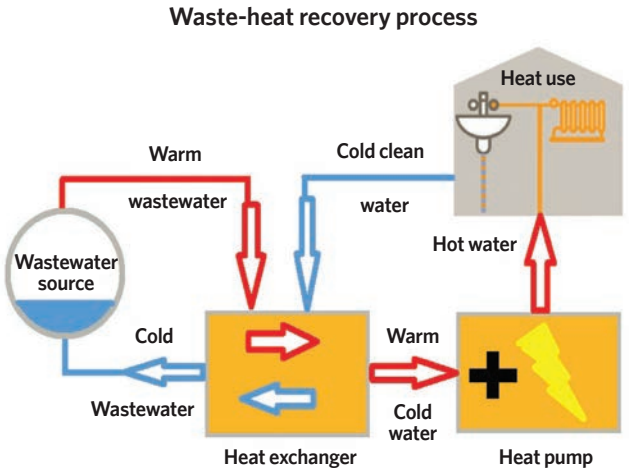


Figure 1: Wastewater heat-recovery process – adapted (13, 14)

If successful, the scheme could heat buildings in Kingston town centre

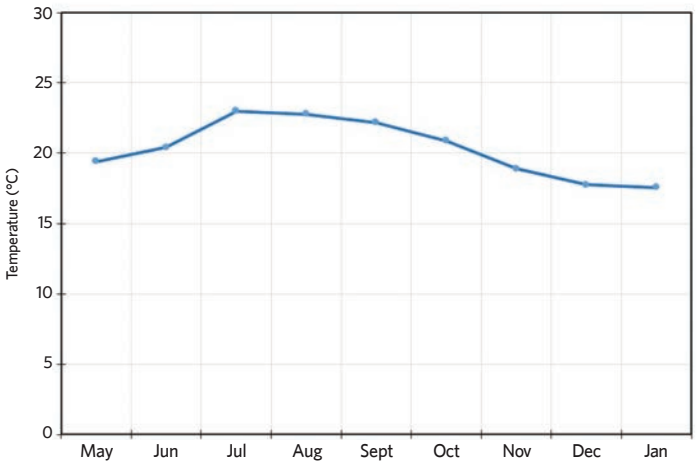
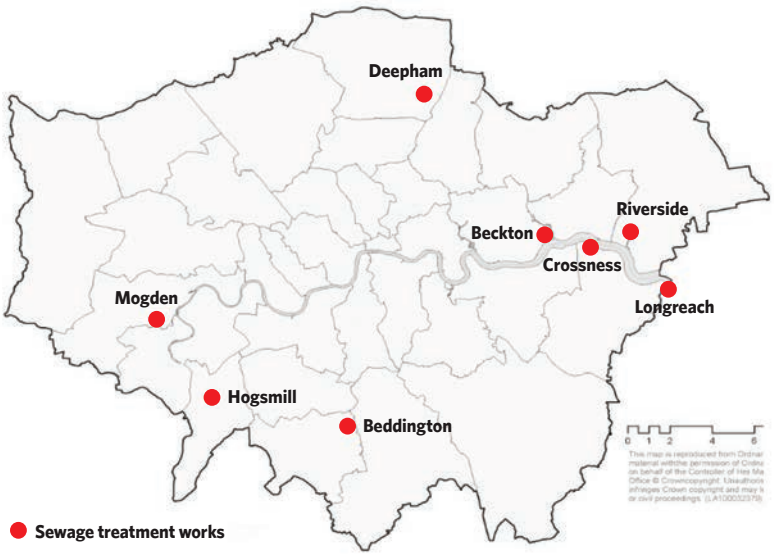


Figure 2: Monthly average raw sewage wastewater temperatures near central London area



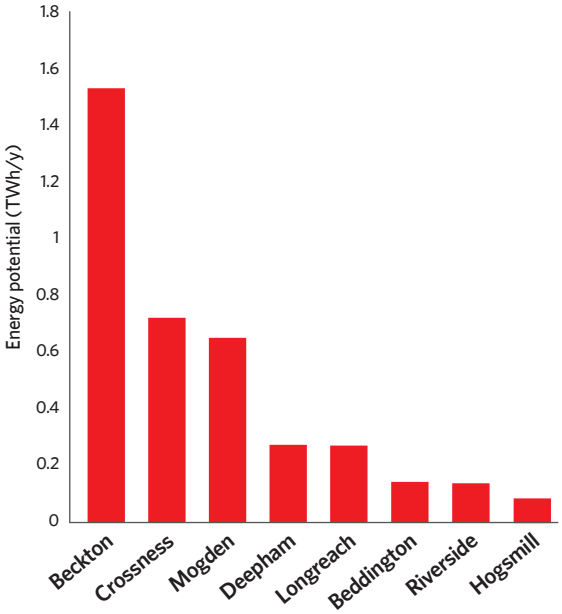


Figure 3: Sewage treatment works across London[1]

» biggest advantages are that the wastewater is cleaner, the flow of water is relatively constant, and removing heat post-treatment will have no impact on the performance of the WWTP. The downside to using treated wastewater is that WWTPs are often located remotely, away from homes and businesses, where there is less demand for the recovered heat.

For both upstream and downstream applications, because the sewer water temperature is significantly lower than that required for heating, the recovered heat cannot be used directly, so a heat pump is needed to increase its temperature. Kingston Council's Cambridge Road Estate scheme will recover heat downstream of the treatment plant.

In total, there are eight wastewater treatment plants in London, which – Ali and Gillich's paper says – have the potential to recover approximately 4TWh of heat annually. The largest of Thames Water's WWTP is Beckton, in East London, with an average treated flow of more than 1,200 million litres per day. According to Ali and Gillich, this has the potential for 1.5TWh of heat energy to be reclaimed annually – enough to provide space heating and hot water to more than 100,000 homes. In contrast, the Hogsmill plant is Thames Water's smallest WWTP, with a treated daily flow of just 69 million litres.

Nevertheless, if the Kingston scheme is successful, it will demonstrate the potential to recover heat from treated wastewater and should act as a model for future schemes. CJ

References:

1 S Farman Ali and A Gillich, *The potential of the heat recovery from urban sewage wastewater for use in residential and commercial buildings*, BSRIA Net Zero Building Centre, London South Bank University. Presented at the 2020 CIBSE-ASHRAE Technical Symposium.

HOW THAMES WATER USES SLUDGE POWER

Whenever you flush a toilet or empty a sink, the wastewater goes down the drain and into a sewer. That sewer will join a network of other sewers, which eventually deliver the wastewater to the sewage treatment works.

- **At the works, the wastewater is screened to remove large objects, before entering large settlement tanks, where the solids sink to the bottom to form sludge.**
- **The sludge is pumped away for further treatment, while the cleaner water flows out of the top of the tank to a second tank, called an aeration lane.**
- **Air is pumped into the water to encourage useful bacteria to break down and eat the harmful bacteria.**
- **The treated wastewater then passes to a final settlement tank, where the useful bacteria are allowed to sink to the bottom as more sludge; however, this useful sludge is collected and recycled back to the aeration tanks.**
- **The cleaned water is then passed through a bed of sand to give the water a final filter before it is allowed to enter local rivers and streams.**

The sludge collected at the start of the process ends up as fertiliser for agriculture, or it is used to generate energy by either:

- **Turning it into biogas in anaerobic digesters, which is then burned in a combined heat and power engine to create electricity; or**
- **Drying it to form cakes, which are then burned to generate heat that is used to drive a generator to create electricity.**

In 2019, Thames Water self-generated 23% of its electricity needs, saving £37m.

Thames Water flushes 69 million litres of clean warm water into the Hogsmill river in Kingston every day, as treated effluent

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Separate ways

Achieving hydraulic separation through well-designed low loss headers is key for efficient heating and cooling systems. David Palmer and Baxi Heating's Ryan Kirkwood provide detailed design guidance, including a recommended system configuration

With the evolving complexities of heat generation, and the need for correct and efficient operation of both heating and cooling sources, it is important to design and integrate headers correctly into systems.

This article aims to provide definitive design guidance and more detail than has previously been published on the subject. It follows 'Talking headers', February 2014, *CIBSE Journal,* which covered key design considerations for headers and flow regimes within headers. This resulted in queries about headers design and the calculation of parasitic flow in offline load circuits: this article sets out to cover both areas.

What is a low loss header?

A widely accepted definition of a low loss header (LLH) is a device that provides hydraulic separation between separately pumped primary and secondary circuits. Hydraulic separation means that primary/secondary pump interactions are avoided, with primary/secondary pumps operating independently of each other. For this reason, they are also known as hydraulic separators – but while a LLH provides hydraulic separation, a hydraulic separator is not necessarily a low loss device.

Considerations for designing a low loss header are:

1. The need for a very low pressure drop along the header to achieve low pressure loss mixing of primary and secondary flows
2. The relative locations and sizes of the primary and secondary ports
3. The minimising of parasitic flows in offline load circuits.

Achieving a very low header pressure loss is a straightforward calculation, while the locations of ports depend on whether the design is principally for primary flow (Q_p) greater than secondary flow (Q_s) or vice versa. Ideally, Q_p=Q_s, but this is difficult to achieve in practice. Temperature dilution to the load will occur when Q_s>Q_p, which could impact on, for example, air handling units that require a minimum flow temperature to operate correctly.

Alternatively, a temperature rise to the boilers' return will occur when Q_p>Q_s, preventing boilers from condensing if the load circuit is designed for a return temperature <55°C. Optimising hydraulic separation and minimising parasitic flow is the primary focus of this article, using type 1 or type 2 headers (Figure 1), as perfect hydraulic separation is not achievable in practice.

> "Oversizing the primary and secondary flow ports will optimise hydraulic separation and minimise parasitic flow by reducing the injection velocity into the header"

Calculation of parasitic flow

The calculation of parasitic flow in an offline load circuit requires the pressure drop developed on the header between the secondary ports (both type 1 and type 2 headers) to be considered as a pressure source that creates a flow in the offline load circuit. In addition, a component of dynamic (velocity) pressure from the primary flow

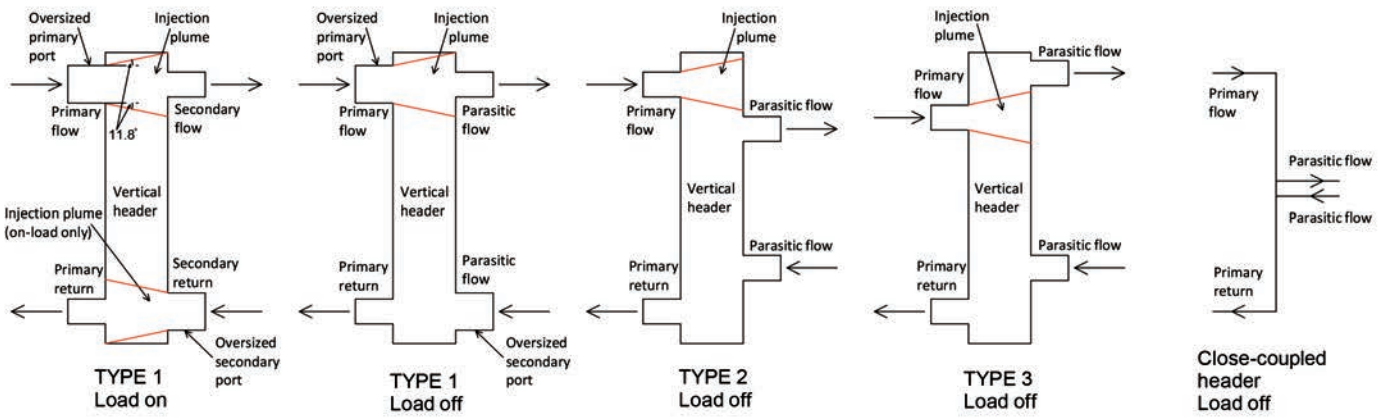


Figure 1: Types of header

entering the secondary flow port from the primary injection plume has to be included in the calculation for type 1 headers.

Oversizing the primary and secondary flow ports will optimise the hydraulic separation and minimise the parasitic flow by reducing the injection velocity into the header.

