CIBSE JOURNAL

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HEAT OF THE MOMENT

Why Copenhagen's drive for zero carbon is attracting worldwide interest

FUTURE RETROFITS FOR ZERO CARBON

UNCERTAINTY SLOWS PAY RISES

SWITCHING TO A COMMUNAL HEAT PUMP

Editorial
Editor: Alex Smith
Tel: 01223 378034
Email: asmith@cibsejournal.com
Deputy editor: Liza Young
Tel: 01223 378048
Email: lyoung@cibsejournal.com
Technical editor: Tim Dwyer
Designer: James Baldwin

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1 Cambridge Technopark, Newmarket Road, Cambridge CB5 8PB.

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Advertisement sales
Display and sponsorship Jim Folley
jim.folley@redactive.co.uk
Tel: +44 (0) 20 7324 2786
Products & services Jonathan Adebayo
jonathan.adebayo@redactive.co.uk
Tel: +44 (0) 20 7880 6217
Recruitment advertising
cibsejournaljobs@redactive.co.uk
Tel: +44 (0) 20 7880 6215
Advertising production Jane Easterman
jane.easterman@redactive.co.uk
Tel: +44 (0) 20 7880 6248

A fresh perspective

The new decade feels like a chance to reset. Tangible consequences of climate change – including bush fires, record-breaking global temperatures and rising sea levels – have shown that the planet can no longer sustain current levels of human activity. The fire at Grenfell Tower also showed that, in the UK, entrenched and dysfunctional building practices, as identified by Dame Judith Hackitt, can no longer continue.

In 2020, the government and industry has an opportunity to set the course for a safer, more sustainable future. Last month, the government announced a series of measures that would implement Dame Judith's proposed reforms in her *Building a Safer Future* final report. These include the setting up of a building safety regulator run by the HSE, which would be at the heart of a more stringent regime. According to Secretary of State for Housing, Communities and Local Government Robert Jenrick, this regulatory body would provide effective oversight of the design, construction and occupation of higher-risk buildings.

In terms of reducing the impact of buildings, the government has a golden opportunity this year to put in place measures to reduce embodied and operational carbon via upcoming changes to Building Regulations governing energy use.

For many working in the industry, there's a sense of 'why wait?' Indeed. The science of climate change is irrefutable, and we have the engineering know-how, so why not create and maintain sustainable buildings right now?

That's the thinking of the London Energy Transformation Initiative, which, as *CIBSE Journal* goes to press, is launching its *Climate Emergency Design Guide*. A year in the planning, the guide has been put together by more than 100 design professionals and has the backing of various industry bodies, including CIBSE and RIBA. It covers five key areas: operational energy; embodied carbon; the future of heat; demand response; and data disclosure. It's a very encouraging start to the year, and a sign that we, as an industry, can put contractual differences aside and change for the better.

Of course, the other great refresh of 2020 is the UK's departure from the European Union. So far, few of us may have felt the consequences of the split from the EU, but for at least some of the 7% of construction workers in the UK who are EU nationals, it has been an unsettling experience, with real-life ramifications. On page 22 Dr Dorte Rich Jørgensen shares her experience of applying for British citizenship and calls on everyone to sign the #ConstructionisOpen pledge to support EU27 nationals, organised by the Edge, at **eu27pledge-edge.squarespace.com**

ALEX SMITH, EDITOR asmith@cibsejournal.com

CONTRIBUTORS

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Tim Dwyer
This month's CPD looks at the selection and design of surface water source heat pump systems

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FOR CIBSE

Journal production manager: Nicola Hurley
Tel: 020 8772 3697, **nhurley@cibse.org**

CIBSE, 222 Balham High Road,
London SW12 9BS
Tel: +44(0)20 8675 5211

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New body to oversee 'stringent' safety regime

Building Safety Regulator set up as government warns owners about cladding

Secretary of State for Housing, Communities and Local Government Robert Jenrick has announced that a new Building Safety Regulator is to be established immediately.

The regulatory body will be part of the Health and Safety Executive (HSE) and at the heart of a new, 'more stringent' regime. Jenrick told the House of Commons last month that it would provide effective oversight of the design, construction and occupation of higher-risk buildings.

Dame Judith Hackitt has been appointed as chair of a board to oversee the transition.

Jenrick said: 'Progress on improving building safety needs to move significantly faster to ensure people are safe in their homes and building owners are held to account. The slow pace of improving building safety standards will not be tolerated.'

The government has also launched a consultation into the combustible cladding ban **bit.ly/30KYwP8**, including proposals to lower the current 18m height threshold to at least 11m.

New advice on building safety for multi-storey, multi-occupied buildings is being issued by the government-appointed independent expert advisory panel. It has clarified and updated advice to building owners on actions they should take to ensure their buildings are safe, with a focus on cladding, and including fire doors **bit.ly/CJFeb20safety2**

The advice reflects the panel's view that cladding material comprised of aluminium composite material (ACM) and other metal composites with an unmodified polyethylene core should not be on residential buildings of any height and should be removed.

A call for evidence **bit.ly/CJFeb20Safety3** seeks views on the assessment of risks within existing buildings.

Jenrick warned that some building owners were still acting too slowly to remove unsafe ACM cladding, and told parliament: 'Unless swift progress is seen in the coming weeks, I will publicly name building owners where action to remediate unsafe ACM cladding has not started. There can be no more excuses for delay. I'm demanding immediate action.'

It is estimated that works are yet to start on 143 privately owned tower blocks, with issues around whether leaseholders or freeholders should be responsible for the high fees often associated with the remedial work.


Robert Jenrick

Government sets out Fire Safety Bill details

The government has given further details of the upcoming Fire Safety Bill being introduced to parliament, which will set out in more detail its response to the Public Inquiry Phase 1 recommendations.

The bill will give local fire authorities the powers to compel the replacement of ACM cladding where it is still not being removed. This will clarify the Regulatory Reform (Fire Safety) Order 2005 – 'the Fire Safety Order' – requiring residential building owners to fully consider and mitigate the risks of any external wall systems and front doors to individual flats.

The changes will make it easier to enforce where building owners have not remediated unsafe ACM by complementing the powers under the Housing Act.

Industry backs LETI's Climate Emergency Design Guide

Leading architects, engineers and building professionals have come together to launch a new *Climate Emergency Design Guide* offering a blueprint on how the construction industry can build zero carbon buildings.

Published by the London Energy Transformation Initiative (LETI), the free-to-access guide has been written by more than 100 industry professionals, and aims to give a consensus on how to design new buildings in a way that does not jeopardise national emissions targets. The project is backed by a number of industry bodies, including CIBSE and the Royal Institute of British Architects (RIBA).

The guide has been developed over the past 12 months and covers five key areas: operational energy; embodied carbon; the future of heat; demand response; and data disclosure. LETI is also publishing the *Embodied Carbon Primer*, which offers supplementary guidance to those interested in exploring embodied carbon in more detail.

Clara Bagenal George, associate at Elementa Consulting and initiator of LETI is lead author of the guide. She said: 'The building industry knows that we should be designing climate-friendly buildings now, but only a fraction of new properties are of the standard needed to meet our climate targets.'

Hywel Davies, technical director at CIBSE, said: 'Delivering zero carbon buildings is a huge challenge. LETI has taken a major step to help the industry work out how this is to be done.'

EU wants trillion euros to avert 'climate crash'

The European Union has pledged to set aside one trillion euros to cut CO_2 emissions to zero by 2050. Half of the money will come from the EU long-term budget, according to the European Commission, with more than €100bn in co-financing from member governments, €100bn from its funds to help coal-dependent regions transition to 'green' energy, and a further €300bn from 'private sources'. 'We need climate cash to avoid a climate crash,' said European Budget Commissioner Johannes Hahn.

Climate change defining financial markets

Global investment markets are 'on the edge of a fundamental reshaping of finance', with climate change as the long-term 'defining factor', says the chief of the world's biggest financial asset management company, BlackRock.

In his annual letter to CEOs, Larry Fink said 'every government, company, and shareholder must confront climate change' and told clients 'that sustainability should be our new standard for investing'. He said BlackRock will back away from companies that produce more than 25% of their revenues from coal production.

IN BRIEF

Generation of power keeps getting cleaner

Last year was the cleanest on record for electricity generation in the UK, according to data from the National Grid.

For the first time, wind farms, solar and nuclear – supplemented by power imported from Europe via subsea interconnectors – outstripped fossil-fuel burning, delivering 48.5% of the country's electricity. Gas and coal was responsible for 43%, with 8.5% provided by biomass.

The UK will have closed all of its coal-fired generators by 2025 and emissions are down by 40% compared with 1990, when just 2.3% of its power came from renewables. 'This truly is a historic moment and an opportunity to reflect on how much has been achieved,' said National Grid CEO John Pettigrew.

Wates aims for 'zero harm' policy

Wates Group has committed to a 'zero harm' environment policy that includes reducing – and then eliminating – waste from its onsite operations within five years. It will also move to an all-electric commercial vehicle fleet to cut carbon emissions to zero.

Chief executive David Allen said: 'We have a responsibility to reduce and, eventually, to reverse the impact we're having on our planet, and are determined that everyone in the Wates Group will do what is necessary to make a real and lasting difference.'

A company statement added that the construction sector was responsible for up to 50% of climate change, 40% of energy use and 50% of landfill waste, according to the Construction Climate Challenge.

CIC past chairman appointed CBE

Professor John Nolan, the immediate past chair of the Construction Industry Council, has been appointed CBE in the New Year's Honours list, for services to structural engineering and the construction industry.

As well as being the current deputy chair of CIC, Nolan is director of Birmingham-based John Nolan Associates, and a past president of the Institution of Structural Engineers (IStructE).

'No excuses' as first UKGBC net-zero buildings unveiled

Mayor of Greater Manchester urges developers to follow Peel L&P's example

Eleven office developments in Liverpool and Greater Manchester have been certified as net-zero carbon under the UK Green Building Council's (UKGBC) standard.

The properties, managed by Peel L&P, include MediaCityUK's The Vic, The Alex, Quay West and the Digital World Centre, along with TraffordCity's Venus and Liverpool Waters' Princes Dock.

Mayor of Greater Manchester Andy Burnham hailed the developments as exemplars of his environmental vision for the city. 'If we are to deliver on our carbon-neutral commitment for 2038, published in our five-year environment plan, we need to make deep cuts, urgently, in emissions from our building stock,' he said. 'Peel L&P has shown that those deep cuts are not only possible, but that they're also good for business. The message to others now is pretty clear: no excuses, if Peel L&P can pull this off, so can you.'

The net-zero standard was achieved in stages – first by building to Breeam standards, and then investing heavily in energy efficiency and offsetting the remaining emissions through a tree-planting programme in Nnorth West England.

In 2011, Peel achieved Breeam communities standard for its MediaCityUK developments, gained ISO 5001 certification in 2015, and, last year, invested £859,000 in energy-efficiency measures, which it estimates will reduce the annual emissions of its office tenants by 13%.

MediaCityUK is one of the developments certifed net-zero carbon by UKGBC

Hydrogen 'first' for Keele pilot project

Hydrogen has been injected into the UK gas grid for the first time in a pilot project at Keele University, to demonstrate how it might be key to a major decarbonisation of heating.

Hydrogen is providing 20% of the volume of gas in the university's network as part of the £7m HyDeploy trial, which is supplying lower carbon heating for 100 homes and 30 faculty buildings.

'It is impossible to overstate the importance of this trial,' said Ed Syson, chief safety and strategy officer for gas distribution firm Cadent. 'This is the first practical demonstration of hydrogen in a modern gas network in this country.'

Cadent had to secure an exemption from the Health and Safety Executive for the trial because UK regulations limit the amount of hydrogen allowed in the gas grid to less than 1% of the total.

The Committee on Climate Change (CCC) estimates that heating and hot water for homes accounts for 15% of the UK's carbon footprint. Researchers at Keele say widespread use of hydrogen in the gas grid could mitigate the emission of six million tonnes of CO_2e annually.

SES WINS HIGH-TECH CONTRACT AT BATH UNIVERSITY

SES Engineering Services (SES) has won the contract to deliver £12.5m worth of mechanical, electrical and plumbing (MEP) services to the University of Bath's £70m Institute for Advanced Automotive Propulsion Systems (IAAPS).

The 11,300m² site is at the Bristol and Bath Science Park, and will house equipment to test vehicle-propulsion systems, offices, experimental spaces, prototyping workshops and start-up space.

Offices must aim for 60% energy cut if UK to achieve carbon targets

UKGBC challenges sector to show the way towards buildings fit for 2050

The UK Green Building Council (UKGBC) has recommended that the office sector reduces energy demand by an average of 60% by 2050 to help the UK achieve its net-zero carbon targets.

Its latest report, *Net-zero carbon buildings: a framework definition*, sets out guidance for buildings seeking to achieve net-zero for construction and operational energy. Offices should first achieve energy performance targets, then meet demand – as far as possible – through renewable energy, and finally offset any remaining carbon, it says. The data should be independently verified and publicly disclosed on an annual basis.

'The most important action the building sector can take is to drive down energy demand,' said senior policy adviser Richard Twinn. 'This will be crucial to decarbonising our energy systems in the most cost-effective way, and ensuring that buildings only use their "fair share" of energy.'

He added: 'The net-zero carbon buildings framework was introduced to bring consistency about what net-zero carbon means in practice. These targets will begin to raise the bar for offices, placing much greater emphasis on energy efficiency before renewable energy and offsets. They will challenge the offices sector and show the way towards buildings that are truly fit for 2050.'

In another paper, *Net zero carbon: energy performance targets of offices*, the UKGBC shows how targets should be tightened every five years up to 2035. By this date, all offices aiming to be net zero should be operating at the energy performance standards that will be needed by 2050, it said.

Intensity needed to decarbonise heat

Industry body the Sustainable Energy Association (SEA) wants a 'carbon intensity regulation' to accelerate the decarbonisation of heat. This would set progressively stricter limits on the level of emissions allowed per kWh of heating, and would help the government deliver on its commitment to phase out fossil-fuel heating in properties off the gas grid by the end of this decade, the SEA said.

A new heating system would have to meet the emissions intensity standard in force at the time that it is installed. This would incentivise manufacturers of low carbon heating to grow production and installers to invest in training so they can work with new technologies.

A study by the SEA recommended that the regulation be part of a 'whole-house approach' that includes financial incentives for consumers to improve energy efficiency and buy low carbon heating systems.

'This regulatory proposal would give long-term certainty to industry and investors, and confidence to the public that the government's decarbonisation targets will be met,' said SEA chief executive Lesley Rudd.

'It should, however, be paired with financial incentives to encourage already proven low carbon heating technologies.'

IN BRIEF

US Congress adopts ASHRAE energy efficiency standard

The US Department of Energy is adopting ASHRAE's Commercial Building Energy Efficiency Standard 90.1 'except in extraordinary cases where a high evidentiary hurdle has been surmounted'. This means it will use the ASHRAE benchmark to set energy conservation standards for consumer products and commercial equipment.

ASHRAE's Standard 90.1 has been adopted as a benchmark for commercial building energy codes in the US and beyond for more than 35 years. A building built to the latest standard will use less than half the energy of one built using the first version of the standard, set in 1975, ASHRAE said.

India imposes 24°C default for air con

The government of India has imposed a relatively high default temperature setting of 24°C on room air conditioners. It is part of the country's strategy to impose energy performance standards that came into effect last October.

Indian seasonal energy efficiency ratios (ISEER) are set at between 3.3 and 5 for split, and 2.7 and 3.5 for window air conditioners.

All types of star-labelled room air conditioners are covered by the new rules, including multi-stage capacity, unitary and split units up to a rated cooling capacity of 10,465W. They apply to all AC units manufactured or bought in India.

PDR 'should be scrapped', says LGA

The Local Government Association (LGA) has called for a ban on permitted development rights (PDR) amid growing criticism of the standard of housing being built under this regulation.

More than 54,000 homes have been created by converting former office blocks through PDR since it was introduced in 2015, but local authorities are concerned this undermines safety and quality.

The LGA said PDR leaves councils powerless to address 'serious concerns about the quality, design and safety of housing' because developers can progress their projects without approval. It also means planning rules that ensure a certain percentage of new homes are affordable cannot be enforced.

Industry urged to switch to reclaimed refrigerants

The international refrigerant supplier A-Gas has called for the air conditioning and refrigeration sectors to step up their use of reclaimed refrigerants in the face of tightening restrictions on 'virgin' gases.

Since the start of the year, virgin refrigerants with a global warming potential (GWP) of 2,500 or greater can no longer be used in new installations, or to service systems with a charge size of 40 tonnes CO_2 equivalent or greater – around 10kgs of the widely used gas R404A.

Virgin R404A is still available for smaller systems, but A-Gas has warned that supplies are limited because of demand pressures caused by the new restrictions.

'Major refrigerant suppliers removing virgin R404A and R507A from sale in the European market reinforces that the switch to reclaimed gases must gain pace if the industry is to manage this change,' said an A-Gas spokesperson.

'It is also key that installers and end users understand the difference between reclaimed and recycled refrigerants. Recycled refrigerant is a handy quick-fix, which is cleaned up and can only be used on site. Reclaimed refrigerant has been reprocessed by a licensed facility to the industry standard AHRI 700. It is purified, certificated and guaranteed to be returned to the same standard as virgin material.'

Low-GWP alternatives are the best solution in the long term, added A-Gas, but reclaimed gases are 'part of the future' because they use material that has already been produced, prolonging the life of equipment and reducing the burden on producing new, quota-restricted material.

Builders demand VAT cut

The Federation of Master Builders (FMB) wants the Chancellor to cut the rate of VAT on home-improvement works in the forthcoming Budget.

'While last year was marked by political and economic uncertainty, there seems to be some small signs of hope for the construction industry,' said FMB chief executive Brian Berry. 'It is too soon to tell whether this will be a longer-term trend, as some sectors – such as private housebuilding, and repair and maintenance – continue to see sluggish growth.'

Berry said the Budget was the 'perfect opportunity for the government to ensure the positive trend at the end of 2019 continues into the new decade'. The FMB also advised the government to invest in construction skills and in improving planning departments, to ensure they do not 'act as a blockage' that undermines their ambitious plans for new housebuilding.

Positive end to 2019

Construction output grew strongly towards the end of 2019, according to government data.

The Office for National Statistics said output rose by 1.1% in the three months to November, compared with the previous three months, driven by a 1.6% increase in new work. Repair and maintenance work grew by just 0.2%.

The largest growth was in infrastructure and private commercial (3% and 1.8% respectively), but new housing work was down slightly.

Record hot year results in more overheating deaths

CCC warns that building designs must adapt to rising temperatures

Two summer heatwaves in the UK last year caused 892 extra deaths, with most victims dying inside their own homes or care homes, according to Public Health England (PHE). The country recorded its highest temperature on record between 21 and 28 July – 38.7°C in Cambridge – while the second heatwave took place between 23 and 29 August. Overall, 2019 was the UK's hottest on record.

The Committee on Climate Change (CCC) has warned that the UK is 'woefully unprepared' to deal with rising temperatures. There is no 'coherent plan' for dealing with overheating in buildings, it said, and its recommendations for changing Building Regulations have been ignored. Unless building designs are changed, the number of premature heat-related deaths will rise to 7,000 a year by 2040, the CCC predicts.

According to PHE, most of the deaths last year were among people aged 65 or over – with the elderly and those with heart and kidney problems most at risk – although 41 in London were among those aged under 65.

Air-quality advocate launches BESA's safe haven campaign

Rosamund Adoo Kissi-Debrah

The UK's first World Health Organization (WHO) advocate for air quality and health has joined the Building Engineering Services Association (BESA) group for health and wellbeing in buildings.

Rosamund Adoo Kissi-Debrah's daughter Ella died in 2013 after a series of asthma attacks linked to air pollution near her home and school in Lewisham, London. Her death is the subject of a second coroner's inquest, which may lead to Ella becoming the first person in the world to have air pollution officially recorded as cause of death.

Having founded the Ella Roberta Foundation (**ellaroberta.org**) in her memory, Adoo Kissi-Debrah has become a high-profile figure in the battle against air pollution. She launched BESA's Building Safe Havens (#buildingsafehavens) campaign, promoting indoor clean air zones.

'The building engineering industry has a particularly important role to play because of the nature of your work,' she said. 'It is so crucial that you don't cut corners, and don't look for loopholes in standards and regulations.'

Peer launches late payment bill

Exactly two years after the collapse of construction giant Carillion, Lord Mendelsohn has introduced a new payment bill to the House of Lords, in a bid to improve payment security for small and medium-sized businesses (SMEs).

It includes a statutory payment limit of 30 days and gives power to small firms to refer payment disputes to the Small Business Commissioner, who will be able to impose penalties on 'serial late payers'.

The bill would also amend the Public Contracts Regulations 2015, to mandate the use of project bank accounts for public sector works of more than £0.5m.

According to SEC Group research, 90% of business owners/senior employees in construction are reporting mental health problems and disruption to family relationships because of payment abuse.

Since October 2017, SMEs in construction have lost almost £580m worth of retention monies as a result of upstream insolvencies.

IN BRIEF

Ken Dale Travel Bursary 2020

Applications are now open for the Ken Dale Travel Bursary 2020. The award offers up to £4,000 to CIBSE members in the early stages of their career to spend three to four weeks travelling, to complete research connected to their field of work.

The bursary offers young building services engineers the chance to experience technical, economic, environmental, social and political conditions in another country, and to examine how these factors affect the practice of building services engineering.

Last year's winner, Raphael Amajuoyi, travelled to San Francisco, Rio de Janeiro and Doha for his research on the design of offices in relation to female occupancy thermal comfort.

Applications for this year's bursary must be received by Friday 10 April. Download an application form at **cibse.org/kendale**

CIBSE pays tribute to regional chairs

With great regret, we report the death of two very active CIBSE volunteers who both gave great service to the Institution. Gary Bennett was treasurer and former chair of CIBSE Northern Ireland Region, served on the CIBSE Professional Conduct Committee and was a member of the CIBSE Heritage Group. Alfred Leung was a committee member and former chair of CIBSE Merseyside and North Wales Region, a member of the SLL Education Committee and an SLL regional lighting representative. Our thoughts are with the families and friends of both Gary and Alfred at this time.

CIBSE Training and Development Forum

Anyone interested in running a CIBSE-approved Training and Development (T&D) scheme is invited to attend the next T&D Forum, at CIBSE's London HQ, on 5 February.

It will offer guidance on setting up a scheme, and the chance to network with administrators, sponsors and mentors. Tea, coffee and lunch will be provided.

To book a place, contact Emma Linnane at **elinnane@cibse.org** or on **0208 772 3691**.

KEIR LOUDON NAMED SoPHE YOUNG ENGINEER OF THE YEAR

Arup's Keir Loudon has won the Society of Public Health Engineers (SoPHE) Young Engineer of the Year Award. The 2019 competition challenged applicants, aged 18-35, to produce a promotional video celebrating the work of public health engineers. Loudon's video provided an engaging insight into the problem-solving they undertake (see the March *CIBSE Journal* for an interview with Keir).

Cross-discipline scheme gains lift-off in Ireland

CIBSE Ireland to extend Workshare Exchange Programme after positive pilot

CIBSE Ireland is celebrating the success of its inaugural Workshare Exchange Programme, which was devised to build and strengthen relationships between engineering and contracting companies in the building services sector. The main objective of the programme is to give participants insight into each other's working practices.

The first programme ran from May to July 2019, with Kerry Taylor, from Axiseng, and Tom Egan, from Winthrop Engineering & Contracting, taking part. They carried out their normal duties, but then spent one day a week at each other's office, effectively doing the other's work.

Tom Egan, of Winthrop Engineering & Contracting, and Kerry Taylor, of Axiseng

Although the main focus was on the engagement between Taylor and Egan, it quickly became apparent that the role of their respective mentors – Richard Vaughan, at Axiseng, and Thomas Sheridan at Winthrop – was equally important. Their involvement meant Taylor and Egan were treated as almost direct employees by the host companies.

In reviewing their experiences, the pair highlighted many challenges that had been anticipated, but also the learning outcomes from issues and situations that had not been foreseen.

Taylor said: 'I found the exchange to be very beneficial to my professional development – a knowledge enhancer and confidence builder.'

Egan noted the value he gained from seeing how design documents are put together through the different draft stages before tender. 'The most important outcome is that I gained an understanding of the various design tools and how designs are produced,' he said

CIBSE Ireland is delighted to announce that the next programme has now been agreed, with the new participants to be formally announced shortly. More details to follow.

To get involved, visit **bit.ly/CJFeb20share**


Morpheus Hotel


Great Arthur House


Bloomberg HQ

SFE Façade of the Year winners revealed

Bloomberg HQ, Morpheus and Great Arthur House pick up awards

Three striking buildings have triumphed at the Society of Façade Engineering's (SFE's) Façade of the Year Awards.

