CIBSE JOURNAL

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September 2021 www.cibsejournal.com

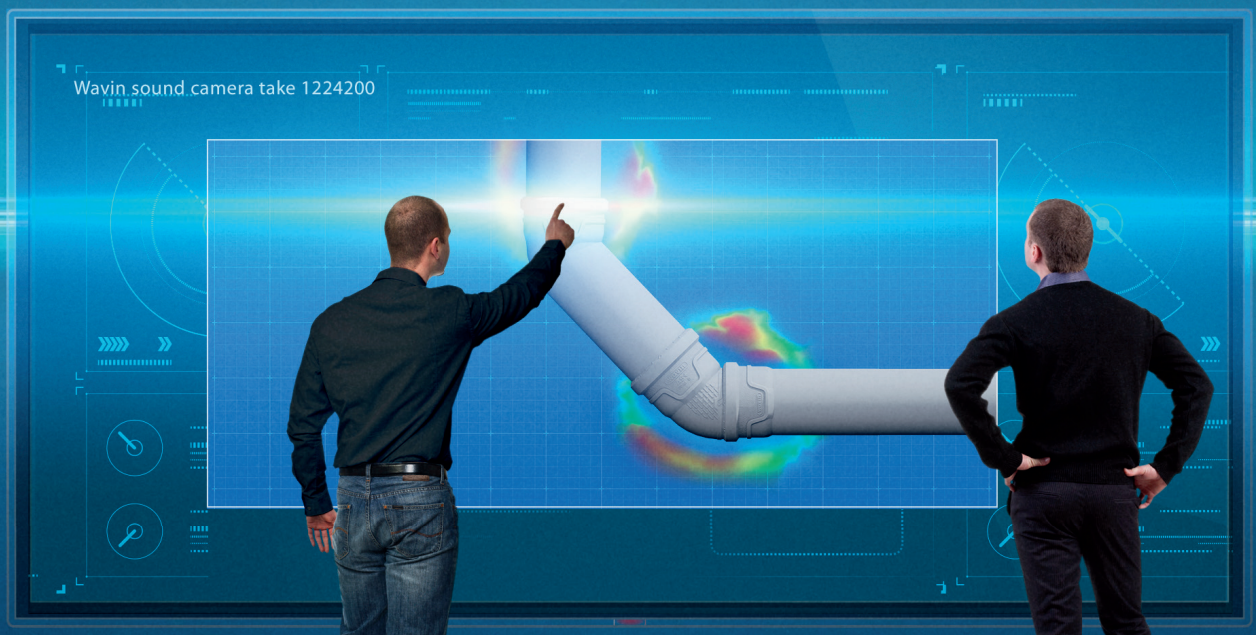
EFFECTIVE VENTILATION IN POST-COVID BUILDINGS

CIBSE GUIDE TO AIR CLEANING TECHNOLOGIES

NET ZERO MODULAR HOMES AT NO EXTRA COST

THE MINDFUL ENGINEER

CIBSE's Engineer of the Year on using engineering knowledge to help communities decarbonise



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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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www.cpl.co.uk
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
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Tel: +44 (0) 20 7880 6215
Advertising production Jane Easterman
jane.easterman@redactive.co.uk
Tel: +44 (0) 20 7880 6248

Clearing the air

Advising clients on mitigating the risks of Covid-19 in buildings has been the biggest engineering challenge of the last 18 months. Where there is no opportunity to bring in outdoor air to dilute any potential virus, engineers have to consider other methods of reducing transmission risk, which can include air cleaning technologies.

One issue with air cleaners is that many depend on chemical reactions to work, which can lead to the generation of pollutants including ozone and volatile organic compounds. The science is complex: there are many variables that need to be considered to ascertain their removal efficacy, including density of occupancy, the volume of space, availability of outdoor air and location of device.

As Covid-19 is a new disease there is also little evidence as to how effective devices are at removing the virus.