An iterative solution was developed whereby the header diameter, the spacing between the secondary ports, and the full-load pressure loss of the load circuit can be varied to achieve a balance between the pressure developed across the header and the off-load pressure loss of the load circuit, for boilers and loads from 50kW to 3MW and at flow temperatures from 40°C to 120°C.

Example calculation

Take a system with a primary circuit rated at 400kW, operating at 80°C/60°C, connected to a 350kW load circuit via a 150mm header with 500mm secondary port spacing. Figure 2 shows the parasitic flow in the load circuit for primary flow port sizes of 65mm, 80mm and 100mm versus load circuit full-load pressure loss (solid lines).

The smaller the primary flow port, the greater the injection velocity into the header and the greater the pressure exerted onto the secondary flow port. Oversizing the primary flow and secondary return ports, and lead-in pipes, will optimise hydraulic separation and minimise parasitic flow.

Close-coupled headers

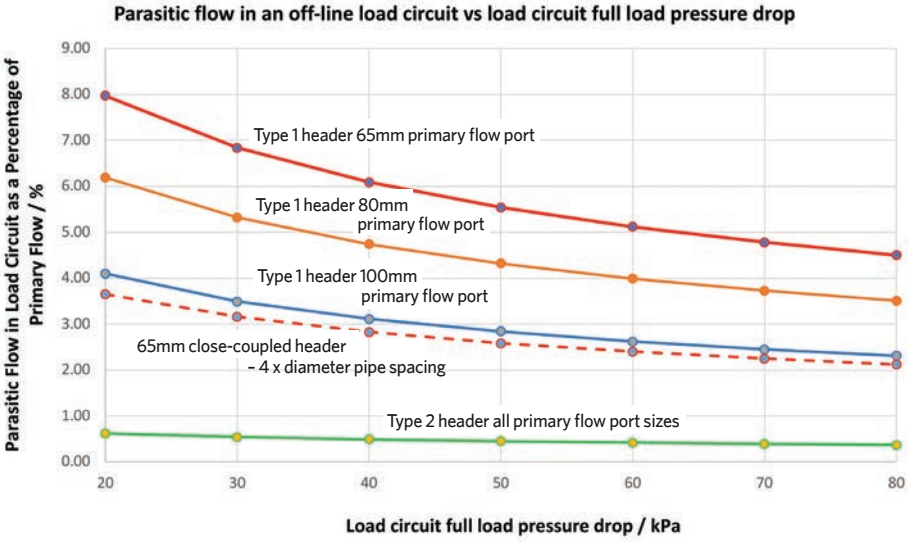
Close-coupled headers (CCHs), as widely used in the USA, can be evaluated by setting the header and primary pipe diameters to the same size in the tool. The dotted red line in Figure 2 shows the parasitic flow resulting from secondary pipes spaced four pipe diameters apart on 65mm primary and secondary pipes. However, CCHs do not meet the definition of a LLH because any flow mixing is not low loss. They are not the same as a LLH, and should not be used in lieu of a LLH, but CCHs can be useful when injecting heat – for example, a combined heat and power output – into a primary circuit.

Uncertainties

1. No information could be found to quantify the effect of offline pumps on parasitic flows. There will be a minimum 'striking' pressure (Psmin) before an offline pump begins to freewheel, below which there will be no parasitic flow. Furthermore, the pressure losses through an offline pump are unknown.
2. Injection plumes are shown in the headers in Figure 1, and further information is sought on the penetration of the primary flow into and through the header, specifically velocity versus distance profiles when the majority of flow is running at right angles down the header.

Surface roughness

The pipe pressure loss tables in CIBSE Guide C do not provide any information »



Notes:

1 Type 1 header primary pipe/port data used:
65mm – 1.32m/s, 233Pa/m
80mm – 0.96m/s, 103Pa/m
100mm – 0.56m/s, 27Pa/m

2 The uncertainty of the results owing to the unknown pressure loss through an offline load pump is a maximum of ± 6%

Figure 2: Parasitic flow versus full-load pressure drop for type 1 and type 2 headers, and close-coupled headers

UPDATED DESIGN RULES

The following revised and expanded design rules should achieve good hydraulic separation and minimise parasitic flow in offline load circuits:

- **Rule 1.** On type 1 and 2 headers, ideally $Q_p=Q_s$, but $Q_p>Q_s$ to prevent temperature dilution to the load or $Q_s>Q_p$ to avoid a temperature increase to the boilers
- **Rule 2.** A type 3 header is preferred for constant return temperature $Q_s>Q_p$, and with the secondary flow port located above the primary flow port
- **Rule 3.** Oversize the primary flow and secondary return ports on type 1 headers, together with lengths of pipe 5-10 times the diameter of the ports on the inlets to each port, to achieve a pressure loss <100Pa.m^{-1}.

For all types of header:

- **Rule 4.** The flow velocity and pressure drop along the header should not exceed 0.3m.s^{-1} and 5Pa.m^{-1} respectively at boiler outputs up to 3MW
- **Rule 5.** The LLH diameter is likely to be a minimum of twice that of the primary flow and return pipes for a boiler output of 3MW, and up to three times that of the primary pipes at 50kW
- **Rule 6.** The physical distance between the secondary ports is a minor consideration if a header conforms to Rules 4 and 5
- **Rule 7.** The header should be mounted vertically to trap sludge at the bottom and permit air removal at the top
- **Rule 8.** The header should operate at neutral pressure with the suction (inlet) side of all pumps connected to the header
- **Rule 9.** System pressurisation should act directly onto the header
- **Rule 10.** Maintain water quality for the life of the system.

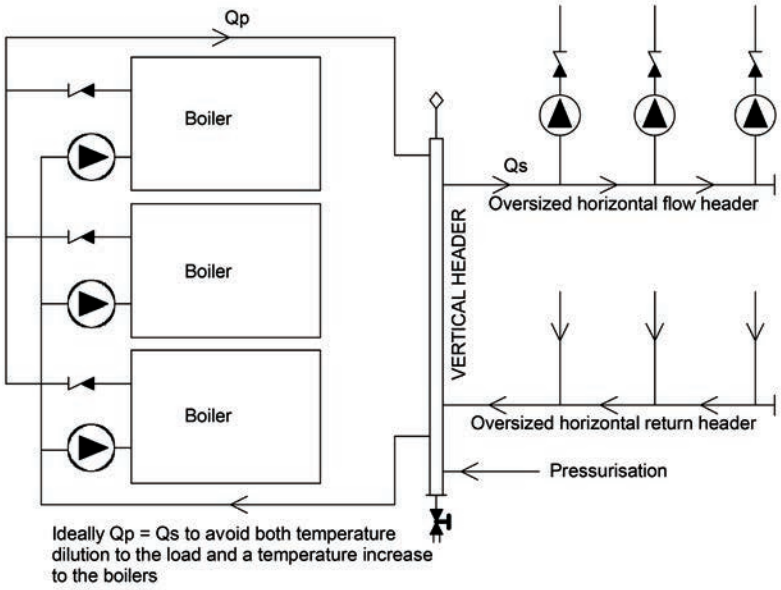
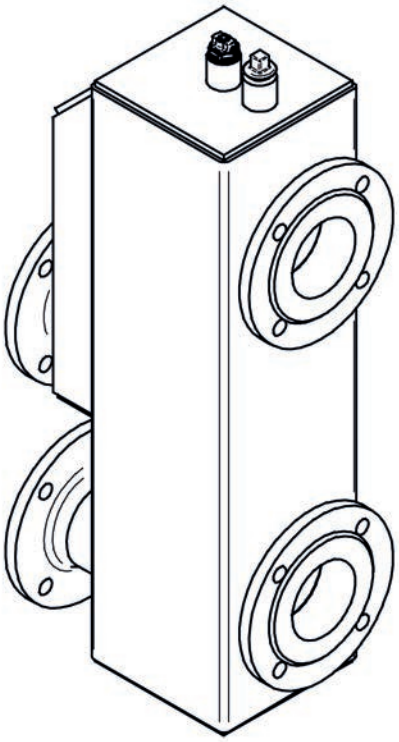


Figure 3: Recommended system configuration



Typical commercially available, compact pre-fabricated header often used in boiler cascades. Note that most commercial headers are rectangular in section, rather than cylindrical for ease of bulk manufacturing (Photographs courtesy of Baxi Heating)

> "It is important to maintain water quality for the life of a system to maintain the low-loss properties of a header over time"

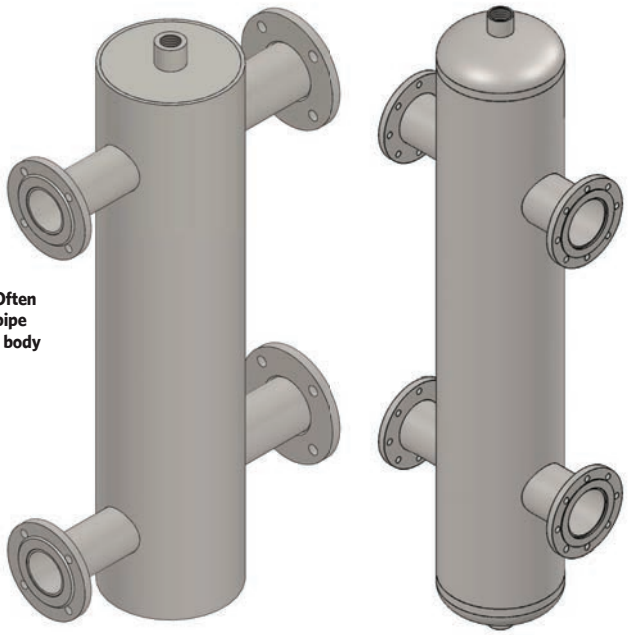
» on the likely increase in pipe pressure losses over time. For the example calculation, while a header using new steel pipe will have a pressure loss of 3.65Pa.m^{-1}, a corroded pipe will have 5.26Pa.m^{-1}, and a badly corroded pipe 11.78Pa.m^{-1}. It is important to maintain water quality for the life of a system to maintain the low loss properties of a header over time.

Recommended system configuration

Figure 3 shows a recommended configuration for a generic system. The use of a type 2 header effectively eliminates parasitic flows, and if – as is likely – Psmin is greater than the static pressure difference across the secondary ports, parasitic flow will not occur.

The pressure developed across the load circuits by a type 1 header when off-load is greater, although still relatively small – a few hundred Pa at most. However, when on-load, a type 1 header does not provide hydraulic separation, as the primary has the potential to pump into the secondary and then back into the primary.

Installing non-return valves (NRVs) in series with each secondary pump has the potential to eliminate parasitic flows, providing the pressure required to open the NRVs is greater than the pressure imposed by the header across the load circuits. **CJ**



Typical bespoke header. Often made to order and using pipe stock for the header main body

- The Low Loss Header calculator, currently in the form of a non-peer-reviewed research tool, can be downloaded from the *CIBSE Journal* site at **bit.ly/LLHcalc**
- Any reader with quantified information on injection plumes, the striking pressure and losses in offline centrifugal pumps, or with comments on the calculator, is asked to post their response (with subject line: Low loss header) to **editor@cibsejournal.com**

- **RYAN KIRKWOOD** is the heat pump business development manager for Baxi Heating
  DAVID PALMER is now retired. He was formerly a director of the Campbell Palmer Partnership

Boiler evolution

Manufacturers must prepare for the energy transition with a mix of technologies to provide a combined solution to the challenge ahead, says **James Galloway**, head of commercial product marketing at Baxi Heating. That includes evolving the boiler to meet immediate and future heating requirements

A step change in the way we heat our buildings is essential if the UK is to achieve its ambitious 2050 net-zero emissions target. So, how are we, as manufacturers, preparing to meet the dynamic demands of heating? What role do we see the boiler playing in heating our commercial buildings – now and in the future?

Hybrid solutions

The merits of applying heat pumps are well established in well-insulated buildings that are designed to require less heat. We view air source heat pumps as the most popular and cost-effective choice of heat pump, and will soon be offering them as part of our portfolio of commercial heating and hot-water solutions.