Bloomberg HQ in London, by Sir Robert McAlpine and Josef Gartner, won the New Build award. The building, which won the 2018 RIBA Stirling prize, impressed the judges with the complexity of the façade engineering. They said the final composition, brought together with brilliant architectural and functional purpose, produced a 'once in a generation project'.

The Refurbishment Award was won by Mott MacDonald for Great Arthur House, in London. A story of persistence and belief by the Mott MacDonald team, the refurbishment symbolises the enormity of the challenge our industry faces in upgrading the stock of 20th-century high-rise apartment buildings, and the further challenge of listed buildings.

The judges felt the solution was innovative and proportionate, balancing the competing needs of conservation, performance, functionality, cost and access, and the constant occupation of residents.

The Morpheus Hotel, Macau, China, won the Innovation Award. Already a global award winner for BuroHappold Engineering, the structure may be the world's best example of a freedom-twisting, geometric exoskeletal supporting façade elements. The judges said the project absolutely mesmerises in respect to difficulty of engineering, design and delivery.

There was also a discretionary award to Seele, for Iconsiam, Bangkok, Thailand, which the judges felt deserved to be commended for its design.

The annual event is the façade industry's longest-running and most prestigious awards. They recognise and reward excellence and achievements in façade engineering, raising the profile of – and drawing attention to – the importance of the discipline in modern architecture.

The 2019 winners, announced at the Glass Supper, in London, in December, demonstrated the diverse and remarkable nature of what can be achieved with façade engineering.

Nominations for officers, board and council

New CIBSE officers, board members and council members take office each year from the AGM in May. Officers and board members serve on the board, the Institution's governing body, which comprises seven officers (President, president elect, three vice-presidents, honorary treasurer and immediate past president) and five board members.

All candidates for officer and board member vacancies arising at the AGM must be considered by the Institution's nominations panel, to which all sections of CIBSE are invited to suggest candidates for consideration. The panel seeks to reflect Charity Commission guidance by nominating a range of candidates with the skills and experience to fulfil the board's role as the governing body of a significant registered charity. It also seeks to ensure a balance of representation from different sectors of the industry.

Having considered the advice of the panel, the board nominates candidates for president elect and board member vacancies. Any eligible candidates proposed by the nominations panel but not by the board may also put their names forward for election; on this occasion, however, there were no such candidates. The board's candidates will, therefore, be declared elected at the AGM in May 2020 as follows:

President elect: Kevin Kelly CEng FCIBSE FSLL
Members of the board: Vince Arnold CEng FCIBSE
David Cooper CEng FCIBSE

The board also appoints three vice-presidents and the honorary treasurer, normally from those who serve – or have served – on the board. All those below are current officers or board members. The board's appointments to take office in these roles from May 2020 are:

Vice-presidents: Ashley Bateson CEng FCIBSE
Susan Hone-Brookes CEng FCIBSE
Kevin Mitchell CEng FCIBSE
Honorary treasurer: Adrian Catchpole CEng FCIBSE

The council is a larger consultative body that advises the board on Institution policy. It includes representatives of Regions, Societies, Groups, Networks and Standing Committees, and elected members who serve a three-year term. The board has agreed to operate a similar procedure for election as that for board members, and two corporate and one non-corporate positions are available for election each year. The board nominated the following individuals. There were no candidates suggested by the panel but not nominated by the board, so the following will be declared elected in May 2020:

Members of council: Scott Mason (non-corporate)
Mike Smith CEng Hon FCIBSE (corporate)
Becci Taylor CEng FCIBSE (corporate)

A solar panel farm in Antalya, Turkey

BSER&T to dedicate issue to decarbonisation

Deadline for submission of 200-word abstracts for CIBSE's academic journal is 1 March 2020

In October 2018, the Intergovernmental Panel on Climate Change (IPCC) released a carbon budget for limiting global warming to 1.5°C. The report stated that immediate and effective action is required to reduce carbon emissions. Cutting energy demand in buildings through improved performance will play a key role in meeting these challenges, yet little action seems to have been taken. *BSER&T* wants to encourage and showcase the latest developments in the decarbonisation of buildings with a special issue publication.

If you have research or practice that is robust enough to form the basis of a peer-reviewed paper in the area of building decarbonisation, CIBSE's journal *BSER&T* (**journals.sagepub.com/home/BSE**) would like to hear from you.

If you are selected to contribute, you will have a maximum of 12 weeks to submit the paper. The issue is specifically looking for material that includes:

- **Low carbon building design**
- **Low carbon building retrofit**
- **Cost optimisation of building design**
- **Heat pumps (technology development and innovative application)**
- **Heat networks as a vector for building decarbonisation**
- **The relationships between ventilation, airtightness, thermal comfort and energy use in highly insulated buildings**
- **Insulation – new technologies or research into lesser-understood effects**
- **Building integrated renewables**
- **Decarbonisation of heat**
- **CHP in the context of grid decarbonisation**
- **Grid decarbonisation**
- **The performance gap and ways to mitigate it.**

Send an abstract of no more than 200 words, by 1 March 2020, to **BSERT-Decarb@cibse.org**

A group of papers will be selected from the abstracts to form an appropriately coherent special issue. We will contact you within three weeks of the closing date to let you know whether your paper will be included. See **journals.sagepub.com/author-instructions/BSE** for details of the requirements for papers that are selected to participate in the issue.

The end of the beginning

The UK may have left the EU, but it still remains a key participant in the European Standards system, says Hywel Davies

By the time you read this, the UK will have left the European Union and started engaging in international trade negotiations with the United States and our former EU colleagues. But what might this mean for the building services sector?

At 11pm GMT on 31 January, an unprecedented period of turbulence and controversy in British political history formally ended, when the UK left the EU after 48 years. It concluded three and half years of discord.

After the rout of General Rommel at El Alamein in 1942, Prime Minister Winston Churchill said: 'This is not the end. It is not even the beginning of the end, but it is, perhaps, the end of the beginning.' And so with Brexit.

After more than three years of conflict, the UK is now an independent, sovereign state, where a democratic choice has been implemented – but we still believe in, and are part of, a rules-based international system of global trade governed by bilateral and multilateral trade agreements.

Outside the EU, we are now free to negotiate a trade deal with the US – and it would be mad not to do so, given the size of the US market, the historical links between the two countries and the 'bond between the English-speaking peoples'. But there are real differences.

"The UK is no longer in the EU, but remains a key participant in the European standards body, CEN, which is not an EU institution"

The UK joined the European Economic Community nearly 200 years after the United States won independence from us. Americans now seem greatly attracted to our monarchy, but they are a republic with an elected head of state, and the present incumbent is particularly committed to doing deals that put America first and 'make America great again'.

In the world of building services, ASHRAE is one of the leading US bodies, and one of just six US standards-developing organisations that can self-certify its standards against the procedural rules of the American National Standards Institute (ANSI). Its consensus-based standards-development process aims to be rigorous, transparent, balanced and robust, with participation from a range of relevant stakeholders who may not be ASHRAE members.

ASHRAE is the premier publisher of standards for many building services products and systems in North America, and is currently pressing hard for the adoption, by the US Department of Energy (DOE), of a formal rule that would direct DOE to adopt ASHRAE technical standards and test procedures under the National Technology Transfer and Advancement Act of 1995.

The UK has hitherto been a part of the European Single Market, with a system of regulations and

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

directives that govern many of the products CIBSE members specify, install, manufacture, maintain and operate. This is supported by the European Standards system, which produces thousands of standards that underpin those regulations and directives.

While we are no longer part of the EU, the UK – through its national standards body, BSI – remains a key participant in CEN, the European standards body, which is not an EU institution. BSI and CEN are currently working to negotiate changes to the CEN Statutes that would formalise continued BSI membership.

As a member of CEN, the UK adopts European Standards when they are published and withdraws conflicting ones. This has not changed.

The UK has a system of Building Regulations based on a series of functional requirements. For tragic reasons, the best known of these may be requirement B4 of Part B of the regulations, requiring that anything used in an external wall of a building shall adequately resist the spread of fire. While that requirement is now reinforced by a specific ban on combustible materials in the external walls of many buildings (see news on page 9), the person building any external wall has to satisfy the building control official that it meets requirement B4.

Approved Document B gives guidance on how that could be done – but it is only guidance, and other solutions are very clearly permitted. So who is to say that, when officials start negotiating a deal with the US covering trade in construction-related goods and services, we will not see the US pressing for the National Fire Protection Association (NFPA) Codes to be given equal status to BS 9999 or other relevant British and European Standards?

If the NFPA Codes deliver buildings that meet the functional requirements of Part B and do not include combustible materials restricted under regulation 7, then that would appear to meet our regulations.

But what if the US also argues that Regulation 7(2) – which currently defines what is deemed non-combustible by reference to a European Standard test – should be amended as part of the US-UK deal to refer to the US equivalent test as well? That will have implications for UK and European-based manufacturers.

We now know we have left the EU. We don't know what a trade deal will look like or what challenges the forthcoming trade talks will create for our sector, but we know they are coming. And while we are currently talking to the US and EU, a quarter of the global market is in the Asia Pacific region, so we will need to cover that, too.

The price of really free trade may be eternal vigilance as trade talks unfold. Really, we've only just begun.

Where we need change

If the UK is to reach net zero by 2050, the industry needs to take action now. Julie Godefroy highlights the key policy decisions that must be made in 2020

Last year, the UK committed to net-zero carbon by 2050. The next 12 months will test how this is put into practice: Building Regulations Part L reviews; the annual UN Conference of the Parties (COP) on climate change, in Glasgow; a Treasury review on how net-zero could be funded; and the Committee on Climate Change (CCC) report on the UK's 6th carbon budget, covering 2033-2037.

This will be the first budget designed to the net-zero target, and it is expected to show a change of trajectory; we cannot expect a drastic 'catch up' step in 2033 and must adopt a steeper reduction curve now. By 2033, we will need:

- New buildings with exemplary levels of energy consumption and peak demand, and achieving net-zero carbon or 'zero carbon ready' pending full decarbonisation of the electricity grid
- Emissions from the existing stock to start reducing through deep retrofit
- All of this to be achieved in practice, rather than in design or as-built targets.

"We can't expect a drastic 'catch up' in 2033 and must adopt a steeper reduction curve now"

CIBSE recently signed a joint statement calling for regulations on actual performance. Contact us if you would like to sign it in support and commit to voluntary disclosure for your own buildings or projects.

New buildings

The proposals in the 2020 Part L and 2025 Future Homes Standard consultation are far from the rate and scale of change required. This would delay us and create yet more buildings that will need retrofitting if the UK is to achieve net zero.

CIBSE has received an unprecedented number of contributions to this consultation, a large majority expressing frustration at this lack of ambition. Last month's column, 'Action and data for 2020', summarised key concerns, and the draft CIBSE response is available on the CIBSE consultation page.[1] Any individual or organisation can submit their own response to government until 7 February.

Existing buildings

The real challenge is, of course, to make the existing stock zero carbon – which is why regulations must get new buildings right as soon as possible. For retrofit to happen at scale, we must capture all available opportunities to trigger works, including sales, leases and occasions when other works are carried out. Currently, the two main instruments to do so are the Minimum Energy Efficiency Standards (Mees), and Part L. A consultation on Part L for existing buildings is expected this year. With regards to Mees, government recently consulted on tightening the requirements, proposing that non-domestic private rented buildings should achieve an EPC of B by 2030.

While the ambition is welcome, this suffers from similar problems to Part L: it only considers the designed and as-built asset, covering just some of the energy uses and without a check of actual in-use performance. So the CIBSE response to that consultation[2] argued for:

- A review of the EPC methodology, which could also benefit the Part L methodology
- Improvement of EPC recommendations
- Reports to become meaningful retrofit plans
- A regulatory framework covering in-use performance.

Retrofit is high on the agenda of the 6th carbon budget, with the CCC interested in what can be achieved, whether the existing stock could become near-zero carbon earlier than 2050, and how to support it.

CIBSE is gathering information on the following areas to inform our policy advice and best support industry with technical guidance, training, events, and so on:

- Do you have deep retrofit case studies? Ideally, this would include holistic in-use performance data – for example, considering energy and operational carbon, but also factors such as fabric, indoor air quality, comfort, user satisfaction, whole-life carbon, and heritage impacts.
- Design and modelling of existing buildings: whole-building approaches and risk assessments (in line with PAS 2035), including air, heat and moisture flows in buildings of traditional construction
- Heat networks: these could make a contribution in areas where networks are already in place and extensive retrofit of the existing stock may be too difficult, costly, or unacceptable for heritage conservation. How do we adapt and retrofit existing networks originally designed for sources such as boilers and gas-fired CHP, to low-carbon sources? What carbon savings can be achieved?
- Please contact **technical@cibse.org** if you would like to give us your views on these, suggestions for other themes, or to be involved in these work streams.

DR JULIE GODEFROY is technical manager at CIBSE

References:

1 Changes to Part L and Part F of the Building Regulations consultation **bit.ly/CJFeb20JG1**

2 Proposals for the MEES for non-domestic private rented sector, CIBSE consultation response **bit.ly/CJFeb20JG2**

Akinola to speak at CIBSE awards night

Laing O'Rourke engineer, TV presenter and new MBE will address BPA attendees in London

The guest speaker at the 2020 CIBSE Building Performance Awards will be Yewande Akinola MBE, innovation lead at Laing O'Rourke. The awards will take place at Grosvenor House London on Tuesday 11 February at 7pm, when the winners in 13 categories and an overall winner will be announced.

Akinola is a chartered engineer, innovator and speaker, and her engineering experience includes the design and construction, innovation and manufacture of buildings and systems in the built environment.

She was an environmental services engineer at Arup for eight years, designing water-supply and water-management systems in buildings, before joining Laing O'Rourke as a principal engineer in 2015. She has worked on projects in the UK, Africa, the Middle East and East Asia, and has been named the UK Young Woman Engineer of the Year by the Institution of Engineering & Technology.

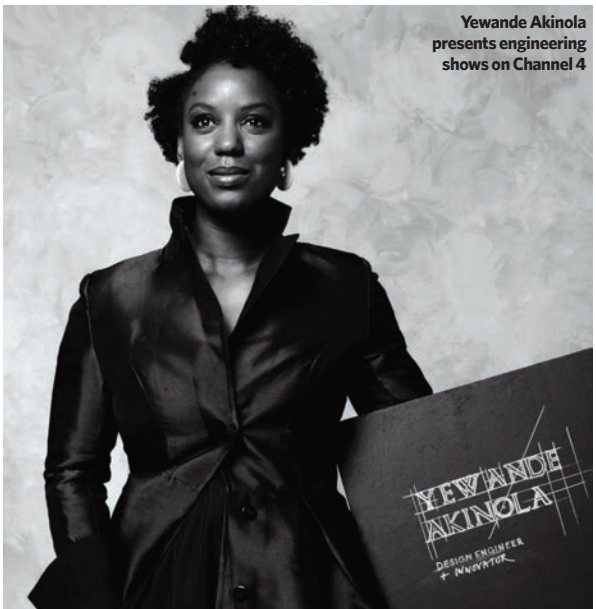
Akinola has also been awarded the Exceptional Achiever Award from the Association for Bame [black, Asian and minority ethnic] Engineers and the Association of Consultancy and Engineering, UK, and is a visiting professor at the University of Westminster. She is passionate about Stem communication and has presented engineering programmes on television. In the 2020 New Year Honours list, Akinola was made an MBE for services to engineering innovation and diversity in Stem.

She holds a Bachelor's degree in engineering design and appropriate technology from the University of Warwick, and a Master's in innovation and design for sustainability from Cranfield University.

New categories

The 2020 BPA awards will feature a new Retrofit Project of the Year category, to recognise the importance of reducing the carbon emissions of existing building stock. There is also a new wellbeing category for product and innovation.

To see the shortlist, and to book your place to see who wins on the night, visit **www.cibse.org/bpa**



Yewande Akinola presents engineering shows on Channel 4

Be open and supportive in post-Brexit Britain

As the UK formally leaves the EU, Dorte Rich Jørgensen MCIBSE reflects on her difficulty in applying for British citizenship and calls on industry to sign the #ConstructionisOpen pledge in support of EU nationals in the UK

Around 7% of workers in the construction industry are EU 27 nationals, compared with the national average (excluding construction) of 6%.[1]

In 2016, after the outcome of the UK's referendum on its membership of the EU, I found myself – as a Danish national – uncertain about my rights, post-Brexit. There were four million others in Britain and Europe in the same position.

In the grip of 'the Brexit Blues', I started trying to understand how to re-secure my rights under British law. Dual citizenship is now allowed for Danish citizens, so I decided to apply for British citizenship because, as well as future security, it would give me full voting rights.

I understood that, under any other category – such as Settled Status – I would be unlikely to maintain even the voting rights in local elections that EU27 nationals currently enjoy.

During the application process, there were real challenges when I needed support from others, while other times provided welcome happiness and relief. The overall process took 22 months, from starting to fill in the forms to completing my British citizenship ceremony in January 2019.

Hurdles buried deep in the permanent residency application included having to give evidence of the comprehensive sickness insurance that I was apparently expected to have taken out when I arrived in the UK as a student. Then, I had access to a local GP and knew nothing about this requirement.

With support from immigration lawyers provided by the volunteer-run project UK Citizenship for EU Nationals (UKCEN), I discovered that I could choose the five years qualifying period for permanent residency from a time when I was in full-time employment, and exclude my student years. As a result, the sickness insurance requirement became irrelevant and fell away.

To obtain British citizenship, you need to pass the Life in the UK Test – I really enjoyed learning about Britain and its history for this. It was great fun testing our British friends and colleagues in an alternative 'pub quiz'.

"Whatever post-Brexit Britain will be like, I hope we will use it as an opportunity to become more aware of our own actions and values"

New rights and new engagements

After obtaining my British citizenship, I voted in a national poll for the first time in 30 years, in the December General Election – as did several other EU27 nationals I know who have secured dual citizenship. For all of us, it was an emotional experience. Having a vote gave me a new and different sense of engagement with national life.

Denmark did not allow dual nationality for its citizens until 2015. Now that Britain is leaving the EU, I am concerned for those EU27 nationals whose countries still do not allow dual citizenship and who, therefore, don't get this option to secure their rights.

It also costs around £1,500-£2,000 to complete a British citizenship application, excluding lawyers' fees. This is a real challenge for those on lower incomes. So I am concerned about how the industry will continue to welcome and support everyone working, or coming to work, in post-Brexit Britain – especially those with additional challenges and limited support.

Whatever post-Brexit Britain will be like, we all have a choice about how to respond. We will, I hope, use it as an opportunity to become more aware of our own behaviour, actions and values.

My expectation is that CIBSE members will use Brexit as a catalyst to foster a culture of greater openness and mutual support, and that it maintains its role as a professional community that welcomes everyone, wherever they come from.

Take the #ConstructionisOpen pledge

To become a dual Danish-British citizen, I had – and gratefully received – support from my MP, UKCEN, the Danish Embassy, my family, colleagues and many other EU27 nationals. Their backing made all the difference to my ability to successfully navigate the complex process

DR DORTE RICH JØRGENSEN is a sustainability leader and CIBSE representative on the CIC diversity and inclusion panel.

involved, and to deal with the situation in which I found myself.

The #**ConstructionisOpen** pledge, developed with and hosted by the built environment sector think tank the Edge, is an invitation to members of the construction industry to make their own difference – to help EU 27 nationals feel welcome and to give them support during and after Brexit.

- Please add your signature here and pick your own action to create a culture in our industry of openness and welcome: **eu27pledge-edge.squarespace.com**

References:

1 Migrant labour force within the construction industry: June 2018, Office for National Statistics **bit.ly/CJFeb19ONS**

THE CONSTRUCTION IS OPEN PLEDGE

By signing the #ConstructionisOpen Pledge, I acknowledge that EU27 nationals are welcome here, and will be proactive by carrying out an action from suggestions below:

- **I will be open and sensitive to the situation that EU27 nationals and their families currently experience in the UK**
- **I will express my welcome, understanding and support to EU27 colleagues here, and thank them for the contribution they make to the UK**
- **I will help identify the needs of EU27 colleagues and do my best to provide support[1, 2, 3]**
- **I will encourage employers to provide information and assistance to their workers in completing their Settled Status applications[2, 3, 4]**
- **I will request professional institutions to provide information and assistance to their members on remaining in this country[5]**
- **I will express my support and concern on social media[6]**
- **I will share my awareness that the current voting rights for EU27 nationals (in local elections) are not guaranteed with Settled Status rights (June 2019).[7]**

References:

1 Guidance is provided by **#ConstructionisOpen**. EU27 nationals could join UK Citizenship for EU Nationals (UKCEN), a group that offers useful support and advice on completing Settled Status and citizenship applications.

2 More information is available from the3million. Sign up to its newsletter to get regular updates. It has also prepared guidance on Settled Status, which is available at **www.the3million.org.uk/applying-for-settled-status**

3 Information is available from the Mayor of London for EU27 nationals **bit.ly/CJFeb20EU27**

4 For example, this could take the form of hosting an information event.

5 This could include help completing Settled Status applications and hosting an information event, as suggested by **#ConstructionisOpen** Support and guidance on how to do this effectively is available from the3million.

6 For example, using hashtags **#ConstructionisOpen** and **#EU27RWelcome**

7 If EU27 nationals want to maintain their current voting rights, this entails applying for British citizenship. This is an expensive and potentially long process (£1,700 fee, plus the cost of legal advice and other expenses).

Collective responsibility

To ensure buildings have safe, comfortable and healthy indoor environments, we must all take ownership of our actions, says **Josh Emerson**

Every year, an estimated 8.8 million people worldwide die as a result of air pollution – 40,000 in the UK. The British Heart Foundation says living in a British city raises the risk of early death by the same amount as smoking 150 cigarettes a year, and that airborne particulate matter is responsible for 11,000 deaths annually from coronary heart disease and strokes. But what about the situation inside buildings?

New research carried out by University of Southampton professor Stephen Holgate revealed that indoor air quality (IAQ) can be 13 times worse than external pollution. The renowned asthma expert, who is leading a review into IAQ for the Royal College of Paediatrics and Child Health, also pointed out that IAQ can be controlled with relatively minor changes to occupant behaviour and improvements to building services.

The building services industry has a big responsibility in this area, and we are already deeply involved in the wider challenge of providing the best possible indoor environment quality (IEQ), covering the full range of factors that affect occupant health, wellbeing and productivity. We have made giant strides in improving thermal comfort, the importance of better acoustics is now widely recognised, and increasing the level of natural daylight in a building has been shown to lower stress levels and improve sleep quality.

This is a complex challenge, however, because so many 'hard' and 'soft' needs must be taken into account, including life-cycle cost, energy consumption, carbon footprint and the impact on the physical health and mental wellbeing of occupants. The industry now has access to a range of 'smart' tools to measure IEQ that can be linked directly to energy-efficient, demand-controlled ventilation and indoor climate systems thanks to improved connectivity in buildings.

For buildings to be properly engineered for IEQ, however, requires the whole supply chain to work collaboratively to deliver it. Unfortunately, important parts of the specification are frequently 'value engineered' out without considering life-cycle costs, and this can have a long-term effect on building and occupant performance.

We must all take responsibility and recognise that every action has a consequence. Everything we do must demonstrate that we do care about the long-term wellbeing of building occupants.

- **Josh Emerson** works on building efficiency and occupant wellbeing at Swegon UK&I. **www.swegon.com/uk**

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A LINGERING FOG

The UK may have left the EU, but there is still plenty of uncertainty over its future relationship with Europe, which means a cautious services sector and sluggish salary growth, according to the 2020 Hays Salary Survey. **David Blackman** reports

'You are driving in the fog and you can't see ahead of you,' says Steven Horn, a director at the North East-based consultancy Black and White Engineering. He is describing what it has felt like to run a building services company during the past few months of economic and political turmoil.

The fog in question, of course, is that resulting from the uncertainty surrounding Brexit, which looks to be heading for a resolution at last, following December's General Election.

Tomás Neeson, managing partner at Cundall, agrees that this has been a problem. 'Uncertainty stops people making decisions.' Economic malaise isn't just a UK concern, though, he adds, noting that the Chinese market has 'definitely slowed down'.

Nigel Williams, director of building services at Atkins, says that while the regional markets – and what he dubs the 'Three Hs': Heathrow, Hinkley and HS2 – are holding up, London has 'slightly slowed down'.

That mixed picture is reflected in UK building services as a whole, judging by the findings of the latest annual salary survey for the sector, carried out for *CIBSE Journal* by recruitment consultants Hays.