CIBSE has now published *Covid-19: Air cleaning technologies* as part of its *Emerging from lockdown* series. Written by Ed Wealend, Chris Iddon and Dzhordzhio Nadzhiev, the guide aims to give designers confidence when specifying air cleaning technologies, so they understand the risks and the long-term maintenance requirements of any device.

The guide includes flowcharts of questions for specifiers and non-specialists to ask potential suppliers, and also considers the consequences for energy consumption and how it can be minimised.

The guide reminds engineers that increased ventilation should be used wherever possible, and on page 62 of this issue of *CIBSE Journal*, Tom Lipinski summarises his Technical Symposium paper that looked at the most effective form of ventilation for removing viruses, according to scientific research. The conclusion was that displacement ventilation was the most effective at reducing the exposure risk.

With high levels of infection still prevalent in the UK and the rest of the world, there is still plenty of uncertainty about the extent to which people will be working from the office in future. CIBSE's Engineer of the Year, Sasha Krstanovic, founded her company mstep in August last year, and all her three full-time co-employees work from home (page 24). She says Covid-19 has accelerated a pre-existing trend for more flexible working, which is of particular benefit for women and families.

She believes companies should support whatever lifestyle employees choose to get the best out of them – and this is no longer a niche view. At her previous company, engineering giant Aecom, an initiative called Freedom to Grow gave 70,000 staff the opportunity to work from wherever they choose.

ALEX SMITH, EDITOR asmith@cibsejournal.com

CONTRIBUTORS

Hywel Davies
An up-to-date guide to Building Regulations and the standards and legislation that support them

Bill Watts
Max Fordham engineer looks at the reality of decarbonising heat and the potential role of hydrogen

Julie Godefroy
The actions CIBSE is taking to tackle climate change in light of the IPCC's latest daunting report

Tim Dwyer
This month's CPD looks at ensuring efficient air conditioning system operation in buildings

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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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LONDON APPROVES EUROPE'S LARGEST PASSIVHAUS PROJECT

Planners have given the green light for a three-tower student accommodation complex in London's Canary Wharf, which its developers claim will be the largest Passivhaus development in Europe.

The complex, providing 1,672 student beds and 80 residential apartments, is being designed by architect Apt for provider Urbanest. The Passivhaus consultant is Henrikson Studio. It will be located on an empty site at the edge of Canary Wharf, and the proposals were backed by University College London.

The developer is aiming for Breeam Outstanding and work is expected to start on-site next year.

Rate of climate change accelerating, warns IPCC

Latest IPCC report is a 'reality check' for the global community

The current rate of global climate change is unprecedented in thousands, if not hundreds of thousands, of years according to the latest report from the Intergovernmental Panel on Climate Change (IPCC).

Many of the changes are now irreversible and every region is already experiencing the impact of the changes, but strong and sustained reductions in emissions of carbon dioxide (CO_2) and other greenhouse gases could still limit the impact and would also quickly improve air quality.

Climate Change 2021: The Physical Science Basis was approved by the IPCC's 195 member governments. It said it could take 20-30 years to see global temperatures stabilise, and that the window of opportunity for limiting global warming to below 2°C was closing rapidly.

The report concluded that emissions of greenhouse gases from human activities were responsible for approximately 1.1°C of warming since 1850-1900, and that global temperature would reach – or exceed – 1.5°C of warming in the next 20 years.

'This report is a reality check,' said IPCC Working Group co-chair Valérie Masson-Delmotte. 'We now have a much clearer picture of the past, present and future climate, which is essential for understanding where we are headed, what can be done, and how we can prepare.'

The IPCC said that climate change was already intensifying the water cycle, which brings more intense rainfall and associated flooding, as well as more intense drought in many regions. It expects more rainfall in high latitudes, but a reduction over large parts of the subtropics.

Coastal areas will see continued sea level rises during the 21st century, contributing to more flooding and coastal erosion. Aspects of climate change may be amplified in cities including heat, flooding, and sea level rise in coastal cities.