We see boilers working alongside heat pumps, in hybrid heating systems and heat networks, as the natural next step to delivering an efficient and cost-effective heating system all year round – at least until heat-pump technology evolves.

Energy efficiency

In older, poorly insulated building stock, the technically and economically viable solutions are currently constrained without funding. Additionally, many businesses affected by the Covid-19 pandemic may struggle to balance environmental and economic concerns when the heating system needs upgrading.

In such scenarios, retrofitting energy-efficient condensing boilers will continue to be an achievable solution to emissions reduction. However, evolving condensing boiler design to optimise adaptability and performance is key to meeting changing requirements and anticipated tighter regulations.

Remeha's next-generation Gas 320/620 Ace boiler series, for example, has been carefully engineered to provide an adaptable, highly efficient project solution to meet modern heating demands.

Its high temperature differential of 10°C to 40°C, and wide operating range of 20°C to 80°C/90°C, make it the perfect heat source for heat interface units, low temperature heating, and hybrid installations. Equally importantly, it is well suited to retrofit applications, while still paving the way for the addition of low carbon technology at a future date or when funds permit.

Hydrogen – the future of the boiler

So, to the future – and to hydrogen boilers. As we phase out carbon-intensive heating, repurposing the gas grid to transport hydrogen represents a low-disruption solution in hard-to-tackle buildings.

Baxi Heating and BDR Thermea Group are proud to be leading the way, working closely with the UK government to trial hydrogen boilers in a number of projects. At the HyDeploy project at Keele University, 20% hydrogen blends are being demonstrated using current boilers. We are also providing 100% boilers for the UK's first 100% hydrogen home public demonstration at Low Thornley site, near Gateshead.

With clear government commitment, it isn't far-fetched to envisage businesses heating their buildings with hydrogen or hydrogen-ready boilers long before 2050.

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Moving towards the increased adoption of heat pumps for heating and hot water

This module explores how heat pumps can make a significant contribution to reducing greenhouse gas emissions in the built environment

The UK government's legal requirement for net zero national greenhouse gas emissions by 2050 means that the UK must cut emissions across the whole economy, including transport, energy supply, industry and the built environment. The UK Climate Change Committee's (CCC) figures show that heating and hot water production in buildings are the largest contributors to emissions from the built environment, and it has noted that the goal is 'feasible but challenging'. This CPD will explore how heat pumps can make a significant contribution to that goal.

The UK *2017 Clean Growth Strategy*[1] highlighted the built environment as a significant source of emissions, with heating in buildings and industry creating around 32% of total UK emissions. The recent report[2] by CCC highlights that, for buildings, 'progress in delivering emissions reductions has broadly flattened since 2015' and, therefore, critically assessing the opportunities for improvements in heating and hot water production is important for potential emissions reductions.

In November 2020, the UK government published *The Ten Point Plan for a Green Industrial Revolution*[3] in an attempt to increase energy efficiency across the economy and grow offshore wind and nuclear energy generation capacity, alongside an aim of developing 5GW of low carbon hydrogen production capacity by 2030. The government plans to trial hydrogen for heating in neighbourhoods and towns by the same date. *The Ten Point Plan* emphasises that the success of the hydrogen approach is only possible when accompanied by the growth of carbon capture and storage infrastructure. By 2050, the CCC believes that all UK heat demand can be met by low carbon sources: 52% heat pumps; 42% district heating; 5% hydrogen boilers; and 1% new direct electric heating. Shortly after the plan was launched, the CCC published *The Sixth Carbon Budget*,[1] which recommends an interim target of a 78% cut in UK emissions against 1990 levels by 2035 – that represents a 63% reduction compared with 2019 levels.

As UK government and CCC reports highlight, a crucial development for the UK's zero net carbon policy is the decarbonisation of its electricity grid. Renewable energy sources (which excludes nuclear) accounted[4] for 41% of UK total electricity use in year ending September 2020, at 130TWh. The main renewable source was wind at 74TWh. The *Ten Point Plan* includes growth of offshore wind from 24GW in 2020 to 40GW by 2030. Natural gas currently remains a significant fuel for UK electricity generation (at about 35%); however, coal use for electricity production has fallen dramatically over the past decade, to below 2%. In December 2020, the UK government published the energy white paper *Powering our Net Zero Future*[5] that reiterates its commitment to reducing the UK's reliance on fossil fuels.

CCC's *The Sixth Carbon Budget* identities that efficiency measures can contribute around 34% of emissions reductions, and notes that the share contributed by low carbon heating 'dominates the picture from 2028'. It also recommends a phase-out of natural gas heating in commercial buildings by 2033, with public buildings working to a deadline of 2030. The CCC's goal is that by »

The UK generated a record 80% of electricity from low carbon energy sources on 5 April 2021 – 39% from wind power

» 2030, 37% of public and commercial heat demand is met by low carbon sources, with around two-thirds of this met by heat pumps, and just under one-third by heat networks. The *Ten Point Plan* proposals for buildings include higher efficiency standards for homes and a drive towards 600,000 heat pump installations per year by 2028 (compared with the 27,000 that were installed in 2019).

Part of the CCC's overall vision is that high-carbon options for heating in buildings are phased out, which may then be switched to electric alternatives, with an aim for UK electricity production to be zero carbon by 2035, and offshore wind growing from a projected 40GW by 2030 to 100GW or more by 2050. The CCC identifies two main pathways that aim to 'reduce emissions in buildings to zero by 2050 at the latest'. The main, so-called 'Balanced Net Zero Pathway' is noted by CCC as requiring 'a major ramp-up from what is happening today in supply chains for insulation, heat pumps and heat networks', but its detailed analysis demonstrates that it is feasible. It reflects four priorities over the coming decade or so:

- Upgrade all buildings to EPC level C over the next 10 to 15 years
- Scale up the market for heat pumps as a critical technology for decarbonising space heating while maintaining quality
- Expand the use of heat networks in areas such as cities using 'anchor' loads such as schools and hospitals. Shift away from using fossil fuel CHP as a supply source towards low carbon and waste heat by preference from the mid 2020s
- Prepare for a potential role for hydrogen heat through a set of trials building on the current innovation programme.

Anticipated updates to the Building Regulations' supporting documents will include fuel carbon factors that reflect the UK's move to renewables for generating electricity. As well as low carbon heating, there is also an increasing interest in reducing the embodied carbon of buildings and their systems. The CCC[6] proposes that the UK government should introduce 'mandatory disclosure of whole-life carbon in buildings and infrastructure to facilitate benchmarking as soon as possible'. Environmental product declarations (EPDs) that comply to BS EN 15804:2012+A2:2019[7] can be used to show the embodied carbon of a product. If an EPD is not available, manufacturers can supply information for a carbon calculation such as that for a 'mid-level' assessment as set out in CIBSE *TM65: Embodied carbon of building services equipment – calculation methodology and guidance*. The example calculation in TM65 for an air-source heat pump illustrates that the choice of refrigerant and refrigerant leakage rates will make a very significant impact on the life-cycle environmental impact (note that refrigerant leakage is an optional inclusion for an EPD). Heat pumps that employ low global warming potential (GWP) refrigerants – such as those discussed in *CIBSE Journal* CPD Module 171, November 2020 – will consequently have significantly lower life-cycle carbon emissions.

The recent consultation on the Future Buildings Standard[8] (which closed in April 2021) will be used to inform the development of the next iteration of Part L of the Building Regulations relating to non-dwellings (new and existing). Although this standard is not yet finalised, it is clear from the consultation that government is focused on raising energy efficiency requirements for new non-domestic buildings. The aim will be to deliver a 27% improvement on new non-dwellings compared with current Part L standards and, practically, reduce the demand on heating systems. One of the specific questions in the consultation document is whether wet space heating systems should be designed to operate with a flow temperature of 55°C, or lower, in the final heating circuit. As well as enabling the widespread adoption of heat pumps, this flow temperature would also increase the efficiency of condensing boilers, and reduce losses and improve system efficiencies in heat networks – easing the transition to low carbon technologies.

Application of heat pumps in buildings, combined with the greening of the UK's electricity grid, will make a significant reduction to UK carbon emissions. The carbon benefit will increase over time as the grid moves further away from fossil-fuel generated electricity. As the CCC indicates, meeting the 2050 net zero target for the built environment requires 'minimising costs and disruption [which] means working as much as possible with existing technology lifetimes – particularly the heating technology stock' while also noting 'we want to move quickly enough to be able to reach Net Zero without scrapping existing heating systems'. The CCC estimates that there is a need to support the heat pump sector on a steep growth curve, from 27,000 units in 2019 to one million units a year by 2030.

Heat pump technology has evolved in recent years to allow increased applications for commercial heating and hot water systems. The seasonal coefficient of performance (SCOP) is the overall performance of a heat pump using electricity across the heating season. It is calculated by taking the reference annual heating demand and dividing that by annual energy consumption for heating (details on the calculation are included in BS EN 14825[9]).

As discussed in CIBSE CPD Module 171, high temperature heat pumps can produce hot water supply up to 90°C, allowing their application in projects that have requirements for significant amounts of hot water with high peak demands (such as hotels, hospitals and leisure centres).

Volume and temperature requirements are key to correct sizing of the system, as well as the hot water usage profile across the day and the ability to meet peak demands. The heating required for the domestic hot water load must be assessed across the operating year, since the performance – and output – of a heat pump will drop with reducing external air temperatures. Heat pumps are available that can operate as part of a modular setup and are able to meet a variety of load requirements. A multiple unit system can cascade heat pumps on and off to meet the heat load from a building. For example, a commercially available heat pump (as shown in Figure 1) can work as a 16-unit system, allowing for 0.5kW increments of capacity, from 18kW to 688kW, with water flow temperatures available from 25°C to 70°C.

In order to meet the necessity of reducing carbon emissions, several technologies are being developed and trialled. As the UK electricity supply grid increasingly supplies electricity with lower carbon impact, heat pumps – in their various guises – look well set to contribute to a more sustainable future of heating and hot water production.

Heat pumps can be applied in buildings alongside other technologies to boost the renewable element of a project – and to reduce the requirement for heat energy. For example, used with on-site photovoltaic (PV) panels, less electrical energy from the grid is required to serve the building and the electrified heating system. As discussed in *CIBSE Journal* CPD Module 174 (January 2021), water source heat pumps can successfully combine with fifth-generation, or 'ambient,' heat networks that employ water at, or close to, ambient temperature. These are used in conjunction with heat pumps to raise temperature for the delivery of heating and hot water, and so utilise heat that may have been recovered from otherwise 'wasted' heat or generated centrally employing lower temperature heat pumps. Water source heat pumps can then be placed around the building to boost the temperature to usable levels at the point of demand.

Figure 1: An example of a modular air source heat pump installation that can be used as part of modular systems able to supply from 18kW to 688kW, in 0.5kW increments, with water flow temperatures available from 25°C to 70°C (Source: http://les.mitsubishielectric.co.uk/)

Where space heating is provided by heat pump technology, it is not unreasonable to expect that the cooling-only chiller market, and the variable refrigerant flow (VRF)/variable refrigerant volume (VRV) markets – where the same parent heat pump technology is being deployed – will transition towards heating and cooling. This means that there may be a move to reversible heat pump chillers, with heat recovery capabilities in the system.

Such systems can be included within the HVAC plant, with little or no impact on space requirements. Heat recovery systems that make use of heat pump technology can be particularly useful for mixed-use developments or large offices, where both heating and cooling demands are present at any one time. Heat can be captured from the cooling process and used to reduce heating requirements in other areas of the building (or to pre-heat domestic hot water). Building operators and designers will seek new options for heating and hot water provision, and this may not always be a direct heat pump swap in place of a natural gas boiler, but also include heat pumps that can provide concurrent heating and cooling.