This shows that nearly all (96%) employers in building services expect business activity levels to increase or stay the same over the next 12 months, while more than half (55%) are planning for increased activity – slightly lower than the 61% figure reported last year. »

» Richard Gelder, director at Hays Building Services, sees healthy activity levels, despite the fall in confidence. 'They [employers] are seeing quite busy workloads in the short- to medium-term pipeline, and have enough to be getting on with,' he says.

However, the broader uncertainties in the market are having an impact.

Hitches in the infrastructure construction pipeline – such as the recently announced pause for HS2 and the cancellation of the Moorside and Wylfa nuclear plant projects – are having a knock-on effect on smaller building services consultancies, says Horn.

It means that small and medium-sized building services companies, such as his, are finding themselves in competition with much bigger practices on the smaller frameworks with which the latter would not normally bother, he adds.

However, more than half (56%) of employers in building services say they are optimistic about the

"There are fewer instances of competitors trying to poach staff, with salary spikes largely confined to 'specific skill sets in specific regions'"

Contractors: Director

Region	Typical salary 2020	Min salary 2020	Max salary 2020
East Midlands	£65,000	£60,000	£80,000
East of England	£62,000	£60,000	£75,000
London	£100,000	£85,000	£120,000
North East England	£56,500	£48,000	£62,000
North West England	£62,000	£60,000	£75,000
Northern Ireland	£72,500	£65,000	£85,000
Scotland	£58,000	£50,000	£65,000
South East England	£76,500	£73,000	£80,000
South West	£64,000	£60,000	£68,000
Wales	£59,000	£55,000	£65,000
West Midlands	£65,000	£60,000	£80,000
Yorkshire and the Humber	£60,500	£57,000	£62,000
National average	**£66,750**	**£61,083**	**£76,417**
% increase year on year: 1.8%			

Contractors: Project engineer

Region	Typical salary 2020	Min salary 2020	Max salary 2020
East Midlands	£39,000	£30,000	£45,000
East of England	£41,000	£32,000	£50,000
London	£53,000	£50,000	£65,000
North East England	£35,500	£28,000	£38,000
North West England	£40,000	£30,000	£45,000
Northern Ireland	£36,000	£30,000	£38,000
Scotland	£40,000	£29,000	£41,000
South East England	£47,500	£42,000	£50,000
South West	£40,000	£35,000	£44,000
Wales	£37,000	£30,000	£40,000
West Midlands	£40,000	£30,000	£45,000
Yorkshire and the Humber	£36,500	£30,000	£42,000
National average	**£40,458**	**£33,000**	**£45,250**
% increase year on year: 3.4%			

Contractors: CAD technician

Region	Typical salary 2020	Min salary 2020	Max salary 2020
East Midlands	£30,000	£25,000	£32,000
East of England	£26,000	£22,000	£30,000
London	£44,000	£40,000	£50,000
North East England	£27,250	£23,000	£28,500
North West England	£30,000	£25,000	£32,000
Northern Ireland	£29,500	£25,000	£40,000
Scotland	£24,000	£22,000	£26,000
South East England	£37,000	£33,000	£40,000
South West	£31,750	£25,000	£32,000
Wales	£30,000	£25,000	£30,000
West Midlands	£29,000	£25,000	£30,000
Yorkshire and the Humber	£26,750	£23,000	£28,500
National average	**£30,438**	**£26,083**	**£33,250**
% increase year on year: 4.1%			

Contractors: Quantity surveyor

Region	Typical salary 2020	Min salary 2020	Max salary 2020
East Midlands	£48,000	£44,000	£55,000
East of England	£46,500	£42,000	£57,000
London	£64,000	£50,000	£80,000
North East England	£43,000	£35,000	£45,000
North West England	£43,000	£40,000	£55,000
Northern Ireland	£44,000	£38,000	£48,000
Scotland	£44,000	£36,000	£46,000
South East England	£65,000	£60,000	£67,000
South West	£50,000	£45,000	£55,000
Wales	£46,000	£43,000	£50,000
West Midlands	£45,000	£44,000	£55,000
Yorkshire and the Humber	£39,500	£32,000	£42,000
National average	**£48,167**	**£42,417**	**£54,583**
% increase year on year: 3.6%			

Contractors: Estimator

Region	Typical salary 2020	Min salary 2020	Max salary 2020
East Midlands	£45,000	£30,000	£50,000
East of England	£47,500	£40,000	£60,000
London	£60,000	£50,000	£62,000
North East England	£38,000	£31,000	£40,000
North West England	£43,000	£38,000	£45,000
Northern Ireland	£37,500	£34,000	£42,000
Scotland	£41,000	£35,000	£44,000
South East England	£63,000	£47,000	£65,000
South West	£45,000	£45,000	£52,000
Wales	£42,000	£40,000	£45,000
West Midlands	£44,500	£30,000	£50,000
Yorkshire and the Humber	£36,500	£27,000	£38,000
National average	**£45,250**	**£37,250**	**£49,417**
% increase year on year: 4.4%			

Contractors: Project manager

Region	Typical salary 2020	Min salary 2020	Max salary 2020
East Midlands	£48,750	£40,000	£55,000
East of England	£50,000	£40,000	£57,000
London	£70,000	£65,000	£80,000
North East England	£46,000	£40,000	£50,000
North West England	£48,000	£30,000	£50,000
Northern Ireland	£40,000	£38,000	£46,000
Scotland	£45,000	£32,000	£47,000
South East England	£66,250	£52,500	£67,000
South West	£48,000	£40,000	£50,000
Wales	£45,000	£40,000	£50,000
West Midlands	£49,000	£40,000	£55,000
Yorkshire and the Humber	£49,500	£40,000	£57,000
National average	**£50,458**	**£41,458**	**£55,333**
% increase year on year: 1.7%			

wider economic climate and opportunities in the next two to five years.

Amid the current hiatus in the economy, the potential silver lining is the prospect of pent-up demand, says Gelder: 'A lot of people say that, once there is clarity, clients will start pushing on with normal commercial levels.'

Horn agrees. 'There's such a huge amount of stuff that people have held on to but still want to do,' he says. 'As soon as we get some clarity on the political direction, a lot of that work will be released.'

Another cause for optimism is the relatively lavish promises of infrastructure spending outlined in the main Westminster parties' General Election manifestos, including the traditionally expenditure-shy Conservatives, says Gelder. 'Even if only half of it lands, there could be a real boost from government spending.'

This means that prospects are potentially bright, adds Horn: 'Next year, or the year after, we'll have so much work we'll be complaining about skills shortages. There will be a flow of work that we won't be able to cope with.'

Reflecting the picture on growth prospects, nearly three-quarters (74%) of employers are planning to recruit staff over the next 12 months – which, again, is slightly lower than the 80% reported last year. Gelder believes employers will adopt a more cautious approach to recruitment, with many reluctant to make hiring decisions before January, when there may be more clarity around the wider economic and political situation.

'There's more consideration and thought about hiring decisions,' he says. 'The conversations around the management table are a bit more detailed. In some cases, people are pressing the pause button. They are making sure they get the right person and pay the right money.

In the current environment, Gelder adds, there's less willingness to take on individuals who need to be developed, as opposed to what he describes as 'round pegs for round holes who can hit the ground running'.

Atkins is looking to grow next year, but instead of increasing the building services business's 310-strong headcount, the focus will be on reshaping the team. 'As we bring in digital tools, we find we need different types of people,' says Williams.

»

Contractors: Senior contracts manager

Region	Typical salary 2020	Min salary 2020	Max salary 2020
East Midlands	£55,000	£45,000	£65,000
East of England	£57,000	£50,000	£67,000
London	£70,000	£65,000	£85,000
North East England	£44,000	£32,000	£46,000
North West England	£48,000	£45,000	£60,000
Northern Ireland	£49,500	£45,000	£60,000
Scotland	£47,000	£40,000	£50,000
South East England	£67,000	£57,000	£69,000
South West	£55,000	£55,000	£65,000
Wales	£51,000	£45,000	£55,000
West Midlands	£52,000	£45,000	£65,000
Yorkshire and the Humber	£40,500	£35,000	£45,000
National average	**£53,000**	**£46,583**	**£61,000**
% increase year on year: 2.8%			

Consultants: Director

Region	Typical salary 2020	Min salary 2020	Max salary 2020
East Midlands	£65,000	£60,000	£70,000
East of England	£65,000	£60,000	£70,000
London	£92,000	£85,000	£110,000
North East England	£53,500	£43,000	£55,000
North West England	£68,000	£60,000	£75,000
Northern Ireland	£62,500	£50,000	£70,000
Scotland	£60,000	£55,000	£80,000
South East England	£72,000	£70,000	£80,000
South West	£63,000	£60,000	£70,000
Wales	£58,000	£52,000	£60,000
West Midlands	£66,000	£60,000	£70,000
Yorkshire and the Humber	£54,000	£43,000	£56,000
National average	**£64,917**	**£58,167**	**£72,167**
% increase year on year: 1.3%			

Consultants: Associate

Region	Typical salary 2020	Min salary 2020	Max salary 2020
East Midlands	£60,000	£55,000	£65,000
East of England	£57,000	£55,000	£67,000
London	£72,000	£65,000	£75,000
North East England	£44,750	£39,000	£46,000
North West England	£58,500	£50,000	£60,000
Northern Ireland	£52,750	£45,000	£55,000
Scotland	£55,000	£55,000	£60,000
South East	£65,000	£60,000	£65,000
South West	£58,000	£55,000	£60,000
Wales	£53,500	£40,000	£55,000
West Midlands	£56,000	£50,000	£60,000
Yorkshire and the Humber	£49,500	£43,000	£50,000
National average	**£56,833**	**£51,000**	**£59,833**
% increase year on year: 2%			

Consultants: Senior M&E design engineer

Region	Typical salary 2020	Min salary 2020	Max salary 2020
East Midlands	£50,000	£45,000	£55,000
East of England	£48,000	£42,000	£57,000
London	£57,000	£50,000	£65,000
North East England	£45,500	£40,000	£45,500
North West England	£50,000	£40,000	£55,000
Northern Ireland	£42,000	£40,000	£48,000
Scotland	£48,000	£38,000	£50,000
South East England	£57,000	£52,000	£57,000
South West	£49,000	£45,000	£55,000
Wales	£47,500	£40,000	£50,000
West Midlands	£47,000	£42,000	£50,000
Yorkshire and the Humber	£44,500	£39,000	£46,000
National average	**£48,792**	**£42,750**	**£52,792**
% increase year on year: 2.5%			

Consultants: Intermediate M&E design engineer

Region	Typical salary 2020	Min salary 2020	Max salary 2020
East Midlands	£37,000	£35,000	£40,000
East of England	£40,000	£35,000	£50,000
London	£40,000	£35,000	£48,000
North East England	£32,000	£28,000	£40,000
North West England	£37,000	£27,000	£38,000
Northern Ireland	£30,000	£30,000	£35,000
Scotland	£36,500	£28,500	£38,000
South East England	£35,750	£33,000	£36,000
South West	£39,000	£33,000	£40,000
Wales	£36,000	£28,000	£40,000
West Midlands	£34,500	£25,000	£40,000
Yorkshire and the Humber	£27,500	£23,000	£28,500
National average	**£35,438**	**£30,042**	**£39,458**
% increase year on year: 1.6%			

Consultants: Junior M&E design engineer

Region	Typical salary 2020	Min salary 2020	Max salary 2020
East Midlands	£28,000	£25,000	£30,000
East of England	£26,000	£20,000	£30,000
London	£31,000	£25,000	£32,000
North East England	£22,250	£18,000	£24,000
North West England	£26,750	£18,000	£27,000
Northern Ireland	£24,500	£21,000	£27,000
Scotland	£29,000	£24,000	£31,000
South East England	£29,750	£22,000	£30,000
South West	£28,500	£20,000	£33,000
Wales	£27,000	£22,000	£30,000
West Midlands	£25,000	£22,000	£30,000
Yorkshire and the Humber	£22,250	£18,000	£25,000
National average	**£26,667**	**£21,250**	**£29,083**
% increase year on year: 1.7%			

» Some of these digital skills are percolating into the firm – in part through the younger staff, who have picked up these skills during their education. Other and more established staff, meanwhile, are developing new skill sets, Williams says: 'We have formulated a different career path, with people slightly deviating from engineering and moving more into digital, but still with an engineering background.'

This is also reflected at Cundall, which has almost doubled its headcount over the past five years, to nearly 1,000 staff, and is planning to bring 30 to 40 new people into the business through its graduate and apprenticeship programmes this year. The two big areas of focus are sustainability and digital transformation, says Neeson: 'We are definitely keen to bring people with those skills into the business.'

Greater rigour surrounding the recruitment process is also reflected in firms' pay awards. More than two-thirds (67%) of employers in building services raised salaries in the past 12 months, with a slightly higher proportion (68%) planning to do so again in the coming year.

Across building services, however, Hays' survey shows that salaries rose by 2.2%, which is lower than the 2.8% seen last year, albeit higher than the UK economy-wide average of 1.8%.

Part of this moderation in pay awards reflects how post-recession salary catch-up pressures have largely fed through the industry, says Gelder: 'The dip in salary increase is probably a result of above-inflation pay witnessed in prior years.'

Williams sees fewer instances of competitors trying to poach staff with salary spikes, with this largely confined to 'specific skill sets in specific regions'. 'Certain skill sets are becoming very attractive,' he says.

An example of this is the 'very hot' Irish market, where it is particularly difficult to recruit engineers, adds Neeson: 'A lot is driven by technology companies flooding in and recruiting anybody who looks like an engineer.'

Deep-pocketed tech companies are also clearly attractive to those engineers who cited salary levels as the most important reason for moving job. Nearly a third (29%) of employees who moved roles in the past 12 months say they did so because their salary was too low, but other factors are important too – such as career progression.

A potential future headache for employers, however, is that fewer than half (46%) of the building services engineers surveyed rate their work-life balance as good – down from 51% last year. More than a quarter of employers in building services (26%) don't offer flexible working options – 'significantly' higher than the UK average of 12%.

'Employers need to address ways to improve work-life balance and support requests for flexible working,' says Gelder, because it is becoming business critical in terms of attracting and retaining staff. 'It's about the battle for talent,' he adds. 'It's about performance and business improvement.

'Those businesses and organisations that won't, or are unable to, offer flexible working will become increasingly unattractive, not only for existing employees, but also for future ones. It is now a normal part of the working contract.' CJ

"More than a quarter of employers in building services (26%) don't offer flexible working options, 'significantly' higher than the UK average of 12%"

Consultants: Sustainability consultant

Region	Typical salary 2020	Min salary 2020	Max salary 2020
East Midlands	£43,750	£35,000	£45,000
East of England	£52,000	£42,000	£60,000
London	£56,000	£45,000	£65,000
North East England	£42,500	£36,500	£44,000
North West England	£47,000	£40,000	£50,000
Northern Ireland	£37,750	£32,000	£42,000
Scotland	£45,000	£35,000	£50,000
South East England	£45,000	£42,000	£47,000
South West	£47,500	£40,000	£50,000
Wales	£44,000	£38,500	£44,500
West Midlands	£45,000	£39,000	£48,000
Yorkshire and the Humber	£45,000	£40,000	£47,500
National average	**£45,875**	**£38,750**	**£49,417**
% increase year on year: 0.9%			

Consultants: Revit/BIM technician

Region	Typical salary 2020	Min salary 2020	Max salary 2020
East Midlands	£35,000	£30,000	£40,000
East of England	£34,500	£30,000	£40,000
London	£48,500	£40,000	£65,000
North East England	£35,500	£28,000	£36,000
North West England	£40,000	£32,000	£45,000
Northern Ireland	£28,000	£24,000	£34,000
Scotland	£32,000	£25,000	£40,000
South East England	£45,000	£43,000	£55,000
South West	£40,500	£35,000	£45,000
Wales	£38,000	£30,000	£40,000
West Midlands	£35,000	£28,000	£40,000
Yorkshire and the Humber	£36,500	£28,000	£38,000
National average	**£37,375**	**£31,083**	**£43,167**
% increase year on year: 2.5%			

Consultants: CAD technician

Region	Typical salary 2020	Min salary 2020	Max salary 2020
East Midlands	£30,000	£25,000	£32,000
East of England	£32,000	£25,000	£38,000
London	£35,000	£30,000	£38,000
North East England	£25,500	£21,000	£26,500
North West England	£29,000	£25,000	£37,000
Northern Ireland	£22,000	£18,000	£28,000
Scotland	£28,000	£22,000	£30,000
South East England	£33,000	£30,000	£35,000
South West	£30,000	£25,000	£35,000
Wales	£31,000	£23,000	£33,000
West Midlands	£28,500	£25,000	£35,000
Yorkshire and the Humber	£27,500	£23,000	£29,500
National average	**£29,292**	**£24,333**	**£33,083**
% increase year on year: 2.5%			

Consultants: Professional quantity surveyor

Region	Typical salary 2020	Min salary 2020	Max salary 2020
East Midlands	£49,000	£47,000	£60,000
East of England	£52,000	£40,000	£58,000
London	£70,000	£55,000	£75,000
North East England	£41,000	£36,000	£42,000
North West England	£45,000	£38,000	£50,000
Northern Ireland	£38,000	£32,000	£45,000
Scotland	£40,000	£35,000	£50,000
South East England	£68,000	£55,000	£70,000
South West	£52,000	£45,000	£60,000
Wales	£44,000	£35,000	£45,000
West Midlands	£44,500	£35,000	£50,000
Yorkshire and the Humber	£43,750	£35,000	£45,000
National average	**£48,938**	**£40,667**	**£54,167**
% increase year on year: 1.9%			

UPWARDLY MOBILE

Aecom's lauded graduate programme aims to develop well-rounded engineers with excellent technical and social skills. **Phil Lattimore** looks at how it is encouraging young engineers to develop strong community ties while progressing their careers

Aecom being crowned overall Employer of the Year at the 2019 CIBSE Young Engineers Awards represented a major step up for the multidisciplinary engineer. In 2018, it won the large company category, but just missed out on the overall title. A year later, it beat allcomers and was praised for its progressive strategy for recruiting, nurturing and empowering young people.

As well as recognising and showcasing exceptional engineering talent in the industry, the awards 'shine a spotlight on those employers who... have provided a suitable environment for our young engineers to flourish', says CIBSE President Lynne Jack.

In the other categories, Fairheat claimed the prize in the small company section and Troup Bywaters + Anders secured the medium company title.

So what is it about Aecom's approach to the training and development of young engineers that continues to win over the CIBSE judges?

Commitment

Aecom's intake of graduates, apprentices and placements has risen consistently over the past five years. In 2018, 359 graduates joined its UK and Ireland graduate programme – 43% of whom were female. The firm's recruitment and training is aimed at ensuring the continuing development and success of its business, and addresses some of the key issues facing organisations in the building services sector.

Its commitment to developing junior staff is evident in its 'Advance' early careers development programme for graduates and apprentices, work experience placements for young trainee engineers, and its Stem ambassador school engagement initiatives.

'Advance is a combined programme for our apprentices and graduates, to help develop their Aecom career,' says Tracy D'Souza, lead for Aecom's MEP programme. 'One of the many ways this is done is through residential training sessions, which allow joiners to network with people across the business and take part in interactive activities that will support them, and give them the knowledge and tools they need to flourish in their role.'

Since Aecom secured the large category Employer of the Year in 2018, it has continued to develop its training programme. In March 2019, for example, it appointed a dedicated MEP training and development administrator. Their job is to source mentors for apprentice and graduate trainees, support junior engineers through placements, and organise technical and mentor training, to ensure a consistent level of professional development across the business.

In addition to its on-the-job training and MEP and Advance training programmes, Aecom's young engineers benefit from accredited CPDs, lunch and learn sessions, and focused mechanical and electrical workshops.

'Graduates are always encouraged to work on site, too,' says D'Souza, 'as this gives them real-life, hands-on experience, as well as the chance to learn from their peers.'

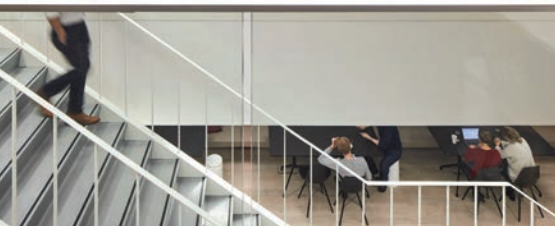
Senior directors – such as Mike Burton and Peter Sutcliffe – lead mentoring programmes, including coaching, careers guidance, shadowing and leadership advice. 'Mentors

"Graduates are always encouraged to work on site as this gives them hands-on experience"

AECOM INITIATIVES FOR YOUNG ENGINEERS

- Hosting YEN and energy performance events, sponsoring South Wales 'Active Buildings' at Swansea University, and involvement in societies such as SoPHE.
- The Imagineers programme – ambassadors visit local schools to inspire young children, especially girls.
- Being an industry partner at a Stem conference hosted by the Army at the Royal Military Academy in Sandhurst, attended by 900 girls aged between 11 and 15 years.
- Being an active partner of Year of the Engineer – hosting open days to promote engineering at its London headquarters for 60+ primary schoolchildren.
- A schools outreach programme that offers a variety of placements, from one-day work shadowing for 14-year-olds to summer placement positions for those 18 or older. Aecom offers up to 250 work experience opportunities across the UK annually.
- mCircles – a UK-wide mentoring programme for women across the business, involving more than 500 women to date.
- Stem champions in Aecom's Leeds and York offices receiving the ICE Yorkshire and Humber Company of the Year 2019 for their efforts promoting Stem careers.

The internal staircase designed to connect Aecom's different disciplines at Aldgate Tower



play a vital role in developing talent, as they have often been in the same position and understand how to overcome certain barriers,' D'Souza says. 'It is important, too, to have buy-in from our senior directors. They have empowered us to drive this initiative forward, which has enabled them to get a better understanding of the talents, interests and capabilities of our young engineers.'

Young engineers are encouraged to join professional industry bodies, and all Aecom's building services schemes are accredited by CIBSE, IET and IMechE. The company also offers a career pathways model, to help young engineers navigate their careers.

Aecom partners with several universities to ensure learning is tailored to individual goals and the relevant accreditations are accomplished with professional bodies, says D'Souza. The firm also promotes the study of Stem subjects in schools and higher education, and has more than 300 Stem UK ambassadors.

Employees are encouraged to use their 'community days' to go into schools and organisations to raise awareness of careers in engineering with Stem workshops. 'For example, using maths, design and technology skills, students are tasked with building a model with our engineers,' says D'Souza. 'If the roads team delivers the workshop, students may have to construct a road from spaghetti – or a cable bridge for the bridges team.'

While Aecom does not operate a defined exchange programme, engineers can move across the business, to different locations and specialisms, if the project need arises or they want to gain experience.

Diversity is also core to the development of Aecom's business. As well as above industry-average female graduate recruitment (43% against 26%), the firm says its Stem engagement and commitment to delivering social value means it can offer support to young people in deprived areas, who may not have considered engineering as a career.

Recruitment, training and education are a core part of the firm's winning strategy. 'We strive to solve the most complex challenges and build a legacy for generations to come,' says D'Souza. 'We believe it is important to invest time in the younger generation so they can be part of creating it.' CJ

BASHEER SOUDI, 23, ENGINEER

I first heard about Aecom when I attended an engineering careers fair at university in 2015, and I became an electrical engineering intern there in 2016. Aecom then sponsored me during my final year of university and offered me a place on its graduate development programme.

I joined the company in 2017, after graduating with a first from the University of South Wales. As a graduate electrical engineer, I was involved in a variety of projects that allowed me to better understand design considerations, develop technical aspects of design solutions and analytical skills, and produce detailed design calculations, schematics and drawings for services and systems. I have also developed my soft skills through the structured programme, which continues to support my professional development towards chartered status.

Aecom supports its graduates to be registered with a professional institute by paying annual membership fees. I joined the CIBSE Young Engineers Network, and have been on its committee since 2018.

Aecom also encourages staff to use two paid working days for voluntary and charity work. It supports the Engineering Education Scheme Wales – with which I was involved – and encourages us to become Stem ambassadors.

JENNIFER COX, 24, GRADUATE ELECTRICAL ENGINEER

I started Aecom's graduate programme in September 2018, after graduating in architectural engineering from Heriot-Watt University. I did an eight-week internship in the summer of 2017, which is when I found out more about the graduate programme.

The programme offers so much in terms of skills development and experience. From the first day, I was put onto projects, allowing me to focus on technical development. Other graduate events developed softer skills – presentation, communication and negotiation.

It prepares you really well to work with other disciplines across the sector. The project work makes you very aware of what's going on within building services and ensures you can work between disciplines. You're exposed to other parts of the organisation.

I'm passionate about being involved in our work in the community and professional organisations. Part of the training programme focuses on the CIBSE chartership skills, which includes encouraging you to get involved in CIBSE, and working as ambassadors to promote Stem learning in schools.