Read Julie Godefroy on page 18.

Climate change is intensifying the water cycle, bringing more flooding

Net zero homes plan 'too complicated and confusing'

Government plans to decarbonise homes are too complicated and confusing, according to a group of consumer and industry groups.

In an open letter to the Prime Minister, Citizens Advice, the Federation of Master Builders, the Aldersgate Group and *Which?* said current schemes to adapt homes often go wrong, and called for more financial support for making changes.

The coalition argued that the process of installing low carbon heating and smart technologies, and upgrading insulation, is 'time consuming, confusing and stressful'. It cited the Green Homes Grant, which was scrapped in March this year after reaching just 10% of the houses that the government promised would be improved.

To ensure plans to decarbonise homes don't fail, the letter called for: more accessible and unbiased information on steps, including installing low carbon heating and upgrading insulation; fit-for-purpose consumer protections for decarbonising homes; and a comprehensive, long-term policy framework that provides certainty for businesses and consumers, and which offers financial support such as grants, low-cost loans and financing.

A government spokesperson said: 'We are investing £1.3bn this year alone to support people to install energy efficiency measures in their homes, with upgrades to 50,000 low-income households already under way.

'Our Simple Energy Advice service offers clear information on what financial support is available for people to make home improvements.'

IN BRIEF

Hoare Lea bought by Tetra Tech

Consulting and engineering services firm Tetra Tech has acquired 100% of the interest in the UK building services consultancy Hoare Lea.

The firm, founded by Henry Lea in 1862, will continue to operate as a standalone entity within the Tetra Tech group.

Tetra Tech is an environmental consulting firm with more than 20,000 engineers, scientists and specialists. Hoare Lea will become part of its High Performance Buildings group, a global alliance of MEP firms.

Managing partner Justin Spencer said the additional resources provided by the new owners would help Hoare Lea adapt to 'a period of accelerated change'.

Commercial buildings could be 'stranded' by new MEES

Some commercial buildings could fail to meet legal minimum energy standards and become 'stranded assets', according to real estate management firm Colliers.

The Minimum Energy Efficiency Standards (MEES), set to be extended in 2023, will mean buildings with an EPC rating lower than E will no longer be lettable. This could affect up to 10% of London offices, the firm said.

Tom Wildash, co-head of office leasing in London's West End at Colliers, told the *Financial Times*: 'If you are sitting on a building that's below an E rating and you want to get to a B rating, that's a substantial bit of refurbishment.'

Intelligent buildings market set for growth

Intelligent building (IB) solutions are projected to grow by almost 15% by 2030, according to a new report.

Guidehouse Insights' *Market Data: Intelligent Buildings* said IB solutions revenue is anticipated to grow globally from $38.2bn (£27.8bn) in 2021 to $127.9bn (£93bn) by 2030 at a compound annual growth rate of 14.4%.

In 2020 and 2021, several building segments faced dramatic decreases in use but, 'in practice, demand increased in all building types in all geographic regions and will likely continue to grow in double digits through 2030', said William Hughes, Guidehouse Insights principal research analyst.

New government strategy backs hydrogen for heat

Final decision on gas potential not expected until trials end in 2026

Hydrogen will have a key role to play in the UK's attempts to decarbonise heating, according to a new government strategy.

The policy is intended to provide 5GW of hydrogen production capacity by 2030 and the government believes hydrogen could replace natural gas in more than three million homes and help power transport and industry.

As much as 35% of the UK's energy consumption by 2050 could be hydrogen-based, according to the strategy. However, the government said it would not make a final decision about the potential for hydrogen in homes until 2026 after a series of trials have been completed.

It sees a role for both 'green' and 'blue' hydrogen and believes the industry could deliver 9,000 jobs and £4bn worth of investment by the end of this decade. Eventually, the sector could support 100,000 jobs and be worth £13bn by 2050, according to the strategy document.