In the UK, commercial electricity is approximately £0.15 per kWh, and with natural gas at around £0.05 per kWh, a commercial heat pump would have to deliver a SCOP of above 3 to deliver an operating cost benefit (at current prices). With appropriate design and operation, this should be readily attainable for modern heat pump installations. As noted in the 2018 study for the Greater London Authority,[10] it is very difficult to draw a simple conclusion on capital costs for new systems, but 'on average, the capital costs of heat pumps are likely to be slightly higher than a "business as usual" heating system'. The non-domestic Renewable Heat Incentive (RHI) has recently been extended[11] to March 2022 for projects in the pipeline, after which date it is due to close. However, the UK government is exploring options for a replacement programme to overcome barriers to purchase, as indicated in the 'Future support for low carbon heat' consultation that took place in 2020. The 'Clean Heat Grant' that is set to start in 2022 is expected to offer grants of up to £4,000 towards heat pump installations that have a capacity of 45kW or less.

Turn to page 60 for references. »

Module 178

May 2021

1. What does CCC consider the percentage of the 2050 heat demand that can be met by heat pumps?

- ☐ A 1%
- ☐ B 5%
- ☐ C 42%
- ☐ D 52%
- ☐ E 63%

2. What proportion of UK energy was produced from renewable sources on 5 April 2021?

- ☐ A 20%
- ☐ B 40%
- ☐ C 60%
- ☐ D 80%
- ☐ E Practically 100%

3. Which of these is not noted as one of the four priorities to a 'Balanced Net Zero Pathway'?

- ☐ A Expand the use of heat networks in areas such as cities
- ☐ B Improve the effectiveness of fossil fuel CHP
- ☐ C Prepare for a potential role for hydrogen heat
- ☐ D Scale up the market for heat pumps
- ☐ E Upgrade EPCs to all buildings

4. What is noted as having a significant potential impact when assessing the life-cycle carbon impact of heat pumps?

- ☐ A The choice of refrigerant and refrigerant leakage rates
- ☐ B The diameter of any associated refrigerant/water distribution network
- ☐ C The distance from factory to installation site
- ☐ D The mass of copper in the associated control system
- ☐ E The weight and materials used for the heat exchanger

5. For the example air source heat pump in Figure 1, what is the maximum flow temperature?

- ☐ A 25°C
- ☐ B 40°C
- ☐ C 55°C
- ☐ D 70°C
- ☐ E 85°C

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Five cooling firms judged to be on path to net zero

New report looks for commitment on efficiency equipment and ultra-low GWP refrigerants

Five cooling companies have been identified as showing the commitment necessary to achieve net zero carbon, say the Carbon Trust and Kigali Cooling Efficiency Program.

However, according to the report *Cooling Suppliers: Who's Winning the Race to Net Zero?*, 90% of suppliers measured were still 'early in the journey' to join the global campaign Race To Zero.

The analysis scored 54 cooling suppliers for their plans for super-efficient equipment and appliances, and ultra-low GWP refrigerants, to determine how committed they were to achieving net-zero carbon.

Race To Zero is a worldwide bid to rally leadership and support from businesses, cities, regions and investors for a healthy, resilient, zero-carbon recovery, as part of the goal to reach net-zero greenhouse emissions by 2050.

The report is a snapshot study of cooling industry companies' climate commitments, looking at their readiness to join the Race To Zero campaign and alignment with the recently published *Climate Action Pathway for Net Zero Cooling* (see page 67).

One company, Daikin, was judged ready to join the race while eight were deemed close to 'ready to join'.

Most firms measured had started their climate journey by focusing on reducing emissions within their control, but have shown limited commitment to more ambitious targets, said the Carbon Trust.

The report found cooling suppliers in countries with legally binding net-zero commitments were more likely to have strong climate commitments, with Chinese manufacturers, among others, behind the curve, despite the nation having a commitment to carbon neutrality by 2060.

Who's joined the Race To Zero?

Joined:
Schneider Electric
Electrolux
Danfoss
Johnson Controls
Orbia Advanced Corp

Ready to join:
Daikin Industries

Close to ready to join:
Carrier
Trane Technologies
Mitsubishi Electric
Hitachi
Fujitsu
LG Electronics
Sharp
Toshiba

Refrigerant prices remain steady

Prices for HFC refrigerants used in air conditioning systems have stabilised despite continued growth in demand, according to a recent European price monitoring survey.

Stockpiling in the final quarter of last year ahead of this year's latest phase down in line with EU legislation was the main factor in driving demand, but over the whole year there was a slight dip in prices, according to the report from German consultancy Öko-Recherche.

Figures for the survey were provided by 74 companies from 12 EU member states and included refrigerant producers, distributors, manufacturers, and end users.

Prices of R134a and R410A continued to fall at producer level, while prices from distributors, manufacturers and service companies dropped slightly or remained stable, the report said. R404A was also slightly down at all stages of the supply chain and the cost of new 'alternatives' remained mostly unchanged or decreased slightly.

Hawco for Haier

Haier HVAC Solutions has announced Hawco as the first of its new UK distributors. Under the new partnership, the HVAC-R supplier will sell the complete range of Haier air conditioning products in the UK.

Toshiba heat recovery air con system installed at London college

A major upgrade project for Barnet and Southgate College in north London has had a high-performance Toshiba heat recovery air conditioning system installed at its main teaching block on its Southgate site.

Selected and installed by mechanical services contractor Bry-Kol Building Services, the Toshiba air conditioning solution comprises Super Heat Recovery Multi (SHRM-e) variable refrigerant flow (VRF) systems linked to Toshiba VN-M heat recovery ventilation units, along with SmartTouch controllers.

Indoor units include mostly four-way ceiling suspended cassettes, plus high wall units and concealed ducted systems.

The Toshiba solution was selected for the project by the contractor for its energy efficiency, noise and comfort characteristics.

The heat recovery ventilation system harvests energy that would otherwise be lost from the building when it is exhausted, and uses it to warm incoming fresh air to reduce the need for heating, saving energy and reducing the building's carbon emissions.

Developing economies given help to manage refrigerants

ASHRAE and UN aim to promote lower GWP refrigerants

ASHRAE and the United Nations Environment Programme (UNEP) have launched a new three-year workplan aimed at supporting refrigerant management in developing economies.

The 2021-23 workplan, the fifth jointly developed by ASHRAE and UNEP OzonAction, builds on the work by the two global organisations since their initial agreement was signed in 2007.

This was aimed at promoting the adoption of state-of-art technologies and practices in developing countries that avoid the use of ozone-depleting substances and promote the deployment of lower global warming potential (GWP) refrigerants.

The bodies have also worked to offer tools and knowledge to help in eliminating emissions of refrigerants while servicing refrigeration and air conditioning applications.

According to ASHRAE and UNEP, the theme of the latest workplan – Refrigeration management for developing economies – recognises the important role that refrigeration and air conditioning play in developing countries in terms of societal benefits and environmental goals.

All ASHRAE-UNEP products and services included in the joint workplans are offered free of charge and are accessible to national ozone units and certain refrigeration and air conditioning sector stakeholders in developing countries through ASHRAE and UNEP OzonAction.

Engie adds heat recovery option for Quantum Air

Engie Refrigeration's Quantum Air range of air-cooled chillers are now available with heat recovery as an option, offering increased energy efficiency and carbon savings, says the company.

The heat recovery option enables up to 100% of the waste heat generated during the cold generation process to be used for other applications, such as heating, says Engie.

This is achieved through the integration of an additional heat exchanger in the Quantum Air chiller unit. This makes it possible to conduct the heat generated during the cold generation process to another heat process – for instance heating or hot water supply in buildings requiring simultaneous cooling and heating solutions, such as hotels, offices, or other commercial facilities.

Johnson Controls acquires Cool Solution

Johnson Controls has acquired Cool Solution, a prominent service provider of air conditioning and refrigeration within the UK and Ireland.

Cool Solution has offices in Cardiff and Tewkesbury. Johnson Controls says the move will allow its HVAC team to service more customers and better serve existing customers in Wales and the South West.

Cool Solution designs, installs and maintains all types of comfort systems, covering ventilation, air conditioning, and heating. Its focus is on commercial buildings, fitting-out offices, retailers, hotels and more to suit the needs of end users.

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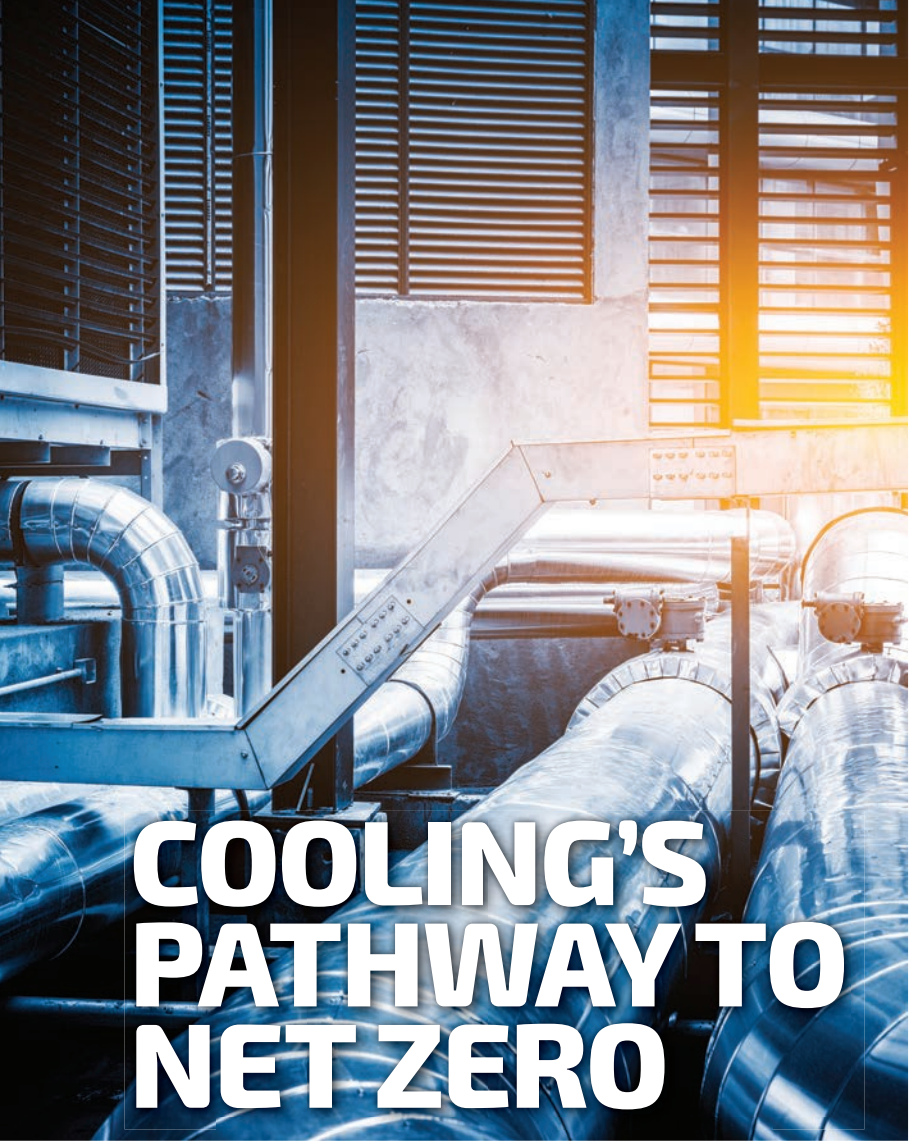


COOLING'S PATHWAY TO NET ZERO

For the UK to achieve net-zero carbon emissions by 2050, the cooling industry must radically improve the efficiency of equipment and switch to ultra-low global warming potential refrigerants. **Andy Pearson** looks at a proposed timetable for action

Cooling is essential; it keeps vaccines safe, food fresh and buildings comfortable. It is also energy intensive; the electrical energy used by cooling equipment accounts for more than 7% of global greenhouse gas emissions. These emissions are increasing rapidly, which is why the Carbon Trust has published *The Climate Action Pathway for Net Zero Cooling by 2050* (The Pathway). Co-authored by the Carbon Trust, Cool Coalition, Kigali Cooling Efficiency Program, Oxford University and High-Level Champions, The Pathway describes a vision of net-zero cooling in 2050 achieved through actions focused on three key areas:

A 'race to the top' for **super-efficient equipment and appliances** powered by zero carbon energy, which 'will build on efforts to set minimum energy performance standards for key cooling equipment and appliances'. High-efficiency urban cooling solutions, such as district cooling, are expected to be deployed widely in high cooling-density areas. In addition, by 2050, the document says 'cooling will support the resilience of the energy system, including through the use of waste heat and cold, and provision of flexibility through ice, liquid air and other solutions to help with energy storage and load shifting'.