MAKING THE SWITCH

Lower carbon factors for Grid electricity proposed for Part L are already in place in London. **Andy Pearson** looks at one scheme in North London where the design is switching from gas CHP to air source heat pump

Pentavia Mill Hill is a pioneering development. The mixed-use scheme of 844 new homes on a brownfield site in Barnet, north London, is set to be one of the first developments to comply with London's tough new environmental rules after being granted planning permission. The development's heating and hot-water system is predicted to save up to 62% carbon emissions compared with the 2013 Building Regulations' notional building emission rate.

For the scheme's MEP engineers, ChapmanBDSP, the journey to planning approval has been far from straightforward, however.

Its involvement with Pentavia Mill Hill started in 2016, when it set out to devise a Building Regulation-compliant MEP design for developer Meadow Residential. It designed a fairly conventional heating solution based on a gas-fired combined heat and power (CHP) engine, which would generate electricity while providing heat to help meet the dwellings' heat and hot-water demand. 'Gas CHP was a good fit with the size of the development and its uses; at the time, it was the easiest way to achieve the carbon reduction target [to enable compliance with the London Plan],' says Joanna Conceicao, an associate at ChapmanBDSP.

In 2018, planning permission for the development was refused by the local council. However, the scale and strategic importance of the scheme in providing affordable homes meant that it had to be referred to London's mayor. The mayor supported the scheme in principle, subject to various design amendments to bring it into line with the London Plan. The scheme was subsequently changed, resubmitted and eventually approved by the mayor.

Architect Arney Fender Katsalidis's design comprises 18 housing blocks, ranging in height from four to 16 storeys, with some of the apartments built above retail outlets. The scheme's massing has the 16-storey block at the east of the site, with a 12-storey one marking the west of the scheme. The buildings frame the southern boundary of the site, with the other 10- to 13-storey blocks interspersed across the scheme to give what the planners describe as 'undulating massing'.

It was during the delay in obtaining planning permission that the Greater London Authority (GLA) introduced new carbon-factor rules under its January 2019 revisions to the London Plan. These include the adoption of Standard Assessment Procedure (SAP) 10, which uses more up-to-date carbon factors for Grid electricity to take into account

decarbonisation of the Grid because of the growth in renewable energy sources. Under SAP 10, carbon-emission factors reduce from 0.519 $kgCO_2/kWh$ to 0.233 $kgCO_2/kWh$.

When ChapmanBDSP first developed the design for its gas-CHP heating system, SAP 2012 was current – but now GLA wanted it to demonstrate compliance with the London Plan using SAP 10.

The carbon factor of Grid electricity is significant because it is used in SAP calculations, which are required to demonstrate compliance with Part L of the Building Regulations for new dwellings. SAP is calculated using an approved computer program. Two emission-rate figures are calculated: the dwelling emission rate (DER) and the target emission rate (TER).

The DER is calculated based on the proposed design of a dwelling. This is compared with the TER, which is the minimum acceptable energy performance of a notional dwelling of similar size and shape to the one proposed. 'To comply [with the London Plan] the DER must achieve at least 35% improvement over the TER,' explains Conceicao.

As the carbon associated with electricity is now a lot less, using a gas CHP (where the electricity generated is used to offset the emissions from gas consumed) gives you significantly less carbon savings.

'We were achieving a 43% carbon reduction using SAP 2012, whereas under SAP 10, we were only achieving a 4% reduction,' Conceicao explains. 'That was when we realised we could not justify using the CHP any longer, so we had to change our energy strategy completely.'

To find the optimum energy strategy to comply with the new rules, ChapmanBDSP looked at seven potential solutions for supplying space heating and hot water to the dwellings, including:

> "SAP 10's carbon factors for electricity take into account decarbonisation of the Grid because of the growth in renewable energy sources"

- Retaining the central gas CHP system but 'drastically improving' the façade insulation to reduce the heat demand
- Using a central air source heat pump (ASHP) to provide low-grade heat for space heating and for hot water via a heat interface unit (HIU) within each flat, with an electric immersion heater to raise hot-water temperature
- Using a central ASHP to provide low-grade heat for space heating, with a gas boiler used to heat hot water
- Using an ambient loop central ASHP coupled with individual air-water heat pumps (AWHPs) in each flat to provide space heating (and potentially cooling) and hot water
- Using two development-wide piped heating circuits – one for heating and a hotter circuit for heat domestic hot water, each supplied from central ASHPs.

All solutions tested also included PV panels on the roof of each block in an attempt to maximise carbon-emissions reductions. The designers are awaiting the go-ahead before developing the detailed design, so »

Pentavia comprises 18 housing blocks, offering 844 new homes

» a final decision on the energy strategy has still to be made. However, Conceicao says the final scheme is likely to be one of two ASHP options: a centralised ambient loop ASHP with individual AWHPs in each flat; or a centralised ASHP with individual electric immersion heaters.

Conceicao says the initial option 'delivers a slightly lower carbon solution', while the immersion option uses conventional technology and 'would have a lower capital cost'. In terms of a carbon reduction, the initial proposal is calculated to deliver a 62% reduction in carbon emissions compared with the TER from the 2013 Building Regulations, while the electric immersion heater option would deliver a 53% reduction.

As a consequence of its work on Pentavia Mill Hill, ChapmanBDSP has developed a suitability matrix for heating solutions. 'At the moment, we are having to educate our clients about why CHP can no longer be used as the default solution,' says Conceicao. 'Demonstrating with actual numbers makes it very obvious to them why they cannot have gas-fired CHP anymore.'

ChapmanBDSP is using the matrix for large-scale projects that are referable to the GLA. However, Conceicao says the matrix 'will be applicable nationally if the proposed changes to Part L are adopted, which include new carbon factors for Grid electricity'. CJ

The tallest block on the site is 16 storeys high

Pentavia's original gas CHP had to be ditched after changes to the London Plan

PROPOSED CHANGES TO PART L

The consultation to uplift the standards of Part L of the Building Regulations is set to close at 11.45pm on 7 February 2020.

Proposed changes to Part L include:

- Changing the whole-building minimum energy performance target, which involves:
  - Introducing primary energy as the principal performance metric, and continuing to use CO_2 as a secondary metric
  - Removing the fabric energy efficiency metric
  - Incorporating the latest evidence on primary energy and CO_2 emissions of fuels, and removing fuel factors in the calculation for high carbon fossil fuels and electricity
  - Introducing a householder affordability standard for new dwellings, so that new homes are affordable to heat.
- Taking a step towards the Future Homes Standard through:
  - Uplifting the minimum standard of whole-building energy performance
  - Improving minimum insulation standards
  - Improving the minimum efficiencies of fixed building services.
- Future-proofing new dwellings to be ready for low carbon heating systems
- Improving compliance with Part L to improve as-built performance
- Aligning the Part L standards for new dwellings with the 2018 revisions to the Energy Performance of Buildings Directive
- Adopting the most recent version of the Standard Assessment Procedure for Energy Rating of Dwellings Version 10 (SAP 10)
- Simplifying the structure and content of guidance relating to Part L.

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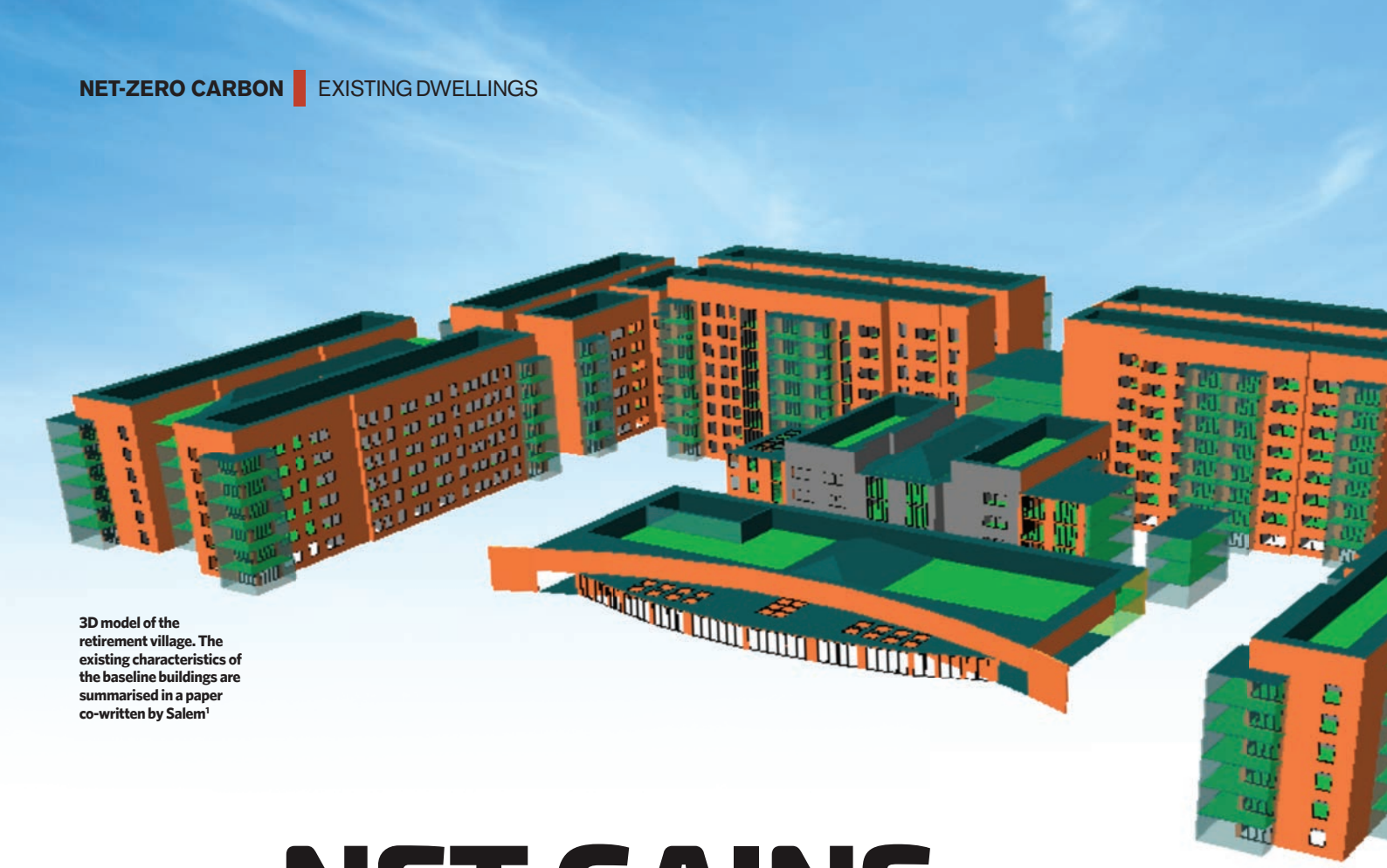


3D model of the retirement village. The existing characteristics of the baseline buildings are summarised in a paper co-written by Salem[1]

NET GAINS

Retrofitting homes to be net-zero carbon is one of the great challenges of the new decade. **Radwa Salem** applies the existing nZEB standard to two dwelling types to assess its suitability and predict the overheating risk of targeting net zero

With legislation committing the UK to legally binding zero carbon energy targets by 2050, close attention is now being paid to the higher energy efficiency standards that will enable the construction industry to achieve its net-zero goals.

The currently available nearly-zero energy building (nZEB) standard[2] is in line with our vision for a decarbonised, sustainable future, but it is unclear whether its targets are realistic for existing buildings.

To assess whether the nZEB targets are achievable for residential buildings, we carried out case-study analysis of two types of buildings – an existing pre-1990s home and dwellings in a retirement village – to assess the energy savings, costs, resilience to future climatic conditions, and the potential risk of overheating.

This article intends to shed some light on the nZEB standard and evaluate whether it is the standard the built environment needs at the moment to achieve its future targets.

Considering that the residential building sector is responsible for around 30% of energy consumption within the UK, it is accepted that this sector is key to meeting the national and global goals set for the shift towards an energy-sustainable future.

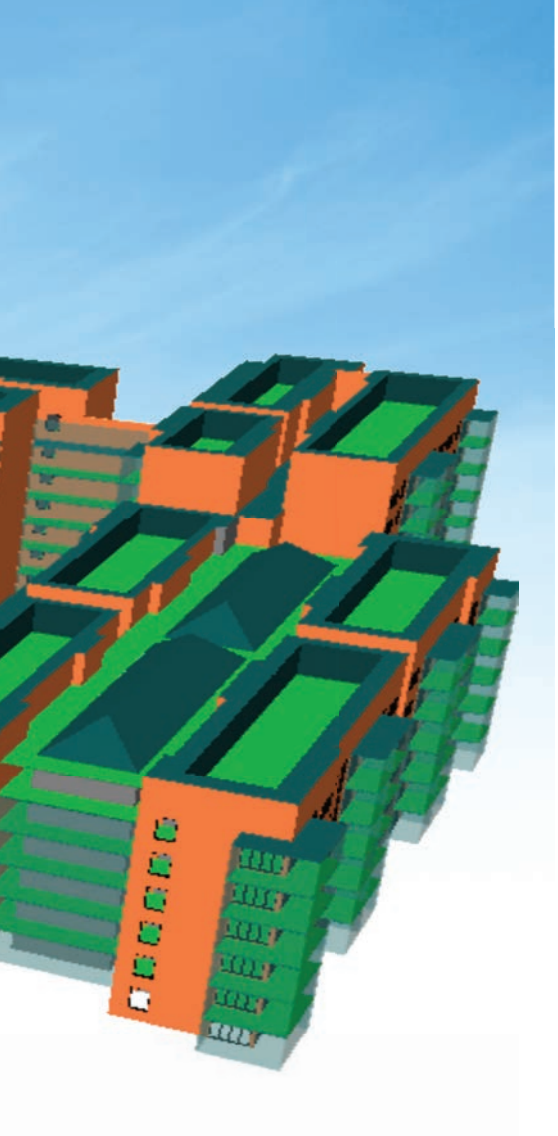
The nZEB standard

The 2010 [recast] Energy Performance Building Directive (EPBD) was introduced as a mitigation proposal to climate change, and has set out a requirement for commercial and residential buildings to be nZEBs – energy-efficient buildings that employ a renewable and/or microgeneration energy-production system.

In principle, however, many residential buildings can reach the 'nZEB standard' by incorporating only a renewable energy system, if the focus is to reduce primary energy consumption and not to improve the actual energy efficiency of the building.

The government has recently offered new proposals for improving energy efficiency in homes and introduced Future Homes Standard (currently under public consultation) to help meet the ambitious 2050 net-zero carbon target.

According to the government, the Future Homes Standard will require new-build homes to be future-proofed with low carbon heating and 'world leading' levels of energy efficiency. This standard is expected to work in line with the EPBD's primary energy target, which, in the UK, is currently 44kWh·m^{-2} per year for residential buildings. The government suggests two routes to



achieve this: significant fabric improvements or small fabric improvements assisted by low carbon heating/renewable systems.[3]

Based on this research, however, the primary energy target will not be reached if designers only focus on achieving high fabric performance without energy-efficient HVAC and renewable systems. An energy-efficient building – relative to the existing building stock – may be achieved, but it will not be nZEB.

Methodology

The methodology adopted for this research involved several stages: first, a site visit was conducted to obtain building information, ranging from floor plans to measurement of windows and doors. Subsequently, thermal analysis and simulation software was used to give a robust prediction of the energy consumption, primary energy consumption (PEC), CO_2 emissions, building fabric and thermal performance of the building.

The relevant CIBSE weather file was selected for the final simulation. To ensure validity of the baseline model, the simulated energy consumption was compared with the actual energy consumption of the case-study building, where possible. This approach was time-consuming, but it ensured that the outcomes are valid and applicable to other buildings of the same stock.

Case study: pre-1990s detached house

The first case study analysed was a typical pre-1990s, detached residential house[4] (Figure 1). It was noted that, to retrofit buildings of this stock successfully, it is necessary for the designer to consider the inclusion of renewables and building-fabric improvements. Results show that, when a solar panel was introduced, the building's performance would not have met the nZEB target unless there were also fabric improvements.

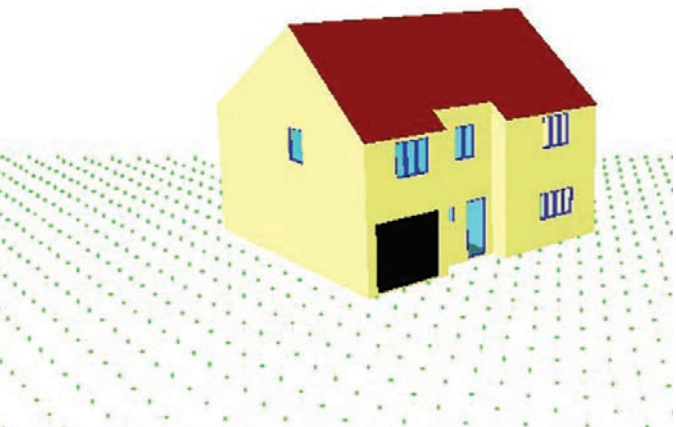
The base-case building (without the retrofit measures) was simulated under future climatic conditions using the CIBSE London TRY 2020s, 2050s, and 2080s [for the high-emissions scenario] weather files. The simulation results showed that the heating demand remains high, »

> "The research demonstrated that, in future, it may be inevitable that energy-efficient buildings will need some mechanical interventions to combat overheating"

RETROFIT MEASURES ON PRE-1990S DWELLING

The type of retrofit options/measures used will always depend on the existing state of the building investigated. However, every case study investigated within this project looked at improving the insulation and glazing, ventilation, HVAC and DHW systems, and lighting, and incorporating a suitable renewable/microgeneration system. To meet the nZEB targets outlined in Table 1, this particular case study required the inclusion of: 130mm expanded polystyrene (EPS) insulation; triple glazing [argon filled, low-e]; LED lighting; mechanical ventilation; and a 20% efficient 2kW PV module with solar battery storage.

(i) Front elevation



(ii) Rear elevation

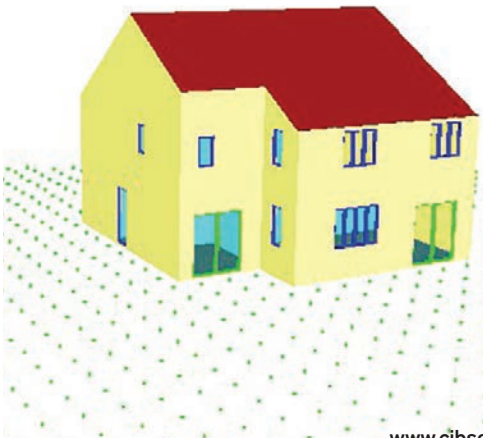


Figure 1: 3D model of the house

> "The high cost of retrofit does not mean it should be entirely neglected. Building fabric material should be carefully sized and selected to improve overall U values while keeping costs to a minimum"

» though it decreased by nearly 24%. Meanwhile, the cooling demand increased by more than 80% between the baseline model and 2080s timeline. This demonstrated that, in future, it may be that energy-efficient buildings will need some mechanical interventions to combat overheating unless other passive building methods are developed that mitigate the need for cooling.

Using the same dwelling, a life-cycle cost analysis (LCCA) of various energy efficient and nZEB retrofit scenarios[5] was conducted (see Figure 2). Results showed that incorporating a renewable/trigeneration system is crucial to achieving the near-zero standard with cost benefits.

A major retrofit to improve the building fabric increased the overall capital investment and life-cycle costs significantly, but their contribution to reducing energy consumption and carbon emissions was insignificant in comparison with some of the renewable measures.

Table 1: Comparison of the baseline model performance with the nZEB target and post-retrofit	nZEB targets	Retrofitted	Baseline model
External wall U value ($W \cdot m^{-2}K$)	0.15	0.15	0.32
Ground floor U value ($W \cdot m^{-2}K$)	0.13	0.12	0.57
Window U value ($W \cdot m^{-2}K$)	0.80	0.83	3.45
Roof U value ($W \cdot m^{-2}K$)	0.13	0.16	0.29
Air permeability rate ($m^3 \cdot h^{-1} \cdot m^{-2}$@50Pa)	1.0-5.0	2.5	6.0
Thermal bridge y value ($W \cdot m^{-2}K$)	0.05	0.08	0.15
Annual primary energy consumption ($kWh \cdot m^{-2}$)	44	47.56	135.91
Annual carbon emissions ($KgCO_2 \cdot m^{-2}$)	10	7.97	51.73

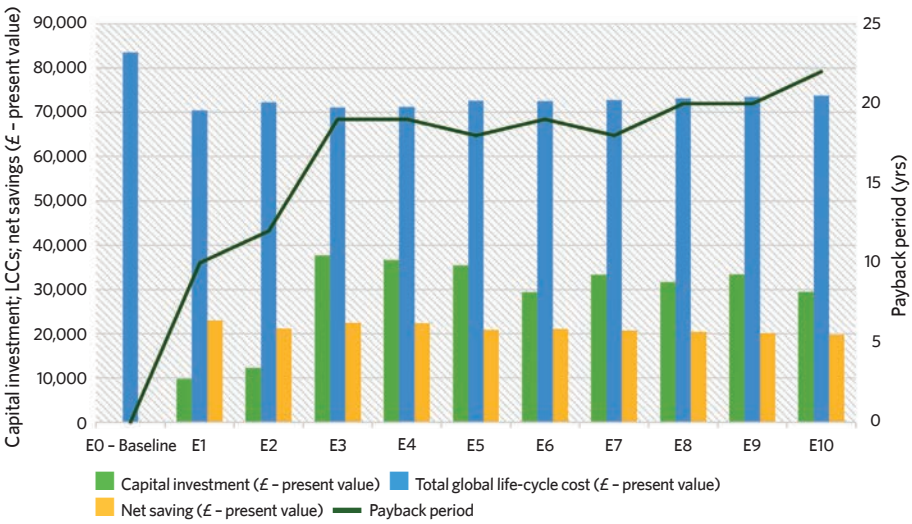


Figure 2: Results of the life-cyle cost (LCC) calculations for the various scenarios

The high cost of retrofit does not mean it should be entirely neglected. Building fabric material should be carefully considered and selected to improve overall thermal performance while keeping costs to a minimum. Once this is completed, they can be complemented by renewable options to meet the nZEB standard.

The cost-optimal solution for the retrofit of a typical UK residential dwelling was estimated at $75kWh \cdot m^{-2}$ per year; meanwhile, the UK's current nZEB target stands at $44kWh \cdot m^{-2}$ per year. Despite this gap between the current nZEB primary energy consumption target and the cost-optimal solution, the study demonstrated that the nZEB retrofit remained a financially viable option compared with the baseline (E0 – do nothing) scenario over a 30-year study period.

The cost efficiency of nZEB retrofit scenarios decreased under future weather projections. This is because the projections showed a continuous increase in temperatures over stipulated timelines, which led to an increase in the energy consumption and, therefore, energy costs. It highlighted that care should be taken with regards to potential overheating that would negate energy and cost-benefits of a substantial retrofit investment.

Case study: risk of overheating in retirement village

Based on the result of these findings, the next case study explored the impacts of a changing climate on the risk of overheating for a UK retirement village. The overheating criteria used was the CIBSE TM59: *Design methodology for the assessment of overheating risk in homes*.[6]

The nZEB retrofit model, summarised in Table 2, failed to pass the criteria under the DSY 2020s, 50th percentile, medium-emissions scenario. It was clear that the typically recommended mitigating strategies within the literature – such as overnight natural ventilation, double glazing (low-e) and shading devices – were not sufficient to reduce the occurrence and severity of overheating throughout the building (see Figures 4a and 4b, where the number of hours the CIBSE TM59 overheating exceedent is reached increases after nZEB retrofits).

A 100kWe combined heat and power (CHP) system and a 100kWe combined cooling heat and power (CCHP) system were simulated as potential mitigating measures for the nZEB retrofit model. Both the CHP and CCHP were proved to reduce and maintain the energy consumption of the

Energy-efficiency measures (EEM)	Insulation	Lighting	HVAC/DHW	Microgeneration	Overheating mitigating strategies
Design measure	180mm mineral wool insulation batts	LED (plus auto presence detection in communal areas)	■ Automatic thermostat-controlled, direct gas-fired boiler ■ Mechanical ventilation with heat recovery	100kWp solar panel system, plus solar thermal collectors	■ Internal shading (vertical blinds) ■ Natural ventilation in residential areas ■ Double glazing, 36mm argon-filled, low-e

Table 2: Summary of final selected energy-efficiency measures (EEMs) for nZEB retrofit in the retirement village

building in the future. The CCHP system was the only mitigating strategy that fully passed the overheating criteria while ensuring the energy consumption of the building meets the nZEB standard under current and future climatic conditions.

For this particular case study, CCHP proved to be the most suitable solution because of the type of heating and cooling demand required throughout the year. However, the type of mitigating strategy will vary depending on the type, location, heating and cooling demand of the building.