The government is consulting on a similar approach to the one used to grow the offshore wind sector. This would include the use of a contracts-for-difference (CfD) scheme, which incentivises investment by shielding developers from volatile wholesale prices and offers consumers protection from high electricity costs.

Business and energy secretary Kwasi Kwarteng said: 'Today marks the start of the UK's hydrogen revolution. This home-grown clean energy source has the potential to transform the way we power our lives and will be essential to tackling climate change and reaching net zero.'

Baxi demonstrates hydrogen boiler

Baxi's Nick Wilson outside the hydrogen house

Baxi Heating has demonstrated its '100% hydrogen boiler' to a range of housing providers and industry figures in the UK's first hydrogen house near Gateshead.

The company has pledged to manufacture only low carbon energy-compatible products from 2025, which means that all of its gas boilers will be 'hydrogen ready'.

'While we are not wedded to any one technology, hydrogen represents a great opportunity,' said commercial and marketing director Nick Wilson. 'It is carbon-free at the point of use and enables families to use their heating and hot water in the same way they do today, without major changes to their central heating systems or homes.

'What starts today with one house will become a community of houses next year and then we could see hydrogen boilers in millions of homes by the next decade.'

Boris planning new 'scrappage scheme'

The Prime Minister is understood to be keen to launch another boiler scrappage scheme with incentives of up to £7,000 to encourage homeowners to switch to low carbon heating alternatives including heat pumps.

Boris Johnson wants to quadruple the budget for the £100m Clean Heat Grant, which is due to launch next April offering grants of up to £4,000 for homeowners to replace their gas boilers for low carbon alternatives. However, the Treasury is believed to be opposed to the extra expenditure that the Prime Minister hopes would deliver up to 60,000 new domestic heat pumps.

The Times reported the plan was seen as crucial to achieving the PM's pledge to have 600,000 heat pumps installed every year by 2028 and set up a town with only hydrogen heating by the end of 2030.

This could be the flagship policy to accompany the much-delayed Heat and Buildings Strategy, which is expected before this November's COP26 meeting in Glasgow. But sceptics are concerned it could suffer the same fate as the Green Homes Grant Scheme, which was scrapped by the government after just six months earlier this year with only a fraction of its budget spent.

The government is also thought to be considering a complete ban on gas boilers by 2035.

All schools to get CO_2 monitors

DfE to spend £25m on portable equipment in bid to reduce risk of Covid-19 transmission

Schools in England will receive up to 300,000 carbon dioxide monitors to help them check air quality and ventilation effectiveness when pupils return this month.

The Department for Education said it would spend £25m on portable monitors that could be used to identify areas where airflow is inadequate to reduce the risk of Covid-19 transmission.

Teaching unions welcomed the announcement, but pointed out that if ventilation problems were detected they must be addressed, which would require investment. Many schools have already reported they do not have the cash to pay for additional mechanical ventilation.

Education Secretary Gavin Williamson said: 'Providing all schools with CO_2 monitors will help them make sure they have the right balance of measures in place, minimising any potential disruption to education and allowing them to focus on world-class lessons and catch up for the children who need it.'

The DfE said it would prioritise special schools as they are likely to have higher rates of vulnerable pupils, but that all schools and colleges should receive at least partial allocations in the autumn.

Geoff Barton, general secretary of the Association of School and College Leaders, said: 'Government guidance... doesn't go much further than recommending that windows should be opened to improve natural ventilation.

'This is challenging in the depths of a British winter and does not make for an environment which is conducive to learning. Our understanding is that carbon dioxide monitors will indicate when spaces need ventilating thereby reducing the need to keep windows open all the time.'

Schools trial air purifiers and UV

Thirty primary schools are to test air purifiers and ultraviolet (UV) lights in a £1.75m trial aimed at reducing the spread of Covid-19 in classrooms.