A market dominated by **ultra-low global warming potential (GWP) refrigerants** (<5) across applications, aided by harmonised and adapted safety standards and regulations, to allow use of all refrigerants.

The widespread adoption of passive cooling. By 2050, every building will incorporate passive cooling measures, which The Pathway says 'will range from shading, glazing, thermal mass and cool roofs to ventilation, green walls and roofs, and evaporative and radiative cooling'.

While net-zero compatible cooling technologies already exist, the authors say 'these aren't being implemented, used or scaled at the pace required to achieve net-zero cooling by 2050'. Barriers include: policy and political will; finance and economic; technology and innovation; business commitments and supply chain readiness; and a lack of understanding of how to decarbonise the sector. Ultra-low GWP refrigerants exist across nearly all sectors, the report says, but there are significant hurdles to their deployment including safety concerns and a lack of skilled workforce.

To realise the vision, The Pathway includes a Net Zero Cooling Action Plan that sets out what needs to be done globally to overcome the barriers. The most significant actions for each key area are summarised below.

Super-efficient equipment and appliances

By 2021

- Governments join the Biarritz Pledge for Fast Action on Efficient Cooling, to transform the global sector and lower emissions by coordinating efforts to improve the energy efficiency of air conditioners and other cooling equipment, in parallel with the phase down of HFCs
- Investors commit to disengage from financing cooling manufacturers that have not made a net-zero pledge
- Leading cooling suppliers commit to net-zero targets
- Leading cooling suppliers support 'product performance ladders' and GWP limits for net-zero cooling products
- Waste cooling is used and delivered to district energy networks to meet cooling loads, where cost effective.

By 2025

- Large-scale public sector procurement for super-efficient equipment and appliances
- Significant adoption of district cooling in leading regions in cooling-dense applications
- Majority of cooling suppliers and operators committed to net-zero cooling targets
- All cooling suppliers and operators committed to product performance ladders
- Businesses invest in resources and skills to operate systems at maximum efficiency and increase energy savings with optimal control settings.

By 2030

- Enhanced product performance ladders, labels and incentives in force for 80% of the global market
- Scale up of district cooling beyond main regions
- Leading investors stop financing businesses that have not made net-zero cooling commitments
- Waste cooling optimised and recycled within industry
- Only net-zero compatible cooling products are sold.

By 2040

- Enhanced product performance ladders, labels and incentives consistent with net-zero cooling in place for all cooling technologies and regions

»

- District cooling adopted as the norm for all cooling-dense applications globally, as appropriate
- Finance only flows to super-efficient, ultra-low GWP products and investments
- New technologies and business models make super-efficient, ultra-low GWP equipment and appliances cheaper in most applications.

Ultra-low GWP refrigerants

By 2021

- New commitments from countries on uptake of ultra-low GWP refrigerants beyond Kigali Amendment
- Nations agree to work together and invest additional funds in F-Gas market surveillance, compliance and enforcement, and to review building codes and standards that stifle the use of ultra-low GWP net-zero products
- Cooling businesses commit to minimising refrigerant leakage and decommissioning at end of life, including recovery, recycling and destruction of refrigerants and ozone-depleting substances, and HFC-containing foams
- Businesses in the largest cooling-consuming sectors commit to only buy low GWP refrigerant solutions
- Equipment and refrigerant manufacturers commit to increased R&D, and to supporting an 'Ultra-low GWP Cooling Accelerator' to identify solutions for hard-to-achieve applications (air con, industry, transport)
- Accelerated development of novel financing mechanisms and instruments for net-zero compatible cooling by Development Finance Institutions.

By 2025

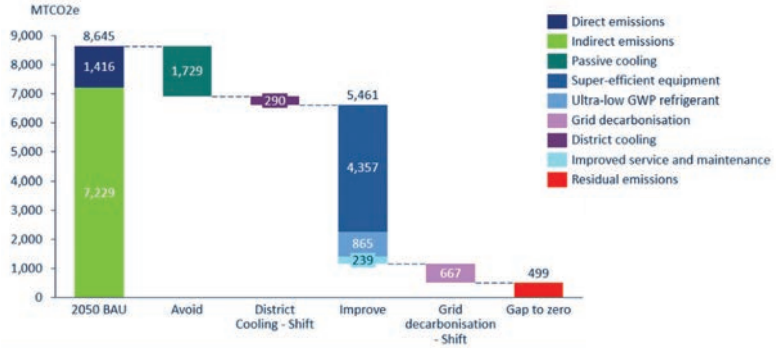
- All countries ratified the Kigali Amendment
- Large-scale public sector procurement for equipment and appliances using ultra-low GWP refrigerants
- Investors commit to only fund manufacturers of ultra-low GWP refrigerants
- Operators trained to reduce refrigerant leakages and to decommission high-GWP refrigerants at end of life, including recovery, recycling and destruction of refrigerants and ozone-depleting substances and HFC-containing foams
- Pressure from civil society reduces manufacturing of high-GWP appliances.

By 2030

- Product performance ladders for cooling technologies mandate use of ultra-low GWP
- Investors only fund ultra-low GWP refrigerant manufacturing
- Refurbishment of cooling technologies with ultra-low GWP options occurs at scale across nations
- Most businesses commit to ultra-low GWP refrigerant
- Cooling equipment is decommissioned, with refrigerants treated in an environmentally friendly way, including recovery, recycling and destruction.

By 2040

- Updated Kigali Amendment has delivered ultra-low GWP cooling
- All investors only fund ultra-low GWP net-zero cooling solutions
- Business commits to ultra-low GWP refrigerant solutions



The emissions reduction that needs to be achieved across the domestic AC sector using different mitigation approaches. It shows the total offset amount needed in 2050 to achieve net-zero cooling for all, using the mitigation hierarchy verses a business-as-usual (BAU) 2050 scenario.

Figure 1: Mitigation scenario for domestic AC as an initial output of the pathway to net-zero[1] analysis

- All purchased appliances use ultra-low GWP refrigerant.

Passive cooling

By 2021:

- Cities commit to integrate passive cooling into masterplans
- Revise building regulations to promote passive cooling
- R&D on innovative passive cooling in new and existing buildings
- Develop in-house technical capability on how to first avoid the need for cooling, before including cooling technologies into buildings.

By 2025:

- Passive cooling considerations included in climate-risk appraisals to disincentivise investment in thermally inefficient buildings
- Passive cooling solutions being demonstrated at scale
- New behaviour-change campaigns launched
- Optimising cooling demand at design stage is a development practice.

By 2030

- All new buildings and urban areas are required to incorporate passive cooling measures through building regulations
- City masterplans with defined Local Climate Zones are enforced
- Passive cooling measures shown to have largest impact are deployed in countries with highest cooling need.

By 2040

- Buildings refurbished to passive cooling standards
- Passive cooling building regulations enforced
- City-level projects only approved if they optimise passive cooling
- Passive cooling the norm and first cooling priority measure in all countries. CJ

References:

1 Based on initial outputs of the Cool Coalition's Cool Calculator tool, available 2021, October 2020 **bit.ly/CJMay21CC**

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Cooling & Heating

Getting heat-recovery ventilation right at commissioning stage

Modern heat-recovery ventilation systems are highly efficient, but commissioning needs to be done properly to ensure optimum performance. Ashley Phillips and Lafia Touré, of John Francis, highlight common issues

As an industry, we seldom have the opportunity to learn from feedback or digest lessons learned. However, over the past 18 months, we have had the benefit of direct liaison with our in-house commissioning and project management team.

Being able to use this commissioning first-hand knowledge at the early stage of the design process has enabled a true commisionability review to be incorporated into our design process – long before the start of any first-fix installations, thereby avoiding abortive site works or costly investigations and potential changes.

In this article, we share a selection of items that our building services consultancy has encountered and resolved when it comes to the commissioning of heat-recovery ventilation systems.

The commissioning of air systems can be a particularly thorny process; if the pre-planning is not right from the outset, problems can be extremely difficult to diagnose and resolve. Issues such as limited access, poor as-built information, and limited measurement points for testing and readings are often overlooked.

In general, the lack of commisionability at pre-construction design stage can result in future fault-finding being intrusive and costly, and remedial actions resulting in repairs that can be aesthetically unpleasing.

One of the primary considerations when commissioning equipment or plant is location, ease of access and adequate clearances; this includes the routing of services that may restrict access or installation height – for example, any component, fitting, equipment or plant – around the air handling unit. This may be an obvious point, but it is easily overlooked. Easier access will result in easier commissioning, fault finding and future maintenance for replacement of filters, fans, and other components.

The successful commissioning of ventilation systems is subject to the particular parameters of the installed and operated system. For example, the pressure drop of the installed system may not be as calculated; additional ventilation air supply may be used to compensate for duct and component leakage; ventilation requirements may have increased because of more occupants or additional rooms; fittings, particularly those that are bespoke, may add unexpected resistances; or the routes of installed ducts may impact originally expected resistances. These can all affect the performance of the ventilation unit and the system balancing.

With regards to application of heat exchangers, there are different types and materials that have limitations and need to be considered with the application. In light of the emergence of Covid-19, use and application of heat exchangers is under greater scrutiny to avoid the recirculation of air particles and contaminants.

Heat-recovery systems will, typically, have a summer bypass function to prevent overheating by diverting the fresh air from passing through the heat exchanger. Not all bypasses are capable of diverting 100% of the airflow and there are no specifically required compliance checks. Employing appropriately approved heat-recovery systems would be most effective for compliance and function.

For commissioning of heat-recovery systems, we have found that, generally, only boost ventilation rates are provided in the operational specification; it is important, however, that trickle ventilation rates are also given in order to set the low background ventilation speed of the heat-recovery mechanical ventilation unit.

The use of MVHR is often applied as a ventilation strategy that aims to maintain occupants' comfort by providing good indoor air quality. It can also have a beneficial effect on energy use and carbon-emission reduction. With regulatory improvements in building fabric performance, the ventilation system has become a more significant element of the total building heat load.

As a rule of thumb, efficient ventilation heat-recovery »

ASHLEY PHILLIPS is technical director and **LAFIA TOURÉ** is an energy consultant at John Francis

"Heat-recovery performance may not be consistent across the operational range, so it is essential to measure high and low airflow rates at the outset"

Heat-recovery unit

» systems should be installed, most effectively, in buildings with an air permeability of $3m^3 \cdot m^{-2}$ hour^{-1} at 50Pa or lower. Passivhaus Trust implies that the system will recover the same amount of energy, regardless of the amount of air leaking through the building structure. However, uncontrolled entering cold air to the building increases energy consumption to maintain thermal comfort. As a result, the building's carbon emissions increase.

A key element related to the energy efficiency of the ventilation system is the specific fan power (SFP), which defines the power required to move the ventilation air through the ducted system. Typical installations will include MVHR units that can recover 90-95% of the otherwise rejected heat and operate at SFP ranges between 0.50W/l/s and 0.90W/l/s in flats. The number of wet rooms within the dwelling will affect the unit performance.

Modern systems are generally designed to operate efficiently; however, ensuring that the installed system SFP is similar to the design expectation is an important element of the commissioning process. The heat-recovery performance may not be consistent across the operational range, so it is essential to measure high and low airflow rates, as well as system pressure while operating. Other commonly encountered issues include blocked filters that are likely to result in poor indoor air quality, impaired ability to provide heat, or increased energy usage because of higher power loads.

Making the most of free heat

There are increasing opportunities to capture waste heat, and its costs can be covered by subscription models, says ICS Cool Energy's **Dave Palmer**

Within every building and process application – be it a hospital, a warehouse, or a chemical plant – where there is a cooling system, there is heat produced by the chillers. This energy is available for free, and instead of being rejected to the atmosphere, it can be recovered, harnessed and used.