Most importantly, the results of this project do not undermine the importance of continuing to improve the energy efficiency of existing buildings but rather highlight that the approach taken should be reconsidered.

This does not mean neglecting lowering the energy demand, but searching for – and selecting – suitable and relevant mitigating strategies, and adequate ventilation strategies, relative to the building being considered that will work to reduce the risk of overheating.

Study outcomes

The outcomes of this research should further encourage the retrofitting of existing buildings with high-energy efficiency standards such as the nZEB. With careful and thorough design decisions that work to lower the energy demand of the building, and considering the building resilience of a potentially different climate in the future, the standard can be achieved, with long-term cost and energy benefits.

The outcomes of this research project will provide two sets of applicable frameworks to achieving the nZEB standard. The first will be a descriptive methodology based on the findings of the various case studies.

The second will redefine the definitions that have been selected from the literature, and develop or alter this, based on findings, where necessary. This framework will suggest a near-zero definition to bridge the gap between technical optimality and cost optimality – thereby ensuring that a realistically applicable high energy efficiency standard may be achieved for UK buildings. **CJ**

■ This project is funded by CIBSE and the University of West London (UWL).

■ **RADWA SALEM** is a CIBSE-sponsored research student at UWL. The supervisors are **PROFESSOR ALI BAHADORI-JAHROMI**, UWL, and **DR ANASTASIA MYLONA**, CIBSE

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4 Salem R, Bahadori-Jahromi A, Mylona A, Godfrey P and Cook D (2018), Retrofit of a UK residential property to achieve nearly zero energy building standard. *Advances in Environmental Research* 7(1): 13-28

5 Salem R; Bahadori-Jahromi A; Mylona A; Godfrey P; Cook D. (2019a). Life-cycle cost analysis of energy-efficient retrofit scenarios for a UK residential dwelling. *Proceedings of the Institution of Civil Engineers – Engineering Sustainability*, 0(0): 1-16

6 CIBSE TM59. *Design methodology for the assessment of overheating risk in homes*, Technical Memorandum TM59, Chartered Institution of Building Services Engineers, London, 2017, ISBN 978-1-912034-17-8

7 Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency

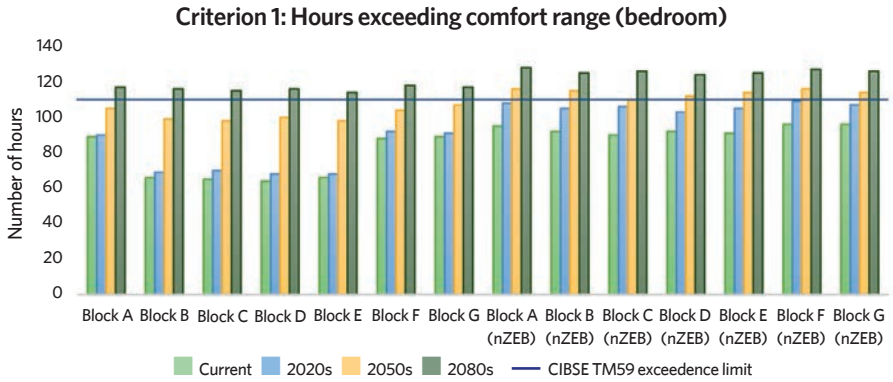

Figure 4a: CIBSE TM59 overheating Criterion 1 results for bedroom (average) within the village as built and after nZEB retrofit under current and future climatic conditions

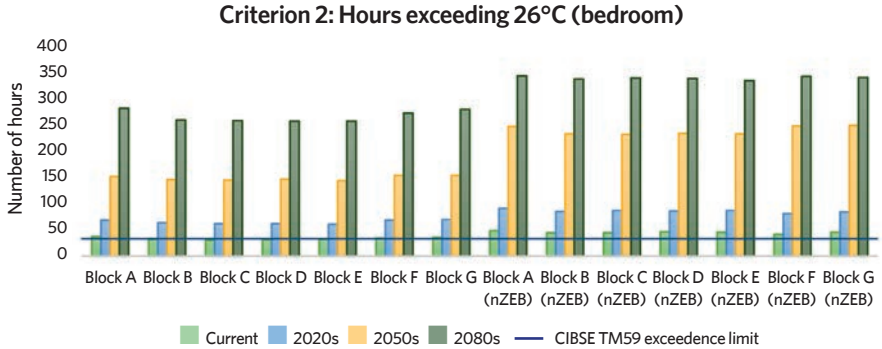

Figure 4b: CIBSE TM59 overheating Criterion 2 results for bedroom (average) within the village as built and after nZEB retrofit under current and future climatic conditions

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Paperboard mill wins first heat recovery grant

Grant will help Iggesund in Workington recover waste flue gas heat from industrial process

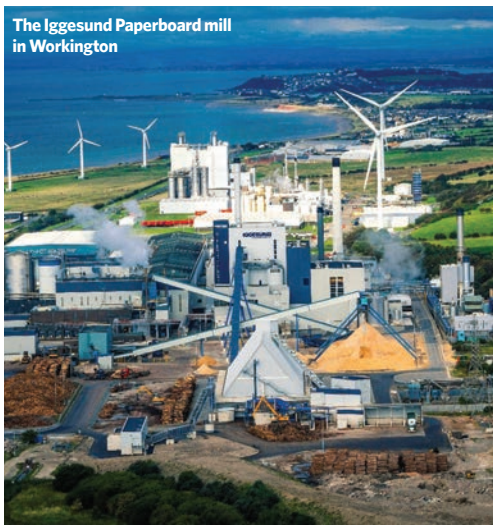
A Cumbria-based paper and paperboard manufacturer has become the first firm to benefit from the UK government's new Industrial Heat Recovery Support (IHRS) programme – a scheme designed to encourage and support investment in heat recovery technologies.

Iggesund Paperboard from Workington was awarded £15,898 towards the firm's flue gas project under the initiative, which is aimed at helping businesses of any size to identify and invest in opportunities for recovering and reusing heat that would be wasted.

The grant will help the company develop plans to recover otherwise wasted flue gas heat from the boiler to heat the incoming condensate for its biomass Combined Heat and Power (CHP) plant. It is anticipated that the project will save Iggesund more than £300,000 and 600 tonnes of CO_2 annually.

The government opened the £18m IHRS programme in autumn 2018 to support manufacturing businesses and data centres get heat recovery projects off the ground. It is estimated the programme, which is scheduled to run to March 2022, has the potential to save businesses more than £500m on their energy bills and halt the emission of up to six million tonnes of CO_2e over the course of its lifetime.

The programme is open to applications until the end of July 2020. For more information, visit **bit.ly/CJFeb20Heat**



The Iggesund Paperboard mill in Workington

Adveco extends MD family

Hot water and heating specialist Adveco has extended its MD condensing gas boiler range by adding 10 new high-efficiency, wall-mounted models to the line-up.

Designed for light commercial applications, Adveco says the new compact boilers offer a high-quality patented heat exchanger construction, with a continuous non-welded run of titanium stabilised stainless steel designed for strength and corrosion resistance. The wall-mounted variants also incorporate the brand's three-pass design, featuring large-bore, circular tube cross-sections that reduce the collection of debris.

All the MD boilers feature efficient pre-mix burner technology designed to help control operational costs and significantly reduce NO_x and CO_2 emissions. The MD range also offers integrated run/fault signal for connection to a BMS system.

The new range includes boilers with rated heat outputs of 15kW, 24kW and 34kW. The MD15, MD24 and MD34 have two variants to accommodate either central heating only or DHW via an indirect water heater. A third variant of the MD24 and MD34 includes an integrated plate heat exchanger for instantaneous DHW.

Aggreko certified for ISO 50001:2018

Aggreko, the UK-based supplier of temporary power, heating and cooling solutions, has been certified to the Carbon Trust Standard and achieved certification to ISO 50001:2018 international standard for energy management.

By implementing ISO 50001, Aggreko has committed to reduce its energy consumption, minimise its carbon footprint and promote sustainable energy usage. This includes applying both internal and external guiding principles including the integration of reducting energy and increasing fuel efficiency in its fleet.

Aggreko is also committing to significantly reduce its power-related carbon emissions, and, as part of this undertaking, has also switched its electricity contract to 100% renewable electricity, with all annual electricity demand required to supply Aggreko's service centres being generated by offshore wind generators.

Toshiba Carrier to build factory in Poland

Toshiba Carrier is investing Yen3bn (£21m) in a new manufacturing subsidiary in Gniezno, Poland, to produce air conditioning and heat pumps for the European and UK markets. The new factory will allow Toshiba Carrier to reduce product lead time by one-third, cut product cost, and bolster its product line-up to cater to particular needs in Europe. The new facility is scheduled to start operations before the end of 2020.

Microsoft to be carbon negative by 2030

Microsoft has committed to 100% renewable energy in all its operations, including data centres, buildings and campuses, by 2025 as part of a comprehensive new programme to become carbon negative by 2030, and by 2050 to remove from the environment all its carbon emissions since the company was founded in 1975.

The company has been 'carbon neutral' since 2012 but is now focused on a more aggressive carbon-reduction policy that includes investment in state-of-the-art data centres using 100% renewable energy for cooling.

Microsoft aims to cut its carbon emissions – both direct and from its supply chain – by half by 2030. It is committed to a package of measures including investing in new carbon reduction and removal technology, and electrifying its vehicle fleet.

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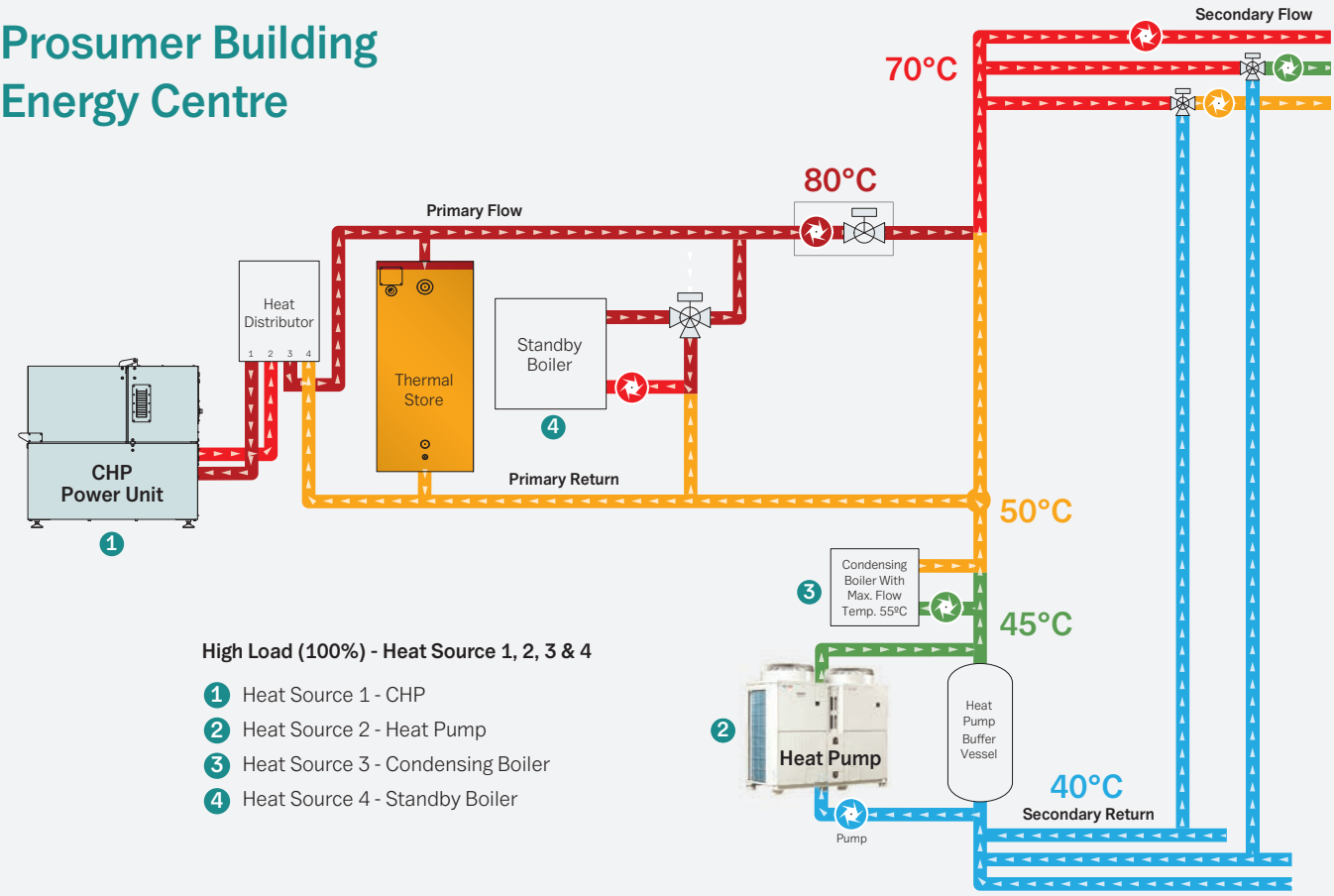

High Load (100%) - Heat Source 1, 2, 3 & 4

1. Heat Source 1 - CHP
2. Heat Source 2 - Heat Pump
3. Heat Source 3 - Condensing Boiler
4. Heat Source 4 - Standby Boiler

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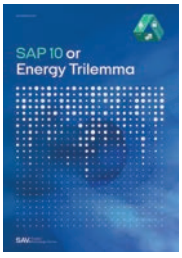

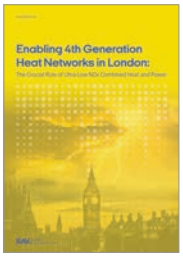

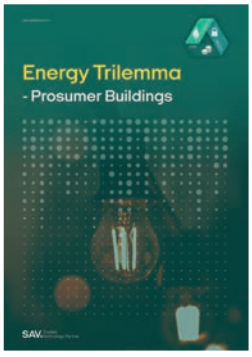

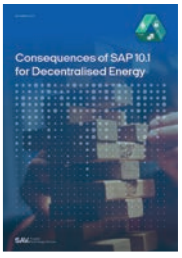

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Copenhagen's Copenhill waste-to-energy plant, designed by Bjarke Ingels Group

EUROPE'S HOTTEST CITY

Copenhagen's district heating relies largely on biomass and waste incineration power plants, but net-zero carbon targets are now encouraging suppliers to harness energy from renewables and industrial by-products. **Alex Smith** reports

Two new landmark power plants make a striking addition to Copenhagen's cityscape. The £670m BIO4 biomass power plant, designed by Gottlieb Paludan Architects, features a 46m-high façade of tree trunks, which signifies that sustainable woodchip, not coal, now generates heat and electricity at the Amagerværket power plant.

Meanwhile, architect Bjarke Ingels Group has taken biophilia to a new level with its recreation of an alpine scheme on the great sloping roof of the Copenhill waste-to-energy CHP plant. Locals have the option of skiing down an artificial ski slope or hiking forest trails as city trash burns below their feet.

The power plants are a key part of the city's plan to be net-zero carbon by 2025. They are connected to Greater Copenhagen's district heating (DH) system, which is the prime means of supplying heating to residents and businesses in Denmark: 64% of households were connected to heat networks in 2019.

While Copenhagen's new generation of CHP power plants are receiving architectural plaudits (and Kara/Noveren's waste incinerator in Roskilde can be added to this list), they are only part of its transition to net zero. The integration of less-visible renewables into existing DH networks is also an important element of the 2025 roadmap. These include solar heating, large-scale heat pumps, biogasification of organic waste, geothermal energy, and surplus heat from industry.

Denmark is also heavily invested in wind turbines and thermal storage facilities that give consumers access to cheap power during periods of high demand. Since 2010, Copenhagen has used seawater to create a district cooling system and the network is still expanding. There is also a drive to replace the fossil fuels used in peak and reserve load boilers in district heating with biofuel, electric boilers and biogas (see panel, 'Energy sources in Copenhagen').

Denmark's heating and cooling industry is attracting global interest, as countries such as Ukraine look to overhaul inefficient DH systems and others, such as the UK, seek best practice in design and installation. »

Copenhagen's district heating network is still growing

History

Denmark's use of district heating stretches back more than 100 years. Its first system was established in 1903, when the municipality of Frederiksberg built an incineration plant to dispose of waste generated by rapid industrialisation. It generated electricity and steam, which was fed, via tunnels, to a hospital, children's home and poorhouse.

By the 1920s, several towns had built diesel-powered electricity-generating plants, and were using surplus heat in the cooling water for nearby buildings. After World War II, local CHP plants closed, but larger heat stations were built to serve the existing DH systems.

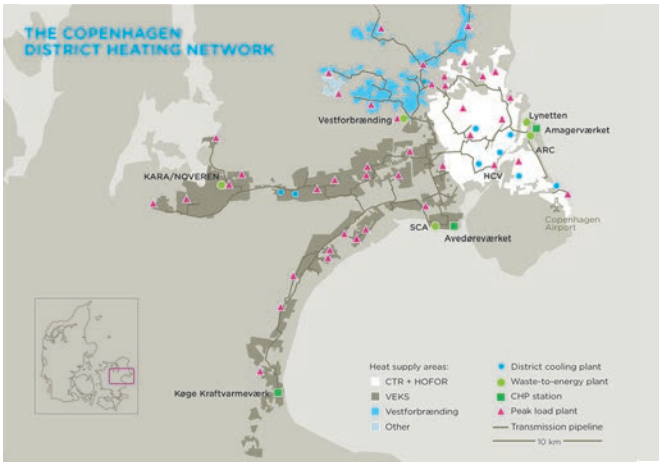
There was a boom in waste incinerators in the 1960s, when the Danes also perfected pre-insulated pipework and started installing leak detectors in the insulation layers. By 1980, 30% of households in Denmark were connected to district heating. The prime source of energy was imported oil and coal, but the global energy crises of the 1970s led to high fuel bills and acute energy shortages. In response, the government devised a strategy to reduce dependence on oil, as well as cut energy demand. There was a drive to insulate buildings and a push to reduce operating temperatures in heat networks. There was also a move to connect local DH systems, to achieve efficiencies of scale and remove outdated plant.

Companies were set up by the municipalities to run the consolidated heating networks. There is now a 180km hot-water transmission system[1] in Greater Copenhagen, operated by CTR, VEKS and Vestforbrænding, which runs a large CHP waste incinerator. Owned by local authorities, they supply heat from waste incinerators and CHP plants to 21 distribution networks. Hofor operates a steam system covering 20% of the system; this is being replaced by hot-water district heating. There are 500,00 end users and 9,600GWh of heat is supplied.

VEKS, owned by 11 municipalities, was established in 1984. Since then, the CHP plants connected to its transmission network have been converted from imported oil and coal to natural gas and biomass, and it bought a biomass CHP plant in Køge in 2012.

While baseload is now covered by biomass and surplus heat from waste incineration, VEKS' managing director, Lars Gullev, sees that changing in the future. 'There are a lot of discussions around whether biomass is sustainable, but it is the only alternative to make a quick reduction in CO_2 emissions. In the long run, there will be other actors.'

The district heating network in Greater Copenhagen



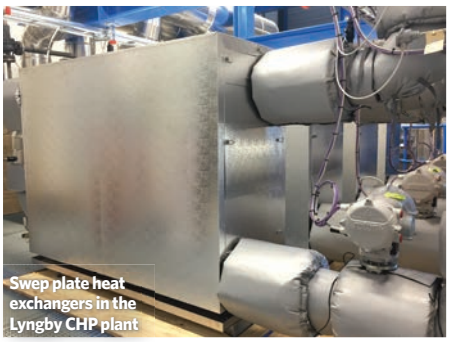
ENERGY SOURCES IN COPENHAGEN

- Two biomass-fuelled CHP plants: Amagerværket and Avedøreværket
- One biomass-fuelled industrial CHP plant in Køge, owned by VEKS
- Three waste-to-energy CHP plants: Copenhill (ARC), Vestforbrænding and Incinerator Line 6 (Kara/Noveren)
- Geothermal heat and surplus heat
- Sludge incinerators at two wastewater treatment plants owned by Biofos
- 30MW gas-fuelled, combined-cycle CHP plant at Technical University of Denmark (DTU), mainly operating as peak capacity in the power system
- 5MW waste heat from CP Kelco's pectin factory
- Several heat pumps for cogeneration of heating and cooling
- Electric boilers
- 50 gas/oil-fuelled, peak-load and spare capacity boilers.

ENERGY FROM WASTE

Vestforbrænding runs Denmark's largest waste incineration plant, burning 550,000 tonnes of waste a year – including 15-20,000 tonnes from the UK – and providing electricity for 80,000 households and heating for 75,000 households.

The company collects municipal waste for around 900,000 people and 60,000 businesses. It is able to recycle 58% of the waste, while 41% is incinerated and 1% is landfilled. Of the energy produced by incineration, 20% is electricity and 80% is used for district heating.



Swep plate heat exchangers in the Lyngby CHP plant

It is aiming to reduce residual waste to virtually zero. Fly ash containing heavy metals is currently deposited in mines, but the firm is running a pilot scheme to clean the ash of heavy metals, which can be sold. The remaining ash can be used in cement, while boiler ash can be used for road aggregate.

Vestforbrænding recently connected its district heating system to the Lyngby gas-fired CHP plant, to expand its network into the Technical University of Denmark (DTU) and surrounding developments.[2] A heat exchanger station was built, designed by Danish consultancy firm Ramböll, featuring a heat accumulator tank and four lines of Swep brazed plate heat exchangers. The units transfer heat from Vestforbrænding to Lyngby CHP plant for distribution, via the storage tank, into the DTU campus and nearby urban areas.

In summer, Vestforbrænding can transfer surplus heat into the accumulator, and in winter – when heat demand is high – the Lyngby gas-fired CHP plant can help Vestforbrænding balance loads.

The installation of the exchanger means that Lyngby can start to phase out the use of gas to generate electricity and district heating, and produce heat from waste incineration instead.

Vestforbrænding's waste-to-energy incinerator is 50 years old this year

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» One emerging 'actor' is large heat pumps, and VEKS is working with CTR and Hofor to take heat from sewage and seawater in Copenhagen Harbour using a heat pump with a capacity of 5MW. Geothermal heat pumps are set to play a big part in the city's renewable future (see Figure 1 for the increase in the proportion of renewables producing heat in Copenhagen's DH network).

VEKS is also developing a 70,000m³ pit thermal energy storage (PTES) project with the Høje-Taastrup district heating company.[3] Essentially a large, thermally insulated, underground water tank with a floating lid, the PTES serves as an accumulation tank for all the CHP plants in the CTR and VEKS transmission systems.

Originally, PTESs were developed for solar thermal storage, such as the 200,000m³ one storing excess heat from a 70,000m² solar thermal farm in Vojens, Denmark.[4] The idea is to use stored heat from PTES when renewables, such as wind and hydropower, are generating a lot of cheap electricity. In that situation, it's more economical to use heat from PTESs than a CHP engine, because the price obtained for generating electricity is low. When renewable electricity generation falls, CHP plants will be used, because electricity can be sold to the grid at a higher price. The aim is to allow flexible electricity production from CHP plants and peak shaving in large DH systems. The PTES is also around a third of the cost of a steel tank.

VEKS says the upper part of the storage can be fixed at 90°C, high enough to replace steel tanks. Construction work has already started on buildings for pumps and heat exchangers, and completion of the PTES is expected in 2021. Its operation will be optimised by using Balmoral software, which gives an economic optimisation of the electricity and DH market. It has calculated that the PTES will be at its most efficient if it is reloaded 25 times a year.

The long-term aim is to transfer more heat production to electric sources of power, such as large heat pumps, to take advantage when electricity prices are low. Gullev says VEKS is already using CHP electric boilers, integrated with solar collectors and seasonal storage on the network.

Copenhagen district heating
Fuel consumption for production

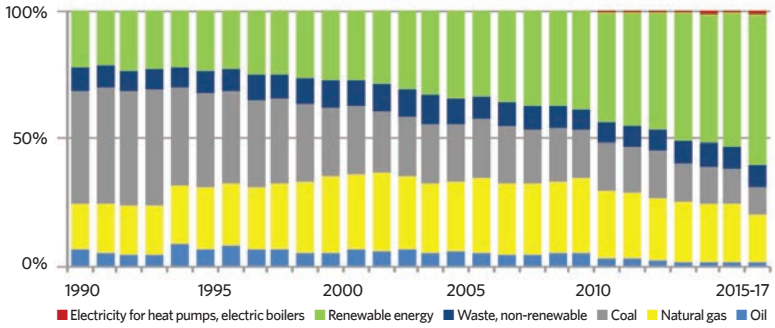

Figure 1: Increase in the proportion of renewables producing heat in Copenhagen's DH network

Using waste heat

The growing DH networks also capture low-grade heat from industrial processes. For example, the CP Kelco factory, in Lille Skensved, produces pectin from citrus peel, which – when heated with sugar – makes a gelling agent used in food. The process generates a lot of waste heat, so VEKS laid pipework to the factory and installed a heat pump and heat exchanger system. The facility – commissioned in 2018 – now contributes 25% of the heat used in the Køge DH system, at 42,000MWh/year. In addition, the waste by-product from extracting pectin from orange peel is sent to the Solrød biogas plant, opened in 2015. Along with manure, seaweed and medicine waste from CHR Hansen, it helps generate 6 million m³ of methane every year.