Ten of the schools in Bradford, West Yorkshire, will be given high-efficiency particulate air (HEPA) filters and 10 will get UV purifiers. The other 10 will be a control group with no devices, researchers said. If the test proves successful, the government says it could be extended to the rest of the country next year.

The Centre for Applied Education Research is collaborating with the universities of Leeds, Bradford and York, Bradford Council and the Department for Education in the government-funded exercise, which will include looking at the practical difficulties of installing this kind of technology in school buildings.

Project leader Professor Mark Mon-Williams, of the University of Leeds, said the study could be 'game-changing for keeping schools open', but it was vital that any measures in schools were backed up by evidence.

Results of the trial should be available before the end of the year.

● Read about CIBSE's guide to air cleaning technology on page 58.

Alliance plans overheating tool for homes

The Good Homes Alliance is to develop a tool for tackling overheating in existing homes.

This project is in response to demand from designers, housing associations, environmental health officers, and other parties concerned with overheating risk in the existing housing stock, the alliance said.

It hopes to produce 'simple practical guidance' to help identify and mitigate the risk of overheating caused by energy retrofits in an attempt to influence design options and mitigation measures.

The work will be delivered by Susie Diamond and Julie Godefroy, who also authored a new-build version of the tool.

The project is supported by the BEIS-funded Refine project on radical decarbonisation of social housing through whole-house energy retrofits, and by the National Energy Foundation. The project is one of the Social Housing Decarbonisation Fund demonstrators led by Warwick District Council and Oxford Brookes University.

The Good Homes Alliance is a cross-sector body with more than 80 members and partners.

Tool will tackle overheating in existing homes

Government under pressure to back national retrofit plan

A coalition of housing, finance, construction, and energy organisations have put their weight behind the campaign for a national retrofit strategy.

Led by the Nationwide Building Society, the group says a centralised strategy is needed to help overcome barriers preventing homeowners from investing in low carbon solutions. They say there remains a lack of public awareness of the climate impact of homes, and low carbon choices such as heat pumps are too expensive. They also point to the shortage of suitably skilled tradespeople as hindering low carbon retrofit work.

Nationwide said the appeal had been designed to unite the various sectors who could help to decarbonise the UK's carbon-intensive and energy-inefficient homes.

The coalition, which also includes British Gas, E.ON, Midas Group, Legal & General, and the Federation of Master Builders, wants the government to launch a national skills strategy and provide grants and other incentives to bring down the cost of 'green' products.

IN BRIEF

Bank boost for hemp insulation factory

A hemp construction materials business will build a factory producing carbon-negative building insulation after securing funding from the new Scottish National Investment Bank.

IndiNature, which has developed a natural fibre insulation system called IndiBreathe using UK-grown hemp, plans to open its new Borders manufacturing hub in summer 2022.

The bank's £3m investment will enable the business to scale up production at its new facility in Jedburgh. It has also unlocked grant funding provided by Zero Waste Scotland (£803,000) and South of Scotland Enterprise (£250,000).

BSI publishes biodiversity standard

A new set of requirements for the implementation of biodiversity net gain (BNG) in construction projects has been published by the British Standards Institution (BSI).

BS 8683: Process for designing and implementing biodiversity net gain – Specification outlines a process to design, implement, maintain and monitor BNG outcomes from a development project.

It provides a framework to demonstrate that a project has followed a process based on the UK's BNG Good Practice Principles.

CPA pushes on with product code

The results of the consultation on the proposed Code for Construction Product Information has been published by the Construction Products Association (CPA).

The 65-page report details feedback from 35 trade bodies and 180 individual provider and user organisations of construction product information.

According to the CPA and its pollsters, the findings show that the industry 'welcomes and supports the code, and considers it a crucial step in the right direction'.

However, it also revealed widespread concern about how compliance would – or could – be policed. Respondents also wanted clarity around the training and competence requirements, and on what exactly was required to comply with the different clauses of the code.

Government offers breathing space for product testing

CE Mark can continue to be used until 1 January 2023

The industry has responded positively to the government's decision to postpone the introduction of new post-Brexit construction product marking rules.