While practically every building and application has a heating need – such as domestic hot water – this, unfortunately, is still largely fulfilled by carbon-intensive, fossil-fuelled boilers.

Thankfully, with the latest innovations, the market's receptiveness to decarbonising heating applications is increasing. Customers are starting to move away from the boilers and are identifying new opportunities.

Solutions such as chiller condenser circuits linked with water-to-water heat pumps open the door to savings reaching 40% of the energy costs – taking the load off the boilers and reducing the reliance on fossil fuel. The combinations are numerous, including: heating while cooling (chillers with heat recovery); heating while cooling or heating (heat pumps with heat recovery); or any of the above (multi-pipe units).

Despite a heat pump having lower operational cost, the typical investment with a payback is, for many, not attractive enough compared with a boiler, and during the uncertainties of Brexit and the current Covid-19 pandemic, nervousness around capital investments has only increased.

However, reaching beyond product innovation, another stimulating factor driving the shift towards free heating is the change in financing options. A significant game-changer is the subscription business model that offers long-term, enhanced and flexible hire instead of purchasing. This would typically allow building owners and operators to get a bespoke free heating solution installed in their process for a monthly or quarterly fee, which can be exchanged and upgraded as technology improves, or adapted to meet their changing requirements. This is also likely to offer full machine maintenance and warranty cover without the need for capital investment.

DAVE PALMER is general manager for UK and Ireland at ICS Cool Energy

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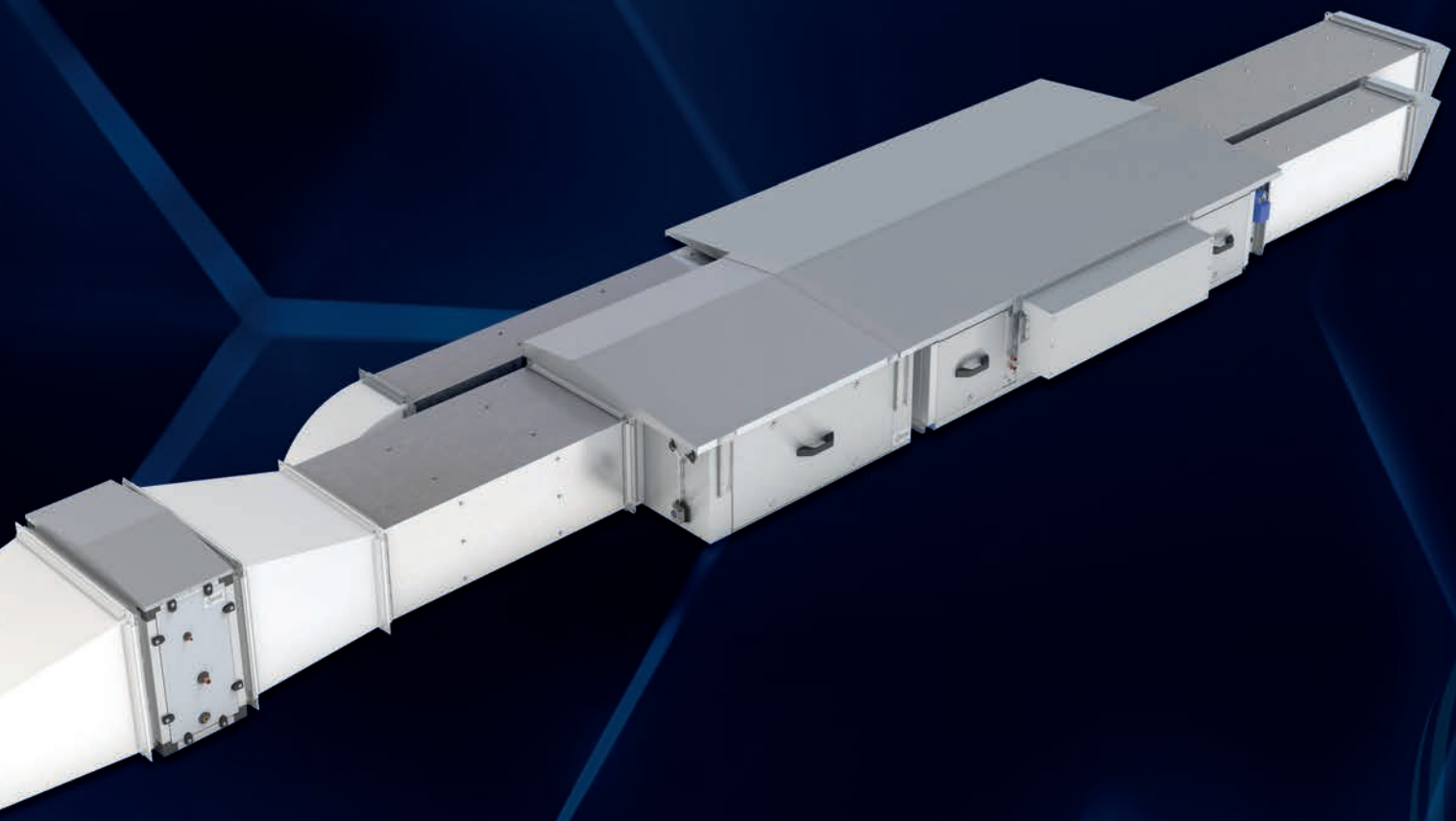

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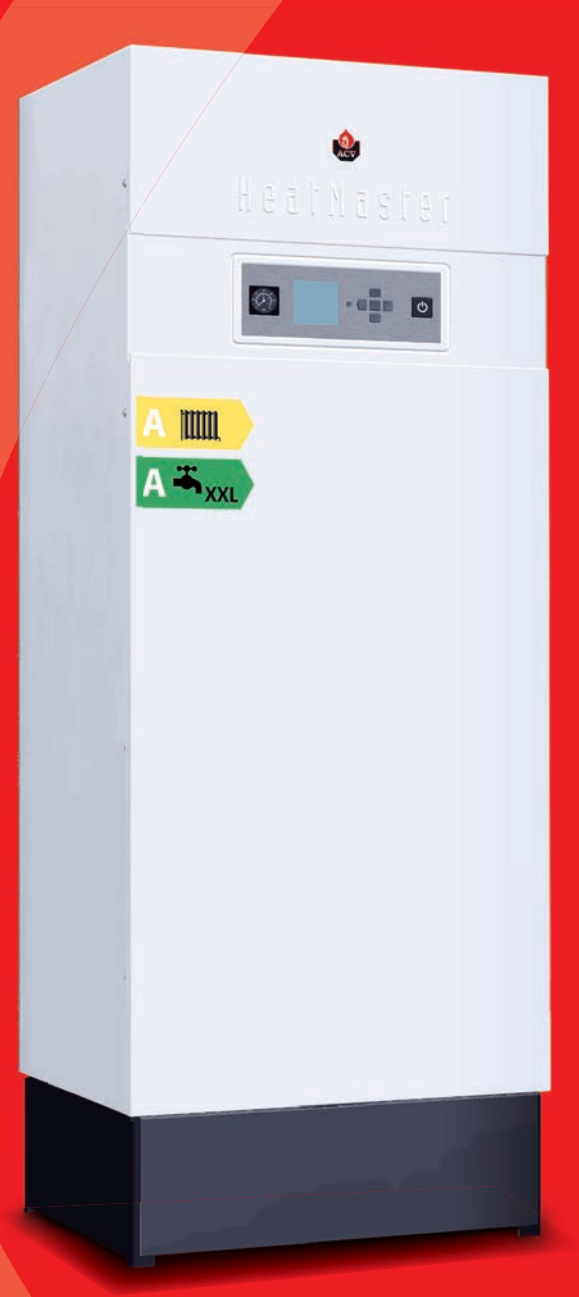

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This module explores the issues around assessing domestic hot-water demand in order to optimise plant and distribution network sizes and capabilities

The estimation of demand for domestic hot water (DHW) in buildings continues to provide an area of uncertainty in building services design. The primary objective is that the hot-water service should be capable of meeting peak demands while attempting to maintain optimum plant and distribution network sizes and capabilities. A contemporary and future-looking DHW system design may vary significantly from historic norms, and so deserves careful assessment to maintain appropriate hot-water supplies while minimising environmental and financial impact.

Hot water systems, which are employed in practically every occupied building in the UK, are increasingly important elements in the design of sustainable and resilient built environments. As the standard of thermal performance in the building envelope improves, the heat required for the DHW becomes a more significant proportion of a building's heat demand. In smaller low-rise buildings, systems supplying hot-water outlets are increasingly being directly fed – without interim cold-water storage – so directly impacting the predicted demand on wholesome cold-water supply. Also, in larger buildings, advances in pumped, pressure controlled water systems are delivering increased precision in design flowrates. Alongside this, the increasingly urgent need to reduce the lifecycle carbon impact of engineered systems means that designers must account for both the embodied, as well as the operational, carbon impact.

Optimisation is therefore the key, but without appropriate data on hot-water consumption to inform that system design, it is very unlikely that systems will be installed and operate economically – in water usage, cost, and carbon terms – while also being able to meet the primary need of delivering hot water to building users.

In Mohammed's recent paper[1] it is noted that water use in buildings has reduced significantly in recent years, owing to increased user awareness of environmental impacts and the adoption of water efficiency measures. However, the paper reports, despite considerable changes in water end use and users' behaviour, there have been no corresponding changes in sizing methodology and no significant update to the design equations. Therefore, as reported by Tindall,[2] it would appear this leads to oversizing of water systems in buildings.

The method adopted for estimating the demand on the hot-water system will depend on the type and application of the system that is being designed, and will also be subject to the building layout, distribution and type of water outlets, and the pattern of hot-water usage across the day. CIBSE Guide G[3] relates that the size of plant required is determined by the draw-off rate and pattern of consumption in each day, and that the hot-water storage capacity should be related to both the design consumption and recovery rate. In the UK, hot-water production and storage temperatures must »

» comply with Health and Safety Executive (HSE) requirements[4] in order to minimise the growth of legionella bacteria. This requires that, if there is hot-water storage, it should be stored at least at 60°C and distributed so that it reaches a temperature of 50°C (55°C in healthcare premises) within one minute at the outlets. In anything larger than small commercial systems, this would likely require DHW recirculation to maintain the minimum required temperatures at the outlets.

UK hot-water systems will normally be arranged as one of three main types:

Storage system – this is often considered as a traditional system in the UK. In both CIBSE[3] and Chartered Institute of Plumbing and Heating Engineering (CIPHE) guidance,[5] the size of the store is established based on expected consumption over a particular time period that can be heated to the normal operational temperature from cold (10°C) in, typically, two hours. Heat is generally provided from a gas- or oil-fired boiler, using a primary circuit to transfer low temperature hot water (circa 80°C flow) through a heat exchanger within the hot-water store. Such systems normally operate with a daily or weekly cycle of heating up, DHW consumption, and then partial cool down before recommencing the heating as the next cycle begins. The store relies on maintaining a thermocline so that the hot water is drawn from the top while the cooler makeup water (or returning recirculating DHW) enters at the bottom of the store. The store can be topped up with heat at any time, and can provide good opportunities to aggregate output from various heat sources such as relatively low-output boilers, heat pumps, solar thermal panels and recovered heat. Storage systems can provide an excellent response to unexpected peak demands (so long as they occur when the bulk of water is heated) but come with the disadvantage of standing heat losses, specific legionella management challenges, and the physical space that they take up in the building.

Part-storage – these include an element of storage together with (typically) direct gas heating that allows the system to meet surge loads of limited duration while also being able to provide a continuous output that meets general, non-peak, requirements. An example of such an appliance is shown in Figure 1, which is able to deliver 440 litres of hot water (with a 50K temperature rise) in the initial 10 minutes, and then sustain a continuous flowrate of 29 litres per minute. The storage component also provides a limited buffer in case of interruption to the heat supply and, being relatively small, can be readily designed with low heat loss so that the stored hot water may be effectively maintained at the design operating temperature at all times when the building is occupied. An example schematic for such a system is shown in Figure 2.