VEKS buys the biogas and uses it in a gas engine, which produces 28GWh of hot water for district heating and 25GWh of electricity. The district heating is primarily supplied to the local DH network in Solrød and the VEKS transmission DH network (see diagram below). After the biomass is degassed, it is used as a natural fertiliser for nearby farmers.

These initiatives will be vital if Copenhagen is to achieve its goal of being net-zero carbon by 2025, and district heating will remain an integral part of the city's energy strategy, extracting heat from Europe's trash. As Gullev says: 'District heating is not a dinosaur system; it's part of the future, because it's the infrastructure that makes possible integration between the heating system and power demand.' **CJ**

References:

1 District heating in the Copenhagen Region, State of Green, accessed January 2019 **bit.ly/CJFeb20DH1**
2 Expansion of innovative Copenhagen district heating project, Hot | Cool, Journal No.4 2019.
3 'New thermal heat storage in Greater Copenhagen', Hot | Cool, Journal No.4 2019.
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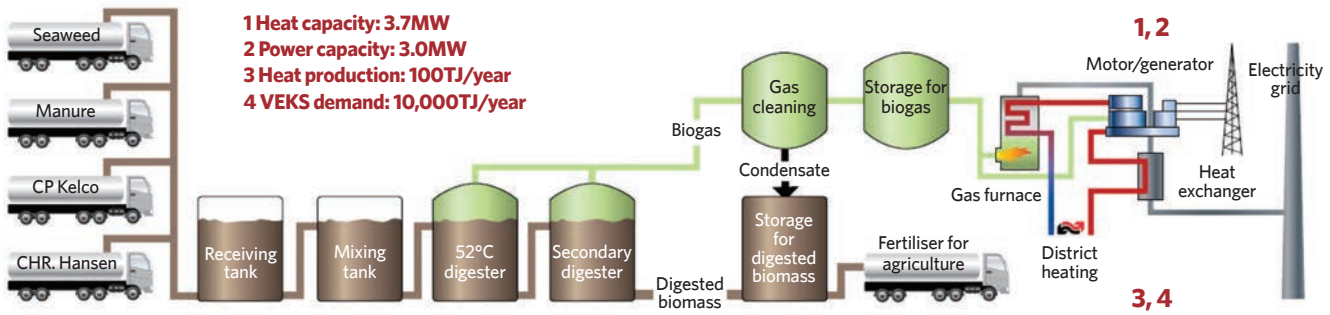
Solrød biogas plant



The biogas plant generates 6 million m³ of methane per year

TAKING THE TEMPERATURE

A CIBSE roundtable looked at the potential to reduce carbon through low temperature domestic hot water systems – and whether revised guidance is needed to deliver modern, safe low energy solutions. **Phil Lattimore** reports

DHW has largely been ignored in the debate around energy and carbon reduction

Does the building services sector have a blindspot when it comes to energy efficiency? While it has focused heavily on fabric energy efficiency to reduce heat demand, a key element of domestic energy consumption – domestic hot water (DHW) – has largely been peripheral to, or ignored in, the debate around energy and carbon reduction. This means a significant amount of energy- and carbon-saving potential may be missed.

In response, CIBSE has started a focused working group, which kicked off with a roundtable event at Arup's London headquarters in late November. The aim was to initiate a discussion around opportunities to optimise the energy consumption of DHW systems, while ensuring health and safety, and the consumer experience, are not compromised. While the prevention of health risks – particularly legionella – remain a fundamental priority in any conversation on DHW, discussions by the working group were framed around how the building services sector can approach the future of DHW. It considered a new focus on the future of low carbon heating, looking again and questioning the historic precedence that has led to current practice, regulation and guidance with reference to the latest knowledge based on thermodynamics and biology.

Arup associate director Becci Taylor, who is chairing the group and is a member of CIBSE's Homes for the Future Group, outlined some of the issues surrounding the energy used in heat pump-led DHW heating and the opportunity for reducing it. 'Every degree by which we drive down the temperature of DHW systems will lead to increased coefficients of performance, reduced energy and reduced carbon emissions,' she said. 'We need to do this while maintaining public health; this is no less important, but we need consistent risk-based guidance on ways we could approach this.'

Taylor added: 'As far as the government policy writers are concerned, the big issue is about reducing space heat loss. They haven't moved on to understand that new buildings – which is what the current conversation is about –have much lower space heating than domestic hot-water loads. A mindset shift is needed to catch up with this changing situation.'

The participants included representatives from CIBSE groups and areas of expertise across the sector, bringing to the discussion their specialist knowledge of issues relating to lower temperature DHW. They included: CIBSE technical manager Julie Godefroy; energy consultant Phil Jones (who is currently authoring the revision to CP1 on Heat Networks); Kiwa's head of training Andrew Mathews, who is chair of the CIBSE Domestic Building Services Panel; Huw Blackwell from Anthesis Group; Jonathan Gaunt, head of the public health team at Cundall and chair of the Society of Public Health Engineers (SoPHE); and Ilaria Ricci Curbastro, of Arup. Although absent, Gareth Jones, managing director of Fairheat and chair of the BESA HIU Standard, provided research material for the working group discussion.

Context

Recent interest from the Committee on Climate Change in the impact »

» of low temperature heating and DHW reflects a growing acknowledgement of the potential significance of low temperature DHW heating in the drive for energy reduction, and that current guidance may need revisiting. While lower DHW temperatures could offer energy savings, however, the Health and Safety Executive (HSE) is taking an interest because of the potential health risks associated with lowering DHW temperatures – particularly through increasing the risks of bacteria, such as legionella, in cooler DHW systems.

Godefroy told the group: 'The HSE is keen to get involved in the discussion and get feedback from the working group on where its guidance is clear, unclear or not reflecting the individual building scale and the heat network scale.'

Terms of reference

Setting out the parameters of the discussion, the working group agreed that it should include non-domestic buildings as well as residential ones, because many office buildings are experiencing increased demand for DHW for shower facilities. Hotels, sports centres and swimming pools also have a large demand for DHW.

The group agreed that a key distinction is instantaneous DHW versus storage systems, rather than defining systems by types of use. 'There is a growing body of evidence around instantaneous DHW – we could have an impact on this fairly quickly,' said Phil Jones.

As low storage volume point-of-use was considered 'low risk' for legionella by the HSE, the group discussed whether this categorisation could be extended to plate heat exchangers. 'The issue with the guidance is that it may be envisaging a small electric with storage instantaneous unit, so it may well be worth getting confirmation from HSE that it is comfortable for plate heat exchangers to be treated on the same basis,' suggested Huw Blackwell, from Anthesis Group.

'What is the acceptable quantity of risk?' Blackwell asked. 'As it's a mortality risk, it needs to be very low.'

> "The group identified the differing requirements and guidelines on DHW temperatures from the HSE and NHBC"

Legionella risks

While the group discussed the key issues surrounding legionella in detail, it identified the differing – sometimes conflicting – requirements and guidelines on DHW temperatures from the HSE and the National House Building Council (NHBC). These are driven by different considerations, such as prevention of legionella and the conservation of water. HSE guidelines require that risk is balanced between scalding and legionella, with scalding risk increasing more than tenfold from 50°C to 55°C. As mentioned above, instantaneous DHW systems are viewed as low risk for legionella, and HSE guidelines are for temperatures of 50°C. The current NHBC requirement, however, is for 55°C at the tap.

The complexity of the issue, and how modern low carbon solutions are not adequately addressed by existing (sometimes contradictory) guidance, was discussed by the group, which highlighted grey areas that need resolving. It attempted to identify some of the key spheres in which new guidance should be developed with relevant bodies, to balance the risks with the low carbon benefits of implementing low temperature DHW systems.

Phil Jones, for example, said there was huge potential for heating interface units (HIUs) in communal blocks, the majority of which are providing instantaneous DHW. He queried whether supply temperature requirements from NHBC could be relaxed for these. 'Around 50,000 are sold every year, so it's a significant market. The majority are instantaneous, yet they are restricted to NHBC's 55°C at the tap guidelines. CP1 is being updated and we recommend 50-55°C at the tap. But all of this is related to HIU testing to the BESA Standard. Most of the HIU market is suggesting to me that we relax these guidelines.'

Solutions and systems issues

The group also considered some low temperature solutions used in critical environments such as hospitals, which have adopted lower temperature water supply, but with copper-silver ionisation measures, to ensure legionella bacteria is controlled. Jonathan Gaunt pointed to a case study from Great Ormond Street Hospital Phase 2a Morgan Stanley Clinical Building, where such a system has been in operation. 'They effectively removed thermostatic mixing valves at the design stage, supplying the DHW system at 43°C, with copper-silver water treatment protection incorporated. The DHW system has now been in operation for seven years with no legionella counts detected. The system is, however, reliant on the water treatment method not failing.'

LEGIONELLA RISK

The risk of legionella increases in warm, static water, and the bacteria can be passed to humans in tiny, aerosol-like droplets of water that they breath in. Legionella is more likely to occur in large buildings such as offices, hospitals, sports centres or swimming pools, where the water supply has been contaminated and there are insufficient levels of chlorine to kill it off. The bacteria can be spread through atomised water in air conditioning, shower heads, taps and toilets, and in places such as spas and hot tubs. Infections from the bacteria are rarely identified in domestic environments, however.






Top, left to right: Working group chair Becci Taylor, Arup; Fairheat's Gareth Jones (who was absent, but contributed to the initial meeting via email); energy consultant Phil Jones; Cundall's Jonathan Gaunt, chair of SoPHE; Huw Blackwell, Anthesis Group; and Andrew Mathews, head of training, Kiwa and chair of the CIBSE Domestic Building Services Panel

As the panel acknowledged, setting temperature points for DHW systems within guidelines does not guarantee a consistent temperature; variation occurs within a 'dead band' above and below the setpoint, and overshoots and lags between temperature adjustments. Similarly, temperatures at the valve in DHW systems are not necessarily the same as at outlets, with no evidence of these lower temperature scenarios increasing legionella risks for consumers using these systems.

While identifying some of the gaps in knowledge that need to be addressed at a system level, the group also acknowledged the wider infrastructure issues that also need to be considered for lower-carbon DHW solutions in any revised guidance or requirements. These include the massive load impact on the electricity Grid of heat pumps installed in homes and instantaneous DHW systems, and the type of pipework required in heat pump/heating network systems for maximising efficiency. 'These additional considerations are precisely why we are keen to look at all options, not just instantaneous DHW,' said Godefroy.

Conclusion

The working group agreed to develop key points brought up in the discussion to feed into CIBSE's responses to the Part L and Future Homes Standard consultations.

It is also aiming to develop a position paper on reducing instantaneous DHW temperature to 50°C at the heat exchanger with a view to changing guidance.

Such a change will bring carbon and operational cost savings, as well as reduce heat losses and scalding risk. The group believes that, using a risk-based approach, there is scope to go further, and even look at removing the need for thermostatic mixing valves altogether. **CJ**

FUEL FOR THOUGHT

Worcester Bosch and Baxi Heating have revealed plans for hydrogen gas boilers. **Phil Lattimore** looks at the technology, while Worcester Bosch's **Martyn Bridges** explains where he thinks hydrogen can replace natural gas

With heating accounting for around half of UK energy consumption and around a third of greenhouse gas (GHG) emissions, removing carbon from heating and hot-water supply has become a key issue if the UK is to meet its 2050 zero carbon targets.

One solution that's gaining traction is replacing natural gas with hydrogen, converting the UK's existing gas infrastructure to be used with this low carbon alternative. Several trials are under way for domestic and commercial hydrogen solutions that could use existing pipework, some of which have been covered previously in *CIBSE Journal* (see 'In the pipeline', October 2019).

As the UK government considers its decarbonisation plans for heat and hot-water generation, Worcester Bosch has announced the country's first boiler system capable of running on 100% hydrogen, while Baxi Heating has said it will launch live trials of hydrogen boilers in the UK this year.

As well as burning hydrogen – the only by product of which is water – the prototypes run on natural gas. This means they could be deployed now and converted to a hydrogen gas supply if/when this becomes a reality, with no need for an entirely new heating system to be installed.

Commerical rollout

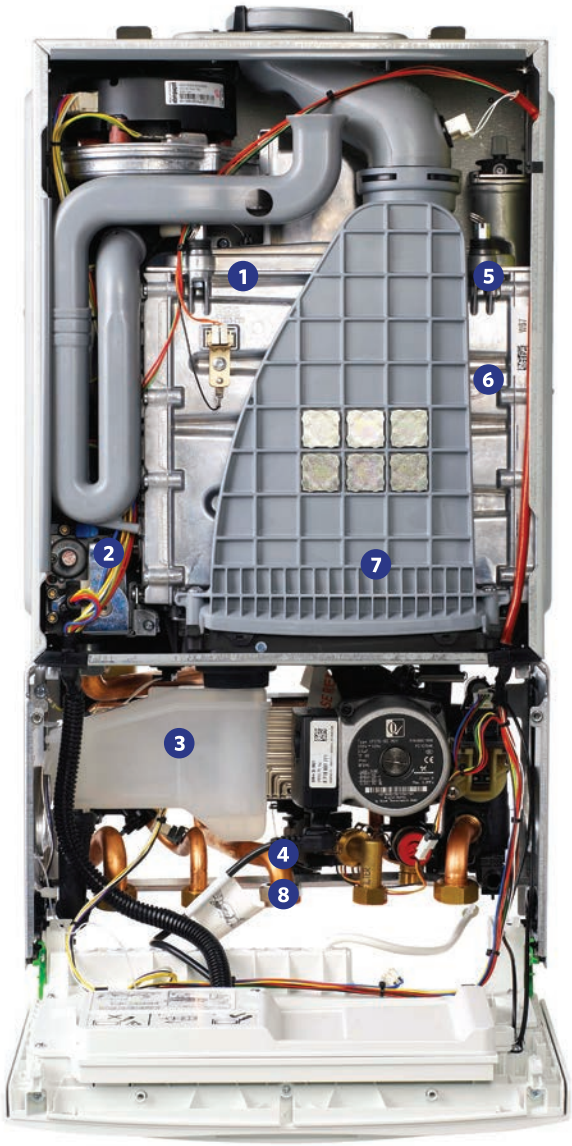
While demonstrating their capability for developing the technology, Worcester Bosch and Baxi Heating concede that a full commercial rollout of 'hydrogen-ready' boilers is still a few years away.

Martyn Bridges, technical director of Worcester Bosch Group, explains that it is supplying two prototype boilers for a showcase event by the Department for Business, Energy and Industrial Strategy (BEIS) in the first quarter of this year. More units will then be produced for a more extensive trial towards the end of 2020.

'To fully commercialise this product, however, we're awaiting a government decision that it is going to press the green button for hydrogen,' Bridges says. 'Once we have that, we could have them commercially available in the volumes we sell now by 2025.'

Jeff House, head of external affairs at Baxi Heating, says his company's hydrogen boilers (like Worcester Bosch's) will be used as part of the Hy4Heat trial programme over the coming months, and further trials are scheduled. 'Once there's a bit of certainty that it is a firm government objective, we can prepare for commercial production,' House says.

Both firms believe a commitment from government to hydrogen as part of a low carbon energy strategy – and to a date from which only 'hydrogen-ready' boilers can be sold – would be the green light for the UK industry and supply chain to ramp up investment in the technology. »



1. **Flashback prevention**
Hydrogen has a higher flame speed than natural gas. One of the key technical advances in hydrogen boilers are burners, which can hold a stable hydrogen flame against its high speed.
2. **Gas-air ratio control**
Hydrogen has very similar energy-flow properties to natural gas, so the new components will be very similar.
3. **Condensate**
Hydrogen produces significantly more condensate than natural gas. This must be considered in heat-cell design.
4. **Materials compatibility**
At the low pressures used in small boilers, most materials currently used for natural gas will be suitable for hydrogen.
5. **Flame detection**
Hydrogen flames are invisible and create no electrical signal, but can be detected by its ultraviolet (UV) emissions.
6. **Conversion**
To minimise the impact of conversion, boilers will be developed to be quickly and easily reconfigured for hydrogen on conversion day.
7. **Performance**
The output, efficiency and emissions of hydrogen appliances will be similar to those of natural gas boilers. The products of combustion are very clean.
8. **Gas-tightness**
Hydrogen has a small molecule size. However, leakage rates are similar to natural gas and there is unlikely to be a need for significant re-engineering.

Worcester Bosch's hydrogen boiler

» The technology

So how different is the technology on a hydrogen-ready boiler, and what does this mean for installation and conversion of the equipment?

A conventional boiler for use on natural gas only can run perfectly well with up to 20% hydrogen in the mix, says Bridges, but some changes in the technology are needed for more than 20% hydrogen. 'The hydraulics, the water system, the pump, the heat exchangers are the same; it's primarily the ignition system and combustion of the hydrogen flame where changes are required,' adds Bridges.

'You can't see the flame. There's no carbon in it either and the current way we sense that it is alight is with a flame-rectification circuit. A small electrical charge is sent between two probes immersed within the flame. If there's no carbon present, there will be no electron flow through it. So we have to use a UV cell to detect that the flame is alight.'

Other characteristics of hydrogen gas require some alterations, too. Hydrogen has a higher flame speed than natural gas, so a different burner is required. One of the key technical advances in hydrogen boilers are burners that can hold a stable hydrogen flame against its high speed.

Converting hydrogen-ready boilers from natural gas to hydrogen is designed to be simple. 'When hydrogen is turned on, only two or three small component changes will be necessary to make it suitable for 100% hydrogen,' says Bridges. 'We anticipate it will take engineers around an hour to make the conversion.'

Similarly, Baxi's House says he expects that the conversion process will be very similar to a typical, day-to-day replacement of a component in a conventional boiler. 'We can send out an engineer with a conversion pack to convert it quickly,' he adds, and no pipework or other heating system changes will be necessary. 'It' a low-disruption intervention.'

Initially, hydrogen-ready boilers may cost £50-£100 more than conventional natural gas boilers, but Bridges sees this as a relatively small premium for future-proofing a unit that costs several thousand pounds to install. If mandated, however, he doesn't anticipate a consumer rush to buy into the new technology when the boilers start appearing, as they will effectively become the default option when any boiler is normally replaced. CJ

'We can reuse 135,000 miles of gas pipework'

Replacing natural gas with hydrogen will enable the UK to use existing infrastructure, says **Martyn Bridges**

MARTYN BRIDGES
technical director of Worcester Bosch Group

BEIS is expected to publish a technology roadmap this summer, but it is currently considering policy and appraising views. We hope it will mandate a 'hydrogen ready' policy for future boiler sales from, say, 2025. This would offer future-proofing but, at the same time, the technology will be compatible with the existing gas supply, even if hydrogen is delayed or doesn't happen.

However, even if the government mandates 'hydrogen-ready only' boilers, converting the UK gas network from natural gas to fully hydrogen is unlikely to happen until the mid-2030s at the earliest – although injecting up to 20% hydrogen blend into the existing gas network before that, to lower carbon, is possible as an intermediate measure that will work with existing conventional natural gas boilers.

Nonetheless, it as an opportunity to use existing infrastructure as part of the UK's decarbonisation strategy. While a great deal of work will still be necessary for the introduction of hydrogen, a lot of the infrastructure is already in place. The UK has an estimated 135,000 miles of gas pipework under ground, much of which is being upgraded to polythene pipes. When completed, it will be a perfect medium for transporting hydrogen. We can use this network infrastructure – which has a public asset value of £40bn – and repurpose it for hydrogen relatively easily.

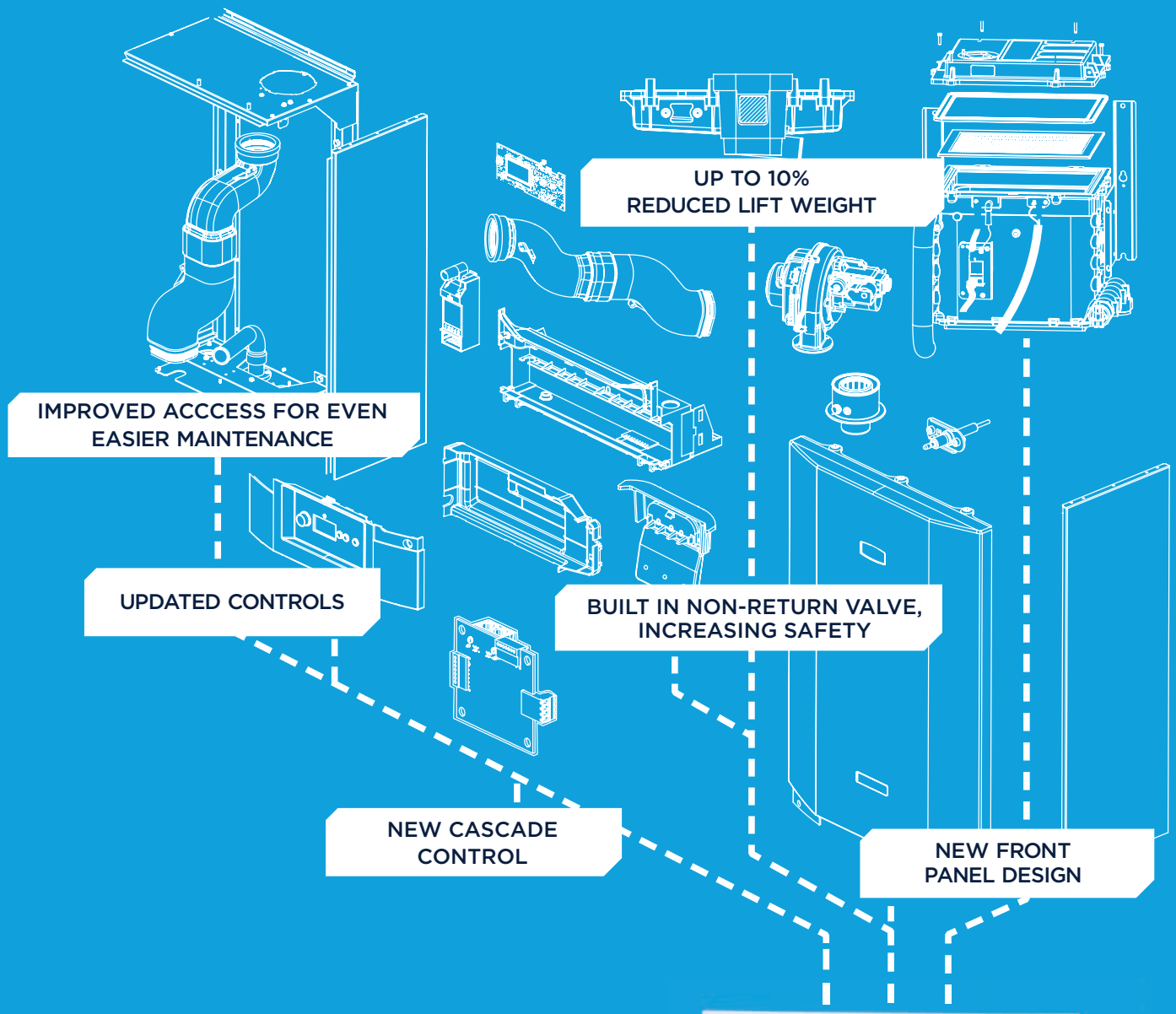
Also, with around 1.7 million boilers sold in the UK each year, if 'hydrogen-ready only' boilers were mandated from 2025, the natural replacement of boilers over the expected 10-year implementation period before the switchover takes place will result in the vast majority of homes having hydrogen-ready boilers in place. It will just require a simple conversion process by an engineer.

Why hydrogen rather than heat pumps? There are a number of benefits of hydrogen over heat pumps, particularly in existing homes. The main one is that there is no disruption – you won't have to change the radiators or the pipework in an existing heating system. Also, there is the issue of space. There are currently around 17 million homes in the UK with a combi-boiler installed, and which don't have a hot-water storage cylinder installed. With a heat pump, you have to have one, and for many homes – particularly small properties, such as apartments and terraced houses – it will be a challenge to find the space.

There is also the issue of the extra demand that heat pumps in every premises would make on the grid. It has been estimated that to make the country's heating and hot water carbon free with hydrogen would cost around £140bn, compared with around £400bn for electricity.

These are tough decisions, but hydrogen appears to be the most cost-effective and least disruptive option – and we have the skills to implement it, with only a short training course needed for gas engineers to transition to hydrogen.

We are hoping that the government will make a decision on hydrogen – one way or the other – and inform the industry towards the end of the year. As soon as it presses the green button, it would allow us to invest in the necessary upscaling of our production facilities – but we won't do it speculatively. We could deliver at volume in 2025 and would like 'hydrogen-ready' to be available across the range.



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TESTING THE WATER

The eChiller is a novel solution that uses water as a refrigerant. Green Thermal Energy's **Garry Broadbent** explains how it works and why it's suitable for applications requiring chilled water flow temperatures of 16°C and above

A chiller that uses water as its refrigerant has been launched in the UK, after being deployed for a series of applications in Germany. Organisations such as Siemens and BT have been early adopters of the natural refrigerant-based eChiller, which was introduced at the end of 2014 by German manufacturer Efficient Energy.

The global phase-out of F-Gases means manufacturers have been developing refrigerants – such as ammonia, carbon dioxide and water – that have less of an environmental impact.

According to Efficient Energy, the eChiller is ideal for applications that require chilled water flow temperatures of 16°C and above, such as cooling via chilled beams or cooling for IT equipment rooms. In the UK, the technology is being supported by natural refrigerant specialist Green Thermal Energy.

Operation

The main components of the water chiller are similar to those of chillers that work on the principles of evaporation, compression and condensation. Important differences are that the 'refrigerant' used is water – designated R718 – and the chiller functions with a very low operating pressure within the refrigeration system.

As a result of the low operating pressure, refrigeration equipment safety standard EN378 certification is not required – and, because there is no risk of F-Gas refrigerant leaks, no leak-detection equipment or F-Gas monitoring procedure is necessary.

Water enters the evaporator, where around 1% of it evaporates, drawing energy from the remaining water and cooling it down. The pressure inside the evaporator is around 18 mbar (0.26psi). This near-total vacuum is created by the rotating impeller in the unit's centrifugal compressor.

The pressure in the compressor is then increased to 136mb (1.97psi) and the temperature rises from 16°C to 52°C. The water vapour is cooled, condensed and fed back into the evaporator through the expansion device, to complete the refrigeration cycle.

As shown in Figure 1, this chiller has two cooling modules and two heat exchangers. All units are also connected to a matched dry cooler, usually placed on the roof of the building. This dry cooler can be an adiabatic cooler or a standard dry cooler, delivered as part of the chiller package. Alternatively, the dry-cooler function could be a centralised condenser loop already installed within a potential application, such as a cooling tower circuit or similar.

The dry cooler, or condenser circuit, also enables the chiller to operate in 100% free-cooling mode. The benefits of free cooling take place at a much earlier point than would be the case with standard free-cooling chillers.

At high ambient temperatures – for example, 35°C – this new chiller operates in mechanical mode, with two compressors »

The standard new technology chiller has two cooling modules and two heat exchangers

Above: High cooling-density server enclosure

Left: New technology chiller and integration/buffer tank system

Below: Drawing of the internal configuration of the cooling unit

» operating fully. At these temperatures, it has an energy efficiency ratio (EER) of 3.4.

When the ambient temperature drops, the second compressor modulates, increasing the efficiency. For example, at an ambient temperature of 21°C the EER increases to 7.4.

When the ambient temperature drops to a level where the cooling water from the dry cooler is at least 2K colder than the return water from the chilled water/cooling circuit, the first stage also switches off. This allows the system to direct the water solely through the chiller without mechanical cooling, achieving 'free cooling', which delivers an EER of more than 20.

Actual efficiency is subject to the cooling load profile of each individual project. However, this mix of mechanical and free cooling results in a system delivering a very high seasonal EER (SEER) in excess of 11 (in representative northern German climatic conditions).

BT case study

An installation has been operating since 2017 at a BT location in Hamburg. At its data centres, BT offers room-in-room 'cube' solutions for high-density server racks, which place gruelling demands on the technical infrastructure because of the concentrated power density.

These 'cubes' can be scaled modularly, each in a power range of 40kW to a maximum 100kW IT load. Uniformly water-cooled, in-row chiller units with hot-aisle housing are used for cooling. With temperatures of 22-25°C required on the intake side of the racks (cold aisle), large temperature differences arise between the supply and discharge air at a simultaneously high temperature level.

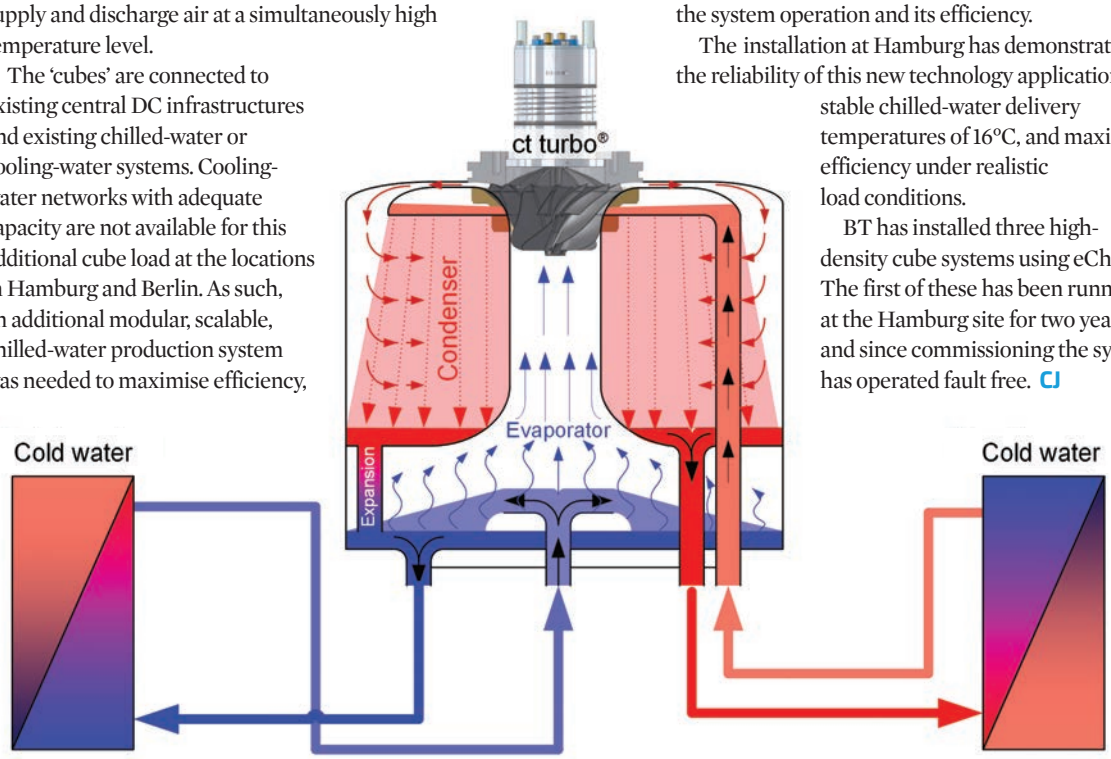
The 'cubes' are connected to existing central DC infrastructures and existing chilled-water or cooling-water systems. Cooling-water networks with adequate capacity are not available for this additional cube load at the locations in Hamburg and Berlin. As such, an additional modular, scalable, chilled-water production system was needed to maximise efficiency, provide fail-safe redundancy and support relatively high system temperatures – the optimal area of application for the new technology chiller.

Three chillers per cube feed a buffer tank with chilled water. An energy-management system controls the number of chillers, which should operate in parallel, depending on the load. This ensures evenly distributed operating times and high operational reliability.

The systems are connected to a building-control system for monitoring relevant operating and performance data, while the manufacturer can actively analyse the installation's process parameters at all times and avoid malfunctions via an installed remote-maintenance interface. In addition to enabling maintenance intervention, the storage of recorded data allows straightforward evaluation of the system operation and its efficiency.

The installation at Hamburg has demonstrated the reliability of this new technology application, stable chilled-water delivery temperatures of 16°C, and maximum efficiency under realistic load conditions.

BT has installed three high-density cube systems using eChillers. The first of these has been running at the Hamburg site for two years, and since commissioning the system has operated fault free. CJ



GARRY BROADBENT is director at Green Thermal Energy

MITSUBISHI ELECTRIC

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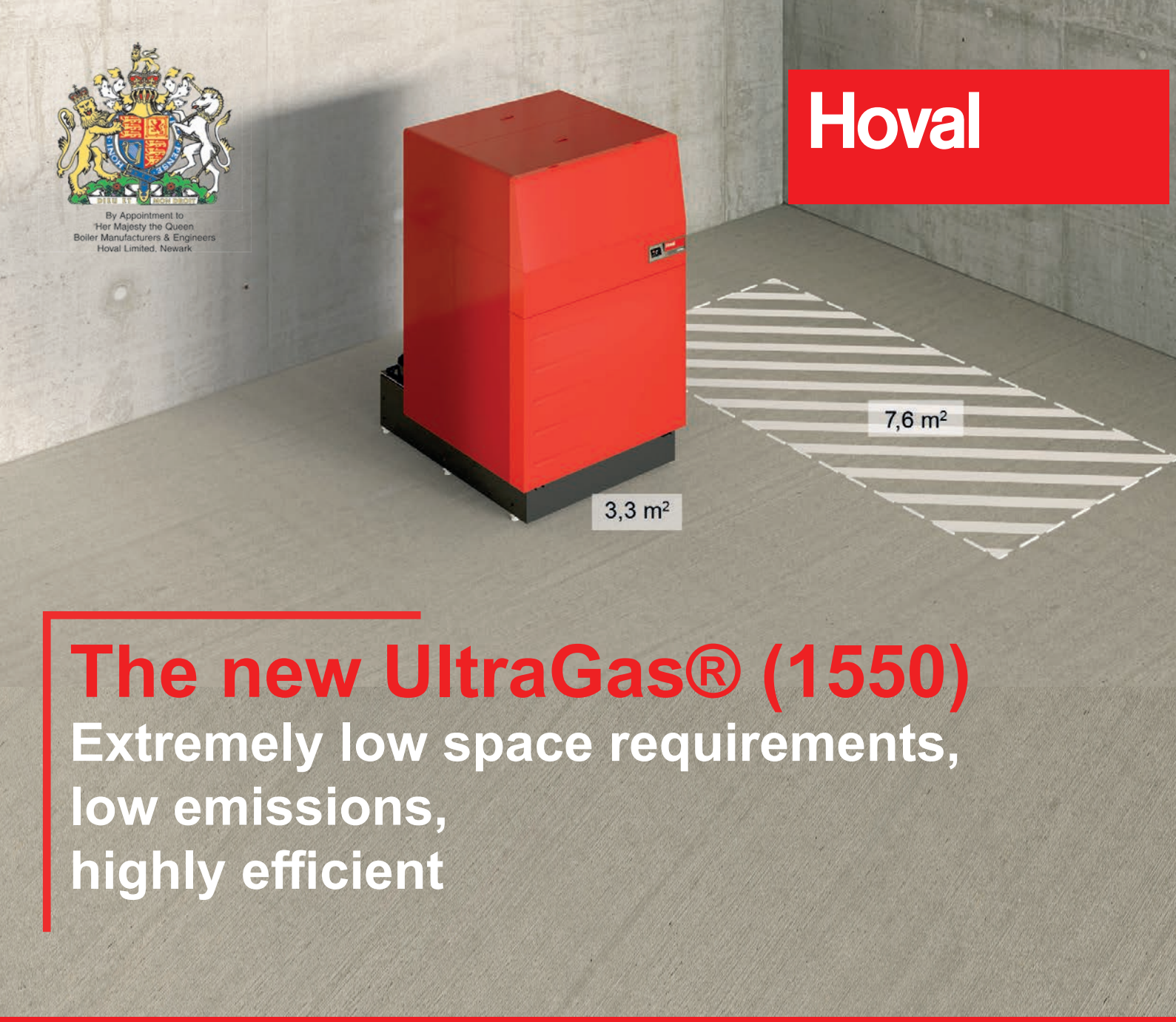

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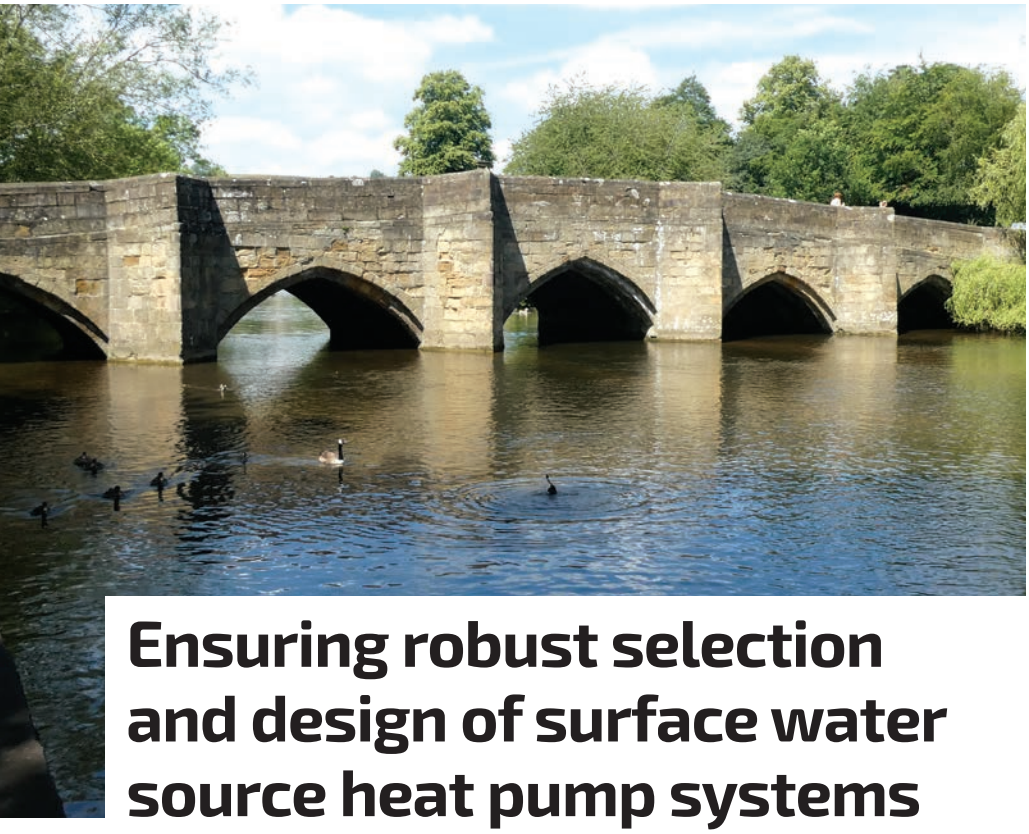

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Modules are also available at **www.cibsejournal.com/cpd**

Ensuring robust selection and design of surface water source heat pump systems

This module explores the main considerations necessary to select and design effective surface water-source heat pump solutions

Heat pumps can provide an efficient and low carbon means of using renewable heat from the sea and from rivers, canals and lakes. Although likely to be more expensive to install than conventional technology, they can deliver a cost-effective return on investment, with significant potential benefits from moving to a more renewable solution. There are currently very few UK installations of large-scale surface water source heat pump (SWSHP) systems despite available grants and incentives (that includes the Renewable Heat Incentive (RHI) – see panel below).

There is significant national and international legislation aimed at decarbonising the UK heat supply, and planning regulations often require new developments to include a proportion of renewable technology in order to reduce carbon emissions. An initiative by CIBSE, the Heat Pump Association and the Ground Source Heat Pump Association created CP2, the code of practice for surface water source heat pumps to provide a framework guiding the proper deployment of SWSHPs. This was aimed at increasing the opportunity of good quality applications of this well-proven technology to help meet the heat demand with reduced environmental impact. A measure of the potential for the deployment of surface water source heat pumps was detailed in research undertaken by Atkins[1] (originally as part of the now-decommissioned UK National Heat Map project). This estimated the total heat accessible capacity from rivers alone at approximately 6GW in England, as illustrated in Figure 2, which equates to direct electrical heating by the equivalent of six Hinkley B nuclear power stations.

The water source heat map document not only analyses the potential of water heat sources in England (as in the example map shown in Figure 3), but also includes an extensive commentary on the methodology to assess the feasibility of water sources.

As part of *Monitoring of Non-Domestic Renewable Heat Incentive Ground-Source & Water-Source Heat Pumps*,[3] produced for the UK government, the performance of several non-domestic water source heat pumps was monitored over at least one heating season. Since it was for a limited period and for relatively few installations (that were chosen from those registered for the non-domestic RHI[4]), the authors of the report are clear that the observed performance of this sample should not be taken as representative of the whole marketplace. However, their work identified aspects that impact all installations, a few of which are described here.

As with the application of any heat pump (such as the 42kWth unit shown in Figure 4), the report notes that the main influence on heat pump performance is the difference between the temperature of the cold source as input to the heat pump and the »

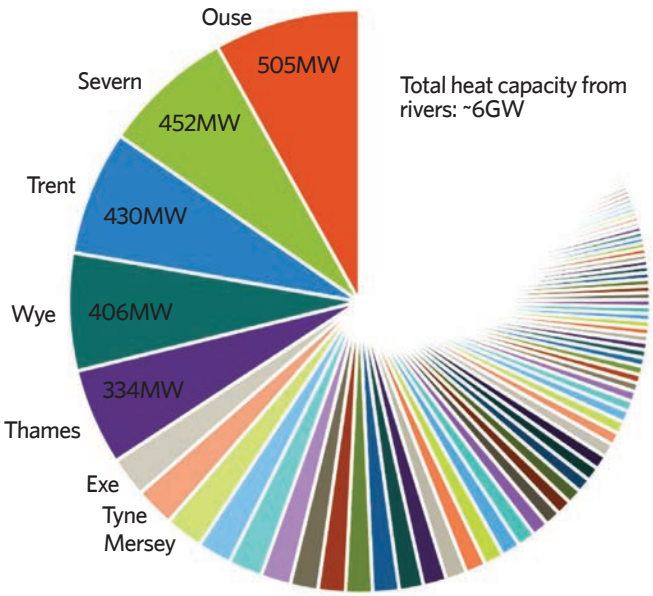
ENSURING RENEWABLE HEAT INCENTIVE BENEFIT

There are a number of requirements[2] for an installation to benefit from the Renewable Heat Incentive (RHI) for electrically driven water source heat pumps. These include that the heat pump should have a coefficient of performance (COP) of at least 2.9 and a design seasonal performance factor (SPF) of at least 2.5 (based on heating and not cooling). For smaller installations (<45kWth), despite not being 'domestic' systems, the installations must have Microgeneration Certification Scheme (MCS) certification or equivalent – this is also required if any of individual heat pumps have a thermal output of less than 45kWth when several heat pumps USE a shared source loop.

» temperature of the hot output – known as the 'temperature lift'. And this proved to be the case in the monitored systems, as those with low temperature lift tended to have higher performance. Two of the systems monitored used source water pumped directly to the heat pump evaporator, with no intermediate heat exchanger, and one of these was the one with the highest performance of all monitored systems. The report does, however, identify the challenges of using direct source water, including fouling and freezing in the evaporator. This report – and particularly the associated case studies – provides an extremely well-illustrated reference to the operational performance of the systems, and has some useful system schematics. It concludes that 'numerous factors influence heat pump performance. There is not one overriding factor that needs to be addressed, but more careful design, installation, commissioning and operation are all required to ensure a high-performance system'.

CP2 *Surface water source heat pumps: code of practice for the UK*[5] aims to raise standards across the supply chain and so stimulate adoption of the technology. It encompasses all stages of the development cycle – from preparation and briefing through to planning for the eventual end-of-life decommissioning of systems. CP2 is written so that it can be included in the tendering/contracting process to specify minimum requirements for a project. It contends that it 'is not necessary to be a technical expert in SWSHP systems to use the code for procurement or contractual purposes as it has been designed to give clients and developers confidence that commonly agreed minimum standards are being followed, and to allow clear communication between different parties in the supply chain'.

Figure 2: Estimated total heat capacity from rivers in England[3]



CP2 covers the process for assessment and development of both open-loop and closed-loop surface water source heat pumps. However, it is not intended to provide technical design detail, but to set minimum requirements for the technical application of SWSHPs. (It also includes a useful technical primer and some relevant case studies.)

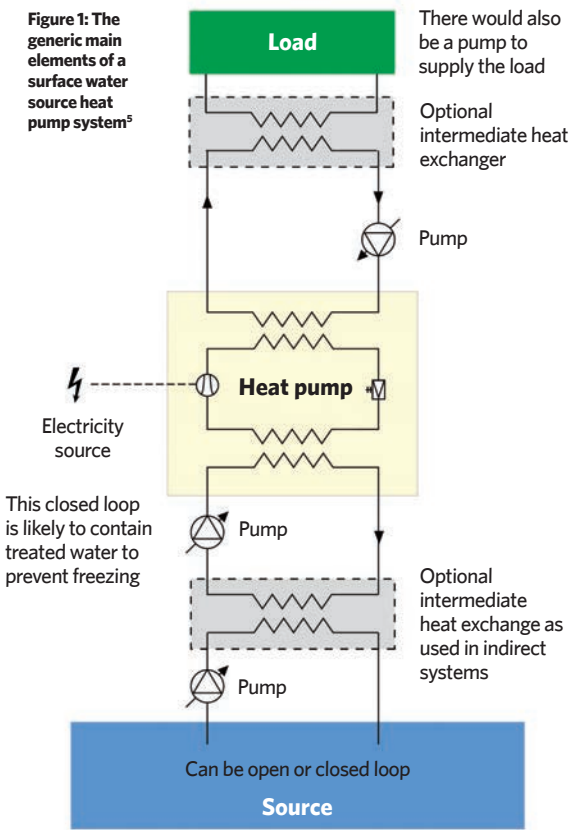
The CP2 framework provides a route to a more integrated design, with key principles properly considered and implemented from the initial brief and feasibility through to operation, ensuring that operational costs are fully accounted for in the design/development stages and that the system is correctly commissioned prior to the operational phase. The overarching aim of the code is to ensure the SWSHP system works effectively, is reliable, cost-effective and does not harm the environment. It emphasises that systems should be specified to have a long life and require little maintenance – in particular, the source side needs careful consideration to ensure filtration systems work with minimum human intervention. There is significant detail in the code, broken into six requirements: preparation and briefing; feasibility; design; construction and installation; commissioning; operation and maintenance; and decommissioning.

At the earliest stages in the project, the owner/developer will need to ensure that the project is likely to comply with relevant legislation and any conditions imposed by other stakeholder organisations – for example, the local planning authority and the relevant environmental agency. The project brief is used to define the steps required to assess the viability, focus project planning activity, assess the marketplace, and identify suitable specialists required to deliver the project. At the feasibility stage, assessments should be made of the environmental impacts and the primary energy demand of a system throughout its life cycle – these will be further developed as the design progresses. The characteristics of the water source will inform the practicality of using a SWSHP, as well as the choice between open- and closed-loop systems.

Accurate estimates of both the peak output requirement and annual heating and cooling demand, together with the consumption profile and desired operating temperatures, are important. For existing non-domestic buildings, the current building operator will need to work with the design team to define the peak heat demand and required temperatures. In new buildings, where modelling will be needed, it will differ significantly from the modelling required to show compliance with local Building Regulations. (CIBSE TM54 *Evaluating operational energy performance of buildings at the design stage*[6] provides a method for making accurate energy assessments.)