Instantaneous/continuous – these are fed with a direct cold-water supply and are able to continuously supply hot water at anything from 0.2 litres per minute for an above-basin 3kW electric handwash unit, through to 'multi-point' heaters (including combi boilers) serving several outlets at 50°C to 60°C, and up to dedicated modular gas hot-water heaters capable of producing, for example, 14 litres per minute of hot water (with a 50K temperature rise) for each wall-hung unit. Some units are designed to accept returning recirculating DHW as well as a cold-water feed, or potentially preheated – but wholesome – water from other sources.

High-efficiency plate heat exchangers are also used for continuous-flow DHW heaters, with hot water – from a boiler or other source – as the primary fluid and the feed to the secondary wholesome DHW. There are hybrid systems deployed that, for example, employ renewable heat sources or recovered/waste heat to pre-heat or fully heat domestic hot water, together with heat exchangers and thermal stores.

There is no lack of information sources that can be used to size DHW systems. The challenge is selecting the source of information, and estimation method, to provide a reasonable prediction of how a particular building and the expected occupants' hot-water consumption are best represented. As discussed in the LUNA project[6] stage 1 report published by the team at Heriot-Watt University, there are many different international standards and codes that are designed to provide information to facilitate hot-water system sizing. The methods of modelling vary (see 'Modelling methods' boxout), and those commonly employed in the UK have evolved from the same root of a probabilistic modelling technique that was originally based around the concept of the 'loading unit' (LU). The origin of the LU is more than 50 years old (see boxout), but the actual values and application of 'traditional' LUs have been developed in an attempt to provide a better prediction of likely water use, principally to reduce oversizing – particularly in larger (non-residential) installations. Many of the methods used around the world are empirically based and, with the increased maturity and availability of digital modelling techniques, there is a growing body of work employing stochastic procedures (such as that being developed at Heriot-Watt University[1]).

In the UK, there are four predominant – and potentially confusing – choices for predicting hot-water needs:

BS EN 806-3,[7] the British adoption of the European standard, has LUs that have a different basis to traditional LUs and, although numerically similar to the CIPHE 'low' category (see right), result in lower predicted hot-water demands when summed

Figure 1: Example of a part-storage gas water heater. This example can provide 440 litres of hot water (with a 50K temperature rise) in the initial 10 minutes and then sustain a continuous flowrate of 29 litres per minute (Source: ACV)

THE ORIGIN AND DEVELOPMENT OF UK LOADING UNITS

In the 1960s, Harry Howick, past-president of the Institute of Plumbing (IoP, now CIPHE), developed a loading unit system based on the concept of the US fixture unit. This designated relative outlet demand compared to the 'base appliance' (a wash basin used every 20 minutes set as one demand unit) and enabled a simplified approach using the theory of probability. A probability graph is used to convert the cumulative load from connected appliances, in a distribution network, into a simultaneous design flow. That original method is reflected in the current BS 8558[7] and CIPHE.[4] (Developed from information in SOPHE TB 16-1[9])

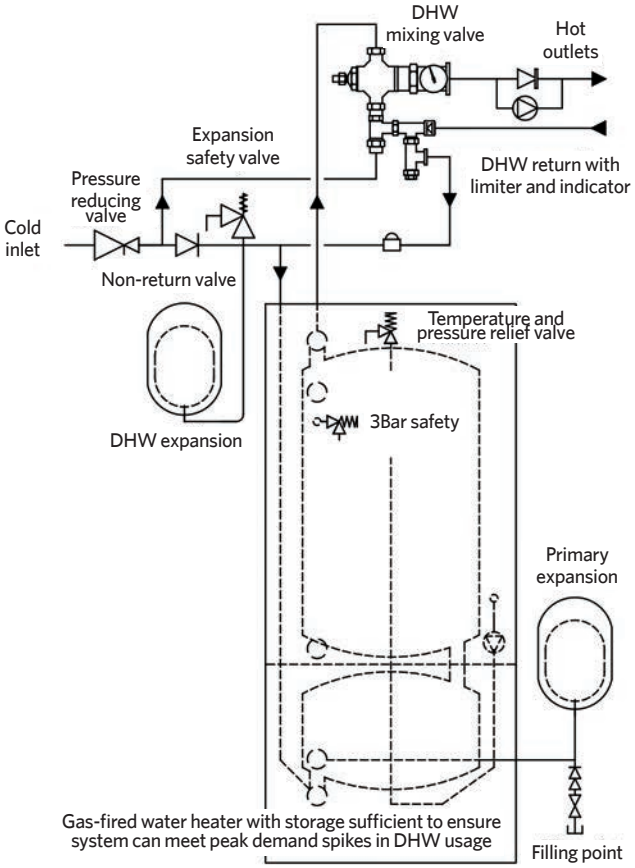

Figure 2: An example schematic of a direct mains cold-water fed, gas fired, part-storage hot-water heater integrated into a DHW distribution system. The DHW mixing valve is set to allow a maximum safe distribution water temperature. (Source: ACV)

and referenced to the method's conversion chart. This is currently the method that is recommended for supplying single and multiple dwellings.

BS 8558,[8] which was written to complement BS EN 806-3 as a means of replacing the long withdrawn BS 6700, maintains the traditional LU method, with LUs that are similar to the CIPHE 'medium' classification (see below). When resolved, using the logarithmic conversion chart, the accumulated LUs provide similar hot-water demands to CIPHE (medium). This is the generally recommended method for larger non-residential buildings.

CIPHE[4] employs LU values developed from the same probabilistic root as the previous methods but provides more detailed LU discrimination by considering period and frequency of use of each appliance, with three classifications of use: low, medium, and high. This is a popular choice for sizing systems, and provides less diversity in the calculation and therefore less risk for design failure, but potentially increases the opportunity for oversizing.

CIBSE Guide G[3] employs the CIPHE LUs for hot-water estimation, and also includes a series of curves to estimate the appropriate size of hot-water storage where a traditional storage system is used.

The current CIPHE and CIBSE guidance were both developed when the bulk storage of DHW was the norm, and newer methods will inevitably evolve in an era where part-storage and instantaneous, continuous-flow systems are becoming more commonplace. Where there are specific known (empirical) flows and periods of use, then these may be applied directly. For appliances that are known to be likely to have short periods of continuous use at intervals – for example in sports stadia, institutional kitchens, theatres and schools – Whorlow[9] explains, with an example, that it is possible to assess the peak simultaneous design flow by reverting to base probability data to meet the normal 99% satisfaction criterion.

Oversizing leads to a number of consequences, which can include oversized plant and distribution equipment; increased opportunities for stagnation in pipework systems (with associated risks of biofilm growth); and increased use of resource with associated financial and environmental impacts. The LUNA report[5] summarises that methods that employ an empirically based statistical framework to offer a better fit with measured data and concludes, on the basis of both statistical validity and a comparison with measured data, that a move away from the use of traditional LUs is now timely.

Turn to page 78 for further reading and references. »

MODELLING METHODS

Probabilistic models are based on a prescribed probability distribution that associates some measure of likelihood of occurrence with each of the possible outcomes. Most of such models are based on the 1940 US paper by Hunter[10] for estimating the 99th percentile of the simultaneous water demand during a busy period. This assumes that water use is a random process, that not all the outlets are used simultaneously, and that estimating simultaneous water demand during a busy period can be modelled within the framework of probability.

Stochastic models are designed to account for randomness and uncertainty, and are often based on Monte Carlo simulation processes that initiate a modelling procedure driven by a set of input parameter values and initial conditions (obtained/collected through some known/measured data or by analysis of information to define various probability distributions). Stochastic models lead to water-demand profiles corresponding to different sets of input parameter values and initial conditions, allowing various aspects of uncertainty that are not possible with a traditional empirical modelling style that can handle extreme values more effectively than the other modelling schemes.

Empirical modelling approaches (sometimes referred to as 'deterministic') use observations to estimate mathematical formulae/expressions. Formulae, charts and tables can be derived by exploring the mathematical/statistical relationships between input and output (measured/observed) data values. In general, most of the standards for the sizing of pipework are based on empirical approaches.

(Developed from information in LUNA stage 1 report[6])

The storage vessel being welded during the manufacturing process (Source: ACV)

Module 179

May 2021

» **1. In the UK, what minimum temperature should the DHW be at the outlet within one minute in offices to meet normal HSE requirements?**

- ☐ A 45°C
- ☐ B 50°C
- ☐ C 55°C
- ☐ D 60°C
- ☐ E 65°C

2. In the illustrated part-storage system, how many litres of DHW can be delivered per minute after an initial 10 minutes' operation?

- ☐ A 3 litres per minute
- ☐ B 14 litres per minute
- ☐ C 29 litres per minute
- ☐ D 44 litres per minute
- ☐ E 50 litres per minute

3. Which method does CIBSE Guide G adopt to determine hot-water flow requirements?

- ☐ A BS 8558
- ☐ B BS EN 806-3
- ☐ C CIBSE method
- ☐ D CIPHE method
- ☐ E SOPHE method

4. What is the simulation process often used in stochastic models?

- ☐ A Madrid
- ☐ B Manchester
- ☐ C Michigan
- ☐ D Midway
- ☐ E Monte Carlo

5. Which one of these was not noted as a consequence of DHW oversizing?

- ☐ A Excessive water consumption
- ☐ B Higher environmental impact
- ☐ C Increase in cost
- ☐ D Oversized plant distribution equipmen
- ☐ E Stagnation in pipework systems more likely

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Further reading:

The LUNA report[6] provides an excellent overview on the validity of loading units

Jess Tindall's 2017 paper[2] in BSERT&T provides a detailed, and accessible, comparison of LU methods, as well as some useful field studies.

BS 8558[8] includes guidance on methods and useful examples in the appendices.

CIBSE Guide G,[3] chapter 2 provides explanations, guidance, examples and links to other relevant documents.

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The Energy Materials Group at the University of Birmingham works with moisture-sensitive materials such as lithium-ion, sodium-ion and solid-state chemistries. All of these require very dry climate conditions to prevent damage or explosive reactions, and to ensure product integrity.

The research team had worked in some of Munters' existing low dew-point facilities in other industry and academic settings, so expectations of a comparable facility were high. As principal contractor for the project, Munters worked with the university to

optimise the dry-room design and ensure reliable climate-control performance. The resulting system is high-performing and energy efficient, and a cost-effective solution for the university.

The 50m^2 dry room maintains conditions at around -40°C dew point at a temperature of 20°C, with capacity for approximately six people. These conditions are created and maintained by Munters' desiccant dehumidification solution installed in the adjacent plantroom.

Low-leakage wall panels and ductwork, and a positive pressure in the room, are also critical. Munters optimised the room and ductwork designs using computational fluid dynamics modelling to ensure it would meet the target dew point in all areas.

'Having the dry room has opened up new opportunities for us,' says Scott Gorman, research fellow and the dry-room manager. 'Around half of the projects carried out each year will use the dry room regularly. It gives us a unique selling point, and allows us to bridge that gap between industry and academia.'

One of the key challenges of the project was working within a Grade II-listed building. Paul Richards, Munters' project manager, said: 'This presented a number of challenges, including working around pillars, matching existing building louvres that were more than 20 years old, and complying with increased planning and building regulations.'

For the full story, visit bit.ly/3cdGZW0
Call 01480 432243,
email info@munters.co.uk
or visit www.munters.com

Rinnai reports on advantages of BioLPG to off-grid sites

Fuel compatible with LPG products and could result in 81% carbon savings, it says

Manufacturer Rinnai has completed a detailed report into the possible 81% savings on carbon emissions if off-grid sites convert to using BioLPG as their main fuel source.

BioLPG is a blend of waste, residues and sustainably sourced materials. Its chemical makeup is identical to LPG, so – from a combustion perspective – it is compatible with existing, in situ LPG products.

BioLPG is a co-product of biodiesel production. Feedstocks are combined with hydrogen in a process called hydrogenolysis, which separates and purifies their energy content.

During refining, waste gases are produced that contain BioLPG; for every tonne of biodiesel, around 5kg of BioLPG is produced from this gas stream.

This co-product is then purified to make it identical to conventional propane.
The carbon factors associated with the BioLPG

used for Rinnai's report are 0.0487kgCO_2e/kWh.