The type and number of heat pumps in the system and the associated elements – such as thermal storage, isolating heat exchangers and dry air coolers – need to be

Figure 1: The generic main elements of a surface water source heat pump system[5]



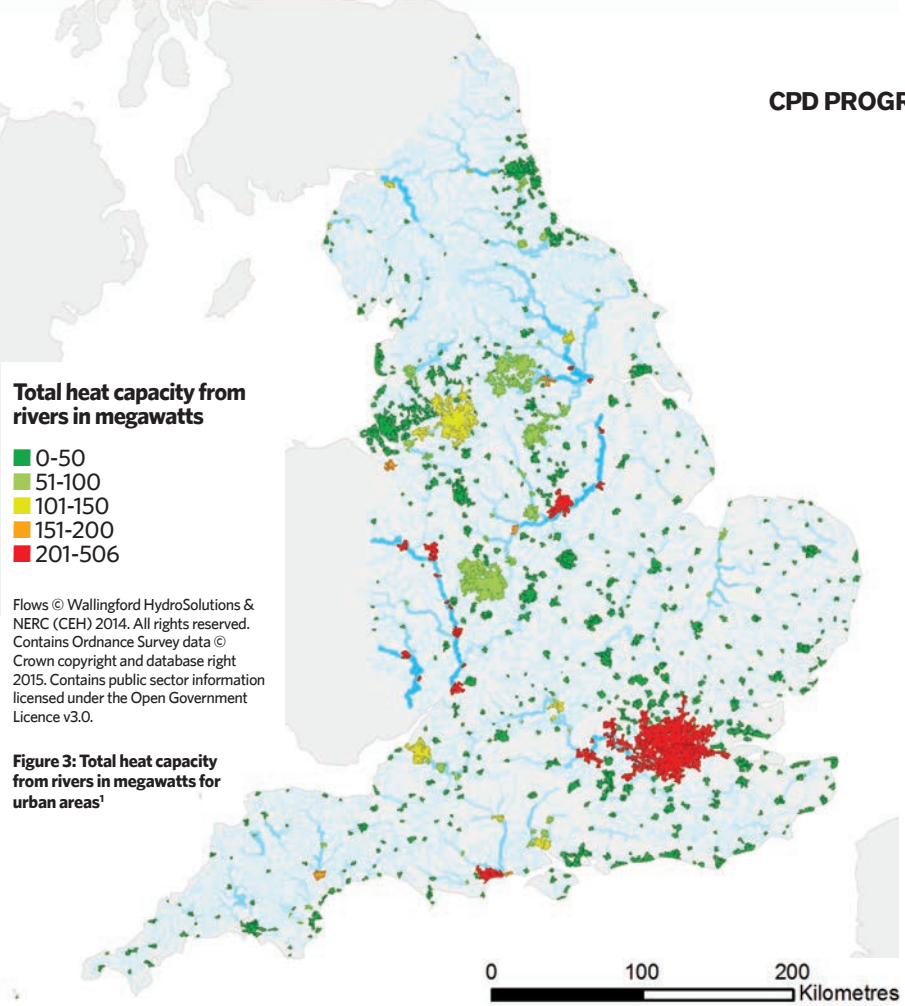


Figure 3: Total heat capacity from rivers in megawatts for urban areas[1]

assessed, as well as the financial and operational advantages of using a multivalent system. The size and selection of components will resolve as the design matures. The location of the heat pump and the positioning and design of abstraction and discharge ports, or submerged closed loop heat exchangers, are critical decisions that will involve accounting for factors such as existing building systems/services, flood risk, access, cost, noise and security considerations.

At the feasibility stage, financial analysis will be required to model the costs and benefits of the various options. Capital cost, operating cost (including income from grants and incentives and from any heat sold), whole life cost (including disposal costs), and internal rate of return on the investment need to be investigated to inform and drive design decisions.

The range of required, and timely, permissions will vary from site to site, and any oversight can cause costly delay and disruption.

A risk register should be developed from the outset, and this should be reviewed and updated throughout the project, with sensitivity analysis applied to quantify the impact of the identified risks.

Financial projections, which benefit from life-cycle cost analysis, are used in conjunction with the risk register to evaluate the effect of uncertainty in a range of appropriate parameters or objectives, and the costs and benefits of mitigating the risk. (CIBSE Guide M[7] provides information for life-cycle analysis of components.)

Having completed a risk assessment, the designer must mitigate these risks by making appropriate design decisions, and assess how the proposed design will be constructed, operated and maintained. The business model should be regularly updated throughout the stages of the project so that, as the design develops, the targets can be checked and adjustments made so that the overall cost of the project is managed within the budget.

Source-side maintenance is particularly important to ensure reliability and provide optimum performance, and the design must take account of the water quality and any other factors that could degrade performance. An important design choice is whether the heating and/or cooling load are directly or indirectly connected to the heat pump through an intermediate heat exchanger, as shown in Figure 1. Indirect connection means that the heat pump and building distribution fluids are kept separate, and this is likely to simplify heat metering. Direct connection is less complex, having fewer components, so potentially lower maintenance is required, and there are fewer potential points of failure – although implications of passing source water directly through the heat pump's heat exchangers need careful consideration. There is no loss of temperature and efficiency between primary and secondary circuits across a heat exchanger, and less plantroom space is needed.

For an efficient system with a low whole-life cost and long life, appropriate standards of insulation should be applied – grants and incentive schemes may have requirements that consider heat loss in pipework. Instrumentation such as flow, temperature and pressure sensors, and associated monitoring hardware and software, is needed to monitor and record the performance of the installation for display, diagnostic and reporting purposes.

The requirements of CP2 continue beyond the design phase, right through to eventual decommissioning needs. However, as with this article, information may be used selectively for a particular stage or stages – although 'the greatest value will be gained when it is followed for all stages of the project'.

Although CP2 may appear to make the deployment of SWSHP complex, many similar tasks and objectives would be required for other traditional and other renewable heating and cooling technologies. Following the requirements of this code of practice will ensure that legislative and regulatory requirements have been met, and that the information produced will allow effective oversight of the project. But, above all, the resulting system has the best chance of providing users increased financial benefit while exploiting renewable energy sources with properly considered environmental impact.

With thanks to the many contributors who created the source material for much of this article – CP2 Code of Practice for the UK *Harnessing energy from the sea, rivers, canals and lakes*.

Turn to page 64 Further reading and references.

Figure 4: Example 42kWth heat pump, COP of 4.9 (0°C source/35°C load), as used for indirect surface water source applications, such as closed loop systems providing heat for underfloor heating (Source: Hoval)

Module 158

February 2020

1. What is the minimum SPF to meet the requirements for the RHI?

- ☐ A 2.3
- ☐ B 2.5
- ☐ C 2.7
- ☐ D 2.9
- ☐ E 3.1

2. How much heat is estimated as being available from the River Wye?

- ☐ A 334MW
- ☐ B 406MW
- ☐ C 430MW
- ☐ D 452MW
- ☐ E 505MW

3. What is the potential thermal output of the heat pump illustrated in Figure 4?

- ☐ A 22kW
- ☐ B 32kW
- ☐ C 42kW
- ☐ D 52kW
- ☐ E 62kW

4. Which CIBSE publication provides specific guidance on life-cycle heat pump technology?

- ☐ A AM14
- ☐ B Commissioning code B
- ☐ C Guide M
- ☐ D KS11
- ☐ E TM51

5. Which of these areas is identified in the article as not being covered in CP2?

- ☐ A Commissioning
- ☐ B Construction and installation
- ☐ C Preparation and briefing
- ☐ D Technical design detail
- ☐ E Feasibility

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Further reading:

This article draws on the text of the CP2. However, there is much greater detail, and range of information in the original document.

CIBSE TM51 *Ground source heat pumps* provides detailed information on the associated heat pump technology and its life-cycle assessment.

The Heat Pump Association recently published *Delivering Net Zero: A roadmap for the role of heat pumps* that highlights policies that the industry regard as needed to support increased deployment of heat pumps in the UK – see **www.heatpumps.org.uk/resources/**

The Ground Source Heat Pump Association's website has a wealth of technical information – see **www.gshp.org.uk/**

References:

1 *National Heat Map: Water source heat map layer* DECC, 2015 – **bit.ly/2SRruLf** – accessed 31 December 2019.
2 *Non-Domestic Renewable Heat Incentive: Guidance Volume 1: Eligibility and how to apply*, **bit.ly/CJFeb20Ofgem** – accessed 31 December 2019.
3 Hughes, D, *The Monitoring of Non-Domestic Renewable Heat Incentive Ground-Source & Water-Source Heat Pumps Final Report Prepared by GRAHAM Energy Management*, BEIS February 2018 – **bit.ly/2ZT2yEF** – accessed 31 December 2019.
4 **www.ofgem.gov.uk/environmental-programmes/non-domestic-rhi** – accessed 31 December 2019.
5 CP2: *Surface water source heat pumps: Code of Practice for the UK. Harnessing energy from the sea, rivers, canals and lakes*, CIBSE, HPA, GSHPA 2016.
6 TM54 *Evaluating operational energy performance of buildings at the design stage'* CIBSE 2013.
7 CIBSE Guide M: *Maintenance Engineering & Management*, CIBSE 2014.

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PRODUCTS & SERVICES

Dunham-Bush provides 21st-century warmth for medieval tower

God's House Tower, a late 13th-century gatehouse in Southampton, has had its heating systems modernised with the installation of a diverse selection of Dunham-Bush heat emitters. These include fan convectors, hydro-course trench heating, and radiant panels, to meet the varying installation requirements of this ancient monument.

The work was part of a £3.1m refurbishment of the building, which has reopened as an arts and heritage centre that houses an exhibition on its 700-year old history.

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

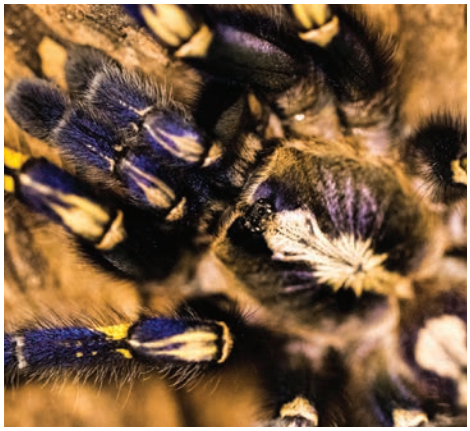
Rinnai celebrates its first 100 years of manufacturing products to serve its customers

Rinnai, best known in the UK for its comprehensive range of hot water and heating home units, is globally celebrating its first 100 years of manufacture in serving its customers. A three-year period of planned anniversary-related events is planned to connect to the start of the company's next century.

The Rinnai Corporation was founded in Nagoya, Japan, and today operates in 17 nations and regions around the world with sales of kitchen appliances, air conditioners, hot water heating and home heating units in more than 80 countries.

Visit rinnaiuk.com

Humidifier helps keep spiders healthy at London Zoo



A Condair CP3 Mini steam humidifier has been installed in the 'spider nursery' at London Zoo. The compact, wall-mounted humidifier supplies up to 4kg of steam per hour to the atmosphere, to maintain humidity at 70% RH, which the spiders would enjoy in their indigenous habitats.

The Condair CP3 Mini is ideal for small areas because of its built-in fan unit and user-friendly design. Unlike most other humidifiers, it has a discrete fan incorporated into the top of its cabinet to disperse the steam into a room.

Visit www.condair.co.uk

Teach yourself a lesson with the Grundfos Ecademy

Finding the time to undertake training can be difficult. That is why many more industry professionals are turning to the Grundfos Ecademy.

It offers modules designed to help you gain a deeper insight into a range of pump facts, whether you focus on large or small projects; are involved with supplying or specifying pumps within a domestic setup or larger commercial buildings; operate mainly within industrial applications; or specialise in water utilities.

The Grundfos Ecademy has been steadily extending its reach in recent years, with a wide range of new topics available to you, 24/7, from a smartphone, tablet or computer.

The Ecademy is committed to delivering on its promise to incorporate a diverse range of themes. This means the subjects cover many different applications and various pump product families, and it looks at the theory behind the engineering.

Visit www.grundfos.co.uk/ecademy

Waterloo brings a breath of fresh air to Studley Castle

Waterloo Air Products' grilles, air valves and diffusers have been used in the recently renovated Studley Castle Hotel, in Warwickshire.

Optimum air quality was an essential requirement, and Waterloo's solution was a series of bespoke grilles that met the aesthetic requirements of each room while operating to the highest standard for maximum comfort levels.

To enable easier maintenance of the air conditioning, Waterloo provided dual-purpose, combined air and access grilles. These are springloaded, so can be pulled down without the need for tools.

Visit www.waterloo.co.uk

Taking it to the roof: Elco boilers specified for London's newest landmark building

A striking new 40-storey office tower has risen from 100 Bishopsgate in London, and at the heart of the 900,000ft^2 building lie six Trigon XXL EVO boilers from Elco Heating Solutions.

The commercial boilers – which are housed in a purposely designed rooftop plantroom – each have an output of 1.7MW and provide efficient heating and hot water to all 36 office floors. Their location also lends itself well to the boilers' lightweight modular construction and low water content.

Call 01268 546700 or visit www.elco.co.uk

Swegon takes command of smoke control

Indoor climate and smoke/fire control specialist Swegon has launched a new range of smoke-control dampers. The Actionair SmokeCommand range has been introduced in response to growing demand for improvements in fire and smoke safety strategies throughout UK buildings.

Actionair SmokeCommand dampers are designed to operate with Swegon's Actionpac purpose-designed control system, to improve long-term performance and reliability while ensuring ongoing maintenance is easier, more cost-effective and less disruptive. Building owners can view the status of the dampers at any time, and receive regular notifications, reports and testing updates.

The dampers are classified to product standard EN13501-4 and tested to EN 1366-10. These slim, lightweight, metal, multi-bladed products are designed for duct installation using a rectangular flange or spigot. They use a two-position actuator for drive open and drive close operation.

SmokeCommand dampers can be interfaced with the building's fire alarm system via the Actionpac damper control panel for automatic activation to clear smoke from the affected area.

Visit www.swegon.com/UK

Top cats for high-duty areas

Based on the successful Lynx fan coil unit, the Super Lynx has been designed to serve high-duty areas.

With outputs up to 15kW, the new series of horizontal, waterside control chassis fan coil units has been developed to meet the demands of the high-end commercial market sectors, where high-quality components and proven reliability are essential.

They join the Lynx range, an established part of Dunham-Bush's fan coil product offering.

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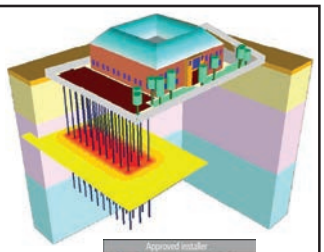

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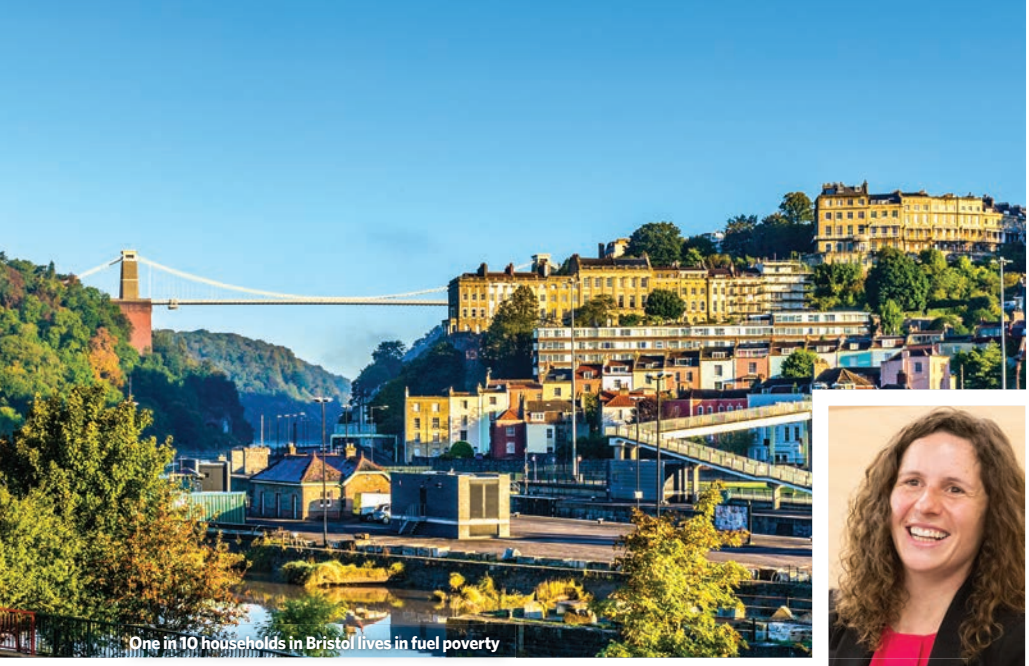
One in 10 households in Bristol lives in fuel poverty


Samantha Nicol

Bristol fashion

Samantha Nicol, head of innovation at Bristol Energy, discusses the council-owned energy company's agenda on sustainability and working with the community

Owned by Bristol City Council, Bristol Energy is a national gas and electricity company that aims to make a positive difference beyond simply offering cheaper energy tariffs. Launched in 2016, it is engaged with its local community in helping to tackle social and environmental challenges such as fuel poverty and climate change, and has put £12m of social value into Bristol as part of its activities. The company is also striving to go wholly green – its fuel mix increased to 79% green in 2018/19 – and has teamed up with local recycling and renewable energy company GENeco to generate biomethane gas from Bristol's sewage system. This green gas currently provides 15% of the company's gas output – enough to power 8,300 homes.

What difference does being owned by a council make?

While we are owned by Bristol City Council, we operate as an independent company. We were set up by the council to be a different kind of energy provider – one that puts people ahead of profits, with a core business objective to help vulnerable residents in the city living in fuel poverty.

Being linked to an innovative and forward-thinking council like Bristol means we can be at the forefront of energy services innovations such as heat networks.

We are looking forward to the City Leap programme coming to fruition as the council forges ahead with its ambition to make Bristol carbon neutral by 2030.

Are you aiming for 100% renewable energy for your customers?

We only offer 100% renewable electricity and carbon offset gas to new customers. We're on a journey to becoming a wholly green energy supplier and these new products are a huge step on that journey, as well as helping Bristol meet its 2030 carbon-neutral target. We have two green tariffs: BE Simply Green and BE Super Green. For the BE Simply Green tariff, we buy Renewable Energy Guarantees of Origin (REGO) certificates that match the electricity customers' use to renewable power that exists on the grid. For the BE Super Green tariff, we source the electricity directly from renewable generators around the country through power purchase agreements (PPAs), so we know exactly where the energy is coming from.

How do you improve the efficiency of people's homes?

Shockingly, one in 10 households in Bristol lives in fuel poverty. On a mission to tackle fuel poverty, we set up our Fuel Good Fund – with every new switch to Bristol Energy quoting 'FuelGood', we donate up to £30 to the fund. Bristol Energy recently donated £25,000 to the Centre for Sustainable Energy's WHAM project, which gives support and advice to those living in cold homes. Our donation helped lift 71 households out of fuel poverty.

This project has brought together multidisciplinary support for vulnerable citizens living in Bristol who are struggling with fuel poverty, whether that's through issues with payment of energy bills, damp mouldy walls or draughty rooms – all of which contribute to poor energy efficiency and higher fuel bills.

Can you be as competitive as other suppliers while delivering social value?

The way we choose to run our business means we can operate and still deliver social value to our city. Since our launch, we have given £12m of social value back, and in 2018/19 it was around £7m [based on the National TOMs (themes, outcomes and measures) framework for measuring social value].

We define social value as the way in which we drive local economic impact via employment and choosing to purchase goods and services from local companies, working with local charities, and protecting the environment.

Does being council-run mean you can reduce bills?

We operate independently from Bristol City Council, so it has no influence over how we set our tariffs or prices. That said, a residential customer can lower their energy bills with an average saving of £232 a year* by switching to Bristol Energy.

Do you have any more plans to tap into Bristol's waste?

Our green gas generators use sewage from one million Bristol people – poo power! This is turned into biomethane, a sustainable, virtually carbon neutral and environmentally friendly substitute for natural gas, by recycling and renewable energy company GENeco. We are also working with Bristol Waste, Bristol Water and Bristol City Council on various ways to use waste sustainably for energy.

*Calculation based on supply of a BE Simply Green tariff in the South West using the latest Ofgem Supply Market Indicator, as of 6 January 2020.

EVENTS

HIGHLIGHTS

Dr Tony Sung will give a presentation at the Yorkshire event on 4 March

Dr Eleanora Brembilla will be guest speaker at the SLL LightBytes in Leeds on 13 February

NATIONAL EVENTS AND CONFERENCES

Building Performance Awards
11 February, London
The awards recognise the people, products and projects that demonstrate engineering excellence in the built environment. Be there on the night to find out who claims the trophies, and celebrate with the best in the industry.
www.cibse.org/bpa

Society of Light and Lighting LightBytes series 2019-2020: People, Space, Time, Place
13 February, Leeds
The series focuses on light and wellness, with presentations divided into four overarching sessions: People, Space, Time, Place. This year's expert speakers will be joined by guest speaker Dr Eleanora Brembilla, research associate in advanced building daylight modelling at Loughborough University.
www.cibse.org/sll

CIBSE TRAINING

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

Fire safety building regulations: Part B
6 February, London

Emergency lighting to comply with fire-safety requirements
7 February, London

LCC design training
11-12 February, Manchester

Electrical services explained
10-12 February, London

Mechanical services explained
11-13 February, Birmingham

Designing water efficient hot and cold supplies
12 February, London

Fire safety in purpose-built blocks of flats
14 February, London

Running projects effectively
27 February, London

Fire detection and alarm systems for buildings – BS 5839 Part 1
27 February, London

Energy Savings Opportunity Scheme (ESOS)
28 February, London

CIBSE GROUPS, SOCIETIES AND REGIONS

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

Lifts Group AGM
4 February, London
AGM and evening meeting.

2020 T&D Forum
5 February, London
The Training and Development (T&D) Forum offers information and useful tips on running CIBSE-approved T&D schemes.

West Midlands: design of an accessible and inclusive built environment
5 February, Birmingham
BS8300 – Code of Practice review CPD seminar with Phil Pearson, of Pearson Consult.

SLL Lighting Guide 14 – Control of electric lighting
6 February, Brighton
Sophie Parry presents a tour of LG14, giving an overview of the approach for a successful lighting installation from initial consultation to handover.

North East – annual dinner
7 February, Newcastle upon Tyne
Annual dinner, with James Bond theme. The charity partner for this event is The Graham Wylie Foundation.

HCNW membership briefing
10 February, London
Session focusing on the routes to CIBSE Associate and Member grades and registration with the Engineering Council at Incorporated and Chartered Engineer levels.

SLL and Scotland: technical seminar on the SLL *Lighting Handbook*
11 February, Edinburgh
Seminar addressing the fundamentals of lighting, lighting technology and lighting applications.

North East: district heating and trigeneration
11 February, Newcastle upon Tyne
Technical presentation and networking event.

West Midlands: heat metering selection – getting it right
12 February, Birmingham
CPD seminar with Russell Hillman, of DMS.

Energy Performance Group: Power hour – getting Bristol off the gas grid
18 February, Bristol
Bristol City Council has set an ambitious goal of making the city carbon neutral by 2030. Four experts discuss how this might be achieved, followed by an open discussion.

UAE dinner and awards
19 February, Dubai
Dinner and awards celebrating achievements in the industry. Hosted by Richard Dean.

South West: the great debate – how can we ensure our urban centres thrive?
20 February, Plymouth
The debate brings together built environment professionals to hear, discuss and question a panel of experts, and to offer insight to agencies tasked with leading sustainability and growth.

East Midlands: membership briefing
25 February, Kegworth
Session focusing on the routes to CIBSE Associate and Member grades and registration with the Engineering Council at Incorporated and Chartered Engineer levels.

New Zealand: AGM
26 February, Auckland
The event will be a good opportunity to get involved in the running of your local chapter.

South West: creating a global data standard – can it be done?
26 February, Bristol
Event looking at the creation of a 'single digital language' across the building services industry.

West Midlands: driving decarbonisation using digital twins
26 February, Birmingham
CPD presentation by Eric Roberts of IES.

Christchurch and New Zealand GBC – a roadmap to zero carbon
27 February, Christchurch
An opportunity to gain knowledge around building performance optimisation using the Green Building Council's Zero Carbon Roadmap and NABERNZ performance tools.

SLL and North West: LG19 *Lighting for extreme conditions*
27 February, Manchester
With speaker David Holmes, lead author of LG19.

ANZ: AGM
28 February, Christchurch
All members are invited, with votes taken on the proposed nominations for the committee.

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

Futurebuild

3-5 March, ExCel London

CIBSE will be taking part in various sessions and exhibiting at Futurebuild, Excel London, from 3-5 March. The event will focus on exploring and tackling the biggest challenges affecting the built environment, and offers more than 200 hours of structured learning. Visit our stand in the Energy section for membership advice and information on our latest services – and don't miss our session on 'Defining and maintaining quality with heat pump technology' on the Energy Keynote stage. Register for your free place at **futurebuild.co.uk**

Futurebuild offers hours of learning

Technical Symposium 2020

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cibse.org/symposium

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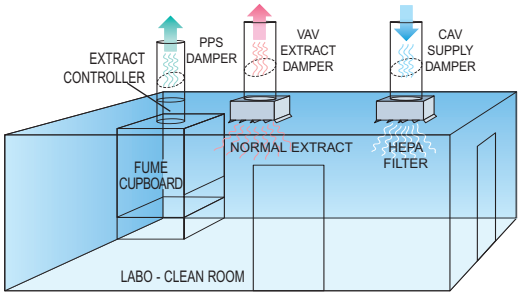

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Tel: +44 (0)1268 287222
Fax: +44 (0)1268 287099
E-mail: sales@cmr.co.uk

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