The report highlights off-grid building envelopes that can benefit from high-efficiency, LPG-fired water heaters, and compares the carbon footprint from an energy-transition perspective.

The transition focuses on carbon savings achieved by shifting from oil heating systems to LPG, and then upgrading LPG to Bio-LPG. Applications are modelled using hot-water intensive buildings in the off-grid leisure and hospitality sector.

Author Chris Goggin said: 'This report sets out to establish the environmental impact of a transition in energy types within typical off-grid, high-volume DHW [domestic hot-water] applications. The energy transition focused on dominant off-grid energy sources – namely, oil, LPG and BioLPG.

'The report sought to establish the possible reductions in carbon emissions if this energy transition was used to support decarbonisation in an off-grid setting. The results demonstrate that there is potential for widespread decarbonisation, while also providing an economical and technically feasible solution for consumers.

'Where LPG is already used, the incumbent water-heating technology can still be used when BioLPG switching is available. This would make use of existing fuel infrastructure and heating technology, which would lead to potential capital and operational expenditure savings for end users.'

Copies of the report are available for free from the company.

Call 01928 531 870, email engineer@rinnaiuk.com or sales@rinnaiuk.com or visit www.rinnaiuk.com

Safe and sound with Grundfos FireSAFE

When a fire broke out at breakfast time in a high-rise residential tower in Manchester recently, it was fully occupied. The building, completed in 2019, had two Grundfos FireSAFE sets installed as part of the fire-suppression system, built and tested at the Grundfos manufacturing plant in Sunderland. They form part of the domestic fire range and deliver a compact, consumer and installer-friendly response to the growing demand for domestic fire-suppression systems.

Models comply with BS9251:2014, are WRAS approved and can be used in a variety of domestic installations, including houses, apartments, sheltered and student accommodation, care homes and small hotels.

In this instance, the pump sets didn't simply suppress the fire, but successfully extinguished it. When the firefighters arrived, there was no need for further action, as they didn't need to plug into the installed Grundfos wet-riser system.

These sets offer a great range of features – such as simple installation and commissioning, compact size, and minimal maintenance – combined with their advanced system controller and in-built self-test.

Visit www.grundfos.co.uk

Online presentations for public health engineers

Engineers can discover how Jung Pumpen pumping equipment works, and which pump system is suitable for which application, with the help of new online presentations.

Learn about the best pumping solutions for hot wastewater appliances, such as dishwashers; how many toilets a Compli sewage-lifting station can service; or when to use a single or a duty standby pump configuration.

Call to arrange a suitable time.

Call 0118 9821 555 or visit www.jung-pumps.co.uk

Aermec extends warranties

Aermec is providing British customers, including those in Northern Ireland, with a free, two-year warranty, as opposed to the standard one-year warranty offered by other manufacturers.

The company has a strong HVAC technology platform that's designed to help customers maximise their investments while addressing environmental concerns.

'Extending warranties adds value, and customers can purchase our AHUs, chillers, FCUs and heat pumps with confidence,' says David Evans, Aermec's general sales manager.

The two-year warranty will be applicable from the date of delivery to site or 18 months from commissioning.

Whatever the size of project, Aermec says it can deliver the right temperature ventilation and cooling for the space, while also reducing operating costs and giving superior energy efficiency levels, optimal performance and low sound levels, with minimal environmental impact.

Email uksales@aermec.co.uk or visit www.aermec.co.uk

Zehnder's innovative radiant heating solution

Indoor climate specialist Zehnder Group UK has combined radiant ceiling panels and LED technology for an integrated heating and lighting solution in a single source.

The Zehnder ZFP radiant ceiling panels use infrared radiation, while the LED 2.0 uses light. Both systems transmit energy in the form of radiation.

'Combining LED 2.0 lighting with radiant ceiling panels optimises the available space on the ceiling,' said David Simoes, marketing and product manager at Zehnder Group UK.

'This solution is particularly suited to commercial buildings – including warehouses and sports halls – where making the most of valuable ceiling space, while ensuring employees and customers are in a comfortable environment, is critical to business performance.'

The Zehnder LED 2.0 can be combined with all Zehnder radiant ceiling panels, and – thanks to the innovative plug-and-play principle – the LED components can be installed quickly and easily, directly on site. It can also be used for any room height. The different beam angles allow for flexibility in the lighting design and ensure the best possible illumination of the room, regardless of the building situation.

Visit www.zehnder.co.uk/zfp

Leren before the Storm

As an IT-focused company, Watford-based Storm Technologies wanted to be at the cutting-edge of lighting technology, too. The Leren, from Luceco, with its sleek modern design and integral sensors with DALI dimmable drivers, fitted the brief and was approved by the client.

Offering upward and downward light distribution, Leren was suspended on three-metre drops to meet the lighting requirements. Supplied complete with adjustable wire suspensions, Leren benefits from through-wiring, including electrical connectors as standard, to assist with both standalone and continuous-run installations.

Available as fixed output, DALI dimmable and emergency back-up variants, Leren offers 100,000 hours of maintenance-free operational life with an efficacy of 120Llm/cW. To integrate with a SAS architectural ceiling area, Luceco helped design and supply a modified 1,200mm x 300mm recessed luminaire to complete the lighting programme.

Call (0)1952 238 100, email UK_sales@luceco.com or visit www.luceco.com

Viega's Smartpress piping system used on high-end London project

Viega's Smartpress range has been installed at a luxury new-build residential development in London's Royal Borough of Kensington and Chelsea.

Royal Warwick Square offers 375 one, two, and three-bedroom apartments and penthouses. Viega's composite pipework, in various sizes from 16mm to 40mm, was specified by developer Berkeley St Edward for use on the potable, boosted cold and heating system pipework.

The Smartpress system consists of an advanced multilayer, flexible pipe that can bend around structures. By reducing – by as much as 80% – the number of joints compared with a metal system, it minimises the chance of leaks.

The simplicity of the cold-applied piping system also means no O-ring is required, taking away the need for complex calibration, and cutting installation time by as much as 30%.

The stainless-steel fittings also feature Viega's SC-Contur technology, which clearly indicates any unpressed connections during a leak test.

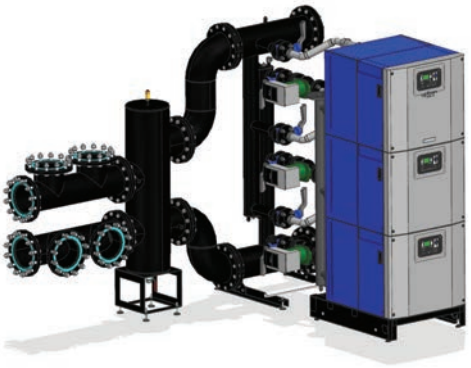
Viega provided onsite training for installer Vital Energi's team. Dean Walsh, project director at Vital Energi, said: 'The Smartpress system was straightforward to install. It is a great product that we believe saved us money when compared against a copper press connection.'

Visit www.viega.co.uk

Better pipework kits for Hamworthy's Upton

Hamworthy's space-saving Upton modular, vertically stacking boiler now has improved pipework kits. The kits have a choice of options, such as matched boiler pumps and low loss headers with integrated air and dirt separators. Improvements include: reduced size, clearances and weight; simpler pump installation; and a new bracket with eyelets, for easier transport and handling. The kits are available for two-and three-high configurations, and three pipe sizes.

Visit www.hamworthy-heating.com/Products/Commercial-boilers/Upton-modular-boiler



DIRECTORY Your guide to building services suppliers

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

Air Handling

Energy Efficiency

Fire Protection

EVENTS

Event details are correct at the time of going to print, but as a result of the ongoing coronavirus (Covid-19) situation, they may be subject to change. For updates, please check cibse.org/training for training and cibse.org/events for CIBSE groups and regional events. CIBSE has a range of online learning courses available to support your learning. Visit cibse.org/training-events/online-learning

CIBSE AGM

6 May

This will be held as a virtual event, and will be followed by incoming president Kevin Kelly's address.
www.cibse.org/agm

TECHNICAL SYMPOSIUM

13-14 July

This year's event, which will be held virtually, is titled 'Engineering the built environment for a new "normal" – delivering safe, healthy and versatile buildings'. The annual symposium encourages the participation of young and experienced practitioners, researchers and building users to share experiences and develop networks. For details and to register, visit **www.cibse.org/symposium**

CIBSE REGIONS AND GROUP EVENTS

Check the website for up-to-date information on regions and groups meetings, webinars and podcasts. Visit **www.cibse.org/events**

Young Energy Performance Group: AGM
4 May
The Group will be looking to recruit new members to its steering committee.

Building Simulation Group: AGM
5 May

SLL webinar: Recommendations for melanopic lighting
5 May
With expert speakers discussing recommendations and practical applications for melanopic lighting design.

Western Australia: Well rating implications on the built environment
6 May
Speaker Oliver Grimaldi, of Cundall, on the Well rating tool and its application in building and services design.

CIBSE JOURNAL WEBINARS

CIBSE Journal hosts regular, sponsored webinars covering a wide range of building services-related topics. All webinars are available on demand on the *Journal* website at **www.cibsejournal.com/cpd/webinars**

SLL and West Midlands: Webinar – DIALux evo and DIALux 4
12 May
With Iain Macrae, SLL past president, chair of SLL Lighting Guide 5: *Lighting for Education*, and DIALux trainer for the UK. The presentation will show live operation of the software.

SLL AGM, awards and president's address
20 May
SLL will present the Leon Gaster and Walsh Weston Awards for research papers, the Regional Lighting Award, the Lighting Award, Honorary Fellowship, and the President's Medal. This will be followed by Ruth Kelly Waskett's incoming SLL president's address.

NEW LIVE ONLINE TRAINING COURSES

CIBSE training courses have been reformatted to work online, with a live trainer, so you can expect the same interaction and participation as you would in a classroom setting.
For details and full programme, visit **www.cibse.org/training**

Energy surveys
5 May

Air conditioning inspection for buildings
6 May

Low carbon consultant building operations
10-13 May

Mechanical services explained
12-14 May

Standby diesel generator
14 May

Heat networks code of practice
17-18 May

Building services explained
18-20 May

Above-ground building drainage
19 May

Understanding and managing moisture risks in buildings
19 May

Mentoring skills workshop
19 May

Heat Networks (CP1) half-day
25 May

Below-ground building drainage
25 May

Electrical services explained
1-3 June

Overview of current fire legislation and guidance
3 June

Low carbon design
7-9 June

Introduction to Heat Networks Code of Practice (CP1)
8 June

Fundamentals of drainage
11 June

Heat Networks Code of Practice (CP1)
14-15 June

High-voltage (11kV) distribution and protection
15 June

Building services explained
16-18 June

Heat Networks (CP1) half-day update
22 June

Mechanical services explained
22-24 June

ESOS – Energy Savings Opportunity Scheme
30 June

#Growyourknowledge

CIBSE's free webinar series continues every two weeks on Thursday at 11am. The webinars are designed to support the CIBSE community in maintaining CPD remotely. All webinars are available to view on demand, **www.cibse.org/growyourknowledge**

CIBSE

YOUNG ENGINEERS AWARDS 2021

OPEN FOR ENTRIES

The CIBSE Young Engineers Awards recognises excellence and showcases diverse, hard-working graduate engineers and apprentices, and the success stories of past winners.

The awards provide an opportunity to also celebrate the very best employers who are committed to nurturing young talent.

These awards are free to enter and open to all.

Enter by

30 July 2021

Awards categories:

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> CIBSE Employer of the Year

> CIBSE Apprentice of the Year

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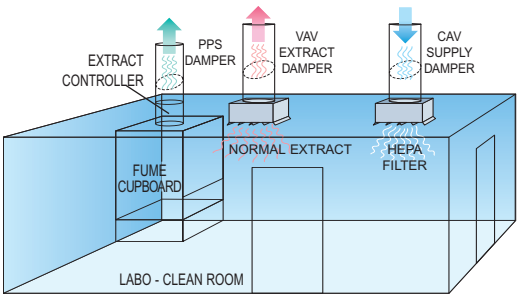

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