The UK was due to switch over from the European CE mark to a new United Kingdom Conformity Assessed (UKCA) mark on 1 January next year, but that deadline has now been postponed for 12 months.

This follows increasingly frantic lobbying from sector bodies that warned the government that the testing capacity was not in place to make the switch possible in time for the original deadline. As a result, the CE mark will continue to be used to show conformity with quality and safety standards for another year.

However, some industry figures have already warned that even the extended deadline will be challenging considering the scale of the exercise needed to test thousands of products used in all parts of construction and its related sectors.

'Given the widespread pressures on product supply, we welcome this pragmatic decision by the government to extend the deadline for CE-marked products,' said Construction Leadership Council co-chair Andy Mitchell.

'However, even with this extension, it will still be very challenging to ensure the whole sector is ready for the new date, given the need to drive major increases in testing capacity.'

He said it would be increasingly important for the government to work closely with industry representatives to set up a 'robust testing and marking regime... ensuring that we don't just postpone the crisis by 12 months'.

Engineering bodies reach out to new generation to tackle climate change

School leavers and other young people are being urged to take up engineering careers as the UK employment market enters uncharted territory.

Actuate UK, a group of eight industry bodies – including CIBSE – representing engineering services professions is spearheading a campaign to encourage more young people to take up emerging job opportunities in a sector that offers the chance to tackle the climate crisis and provide better living and working conditions for communities.

There were more than half a million young people unemployed in May, according to the government's latest figures, with thousands more now joining the jobs market this summer.

The group reported growing interest in apprenticeships linked to engineering professions particularly in the electrical, plumbing, lift, heating, ventilating and air conditioning industries. The Scottish electrical employers' body, Select, said it had seen a record intake of 738 apprentices so far this year with many motivated by the long-term job prospects on offer.

Many are deciding to learn a trade rather than follow a more traditional further education route, according to Actuate UK, which also believes the opportunity to 'earn while you learn' is proving attractive to many young people worried about running up large student debts. This is driving demand for apprenticeships that combine classroom teaching with on-the-job training with an employer. Most of these lead to full-time employment.


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IN BRIEF

Scott Mason elected as CIBSE Patrons chair

Scott Mason has been elected as chair of CIBSE Patrons, taking over the role from Nick Mead.

Mason, who is south regional sales manager at Lochinvar and was a CIBSE ASHRAE Graduate of the Year runner-up in 2016, has been involved with the Patrons for a number of years and is passionate about the division's aim to provide a sustainable platform to improve the recruitment and retention of the next generation of industry professionals.

CIBSE Patrons comprises a group of businesses representing a cross-section of the industry that collaborate to give financial, technical and moral backing to a wide range of initiatives led by the Institution.

When asked about his appointment, Mason said: 'It's an honour to have been elected as chair of CIBSE Patrons. Patrons have so much to offer. There is a wealth of knowledge and expertise that can be used to benefit the wider industry. I am focused on creating a forum for networking and knowledge sharing and investing in the future talent needed to drive our industry forward.'

For more details about Patrons, visit **bit.ly/CJSept21patrons**

Awards deadline extension

The deadline to submit entries to the 2022 CIBSE Building Performance Awards has been extended to 15 September.

The awards, which have led the way in recognising and rewarding the proven performance of buildings, include categories for best consultancies, individuals, teams and building projects. The awards event will be held on 24 February 2022. For the full list of categories, and to enter, visit **www.cibse.org/bpa**

CIBSE HQ gets makeover

CIBSE has refreshed its Balham HQ to make it more welcoming as we return to the office. The entrance has had a makeover from Steve Burns, CIBSE Certification officer, who has created a giant mural featuring the CIBSE hawk.

Young Lighter of the Year shortlist announced

Four lighters will be selected for the final presentations

The Society of Light and Lighting (SLL) has announced its shortlist for the 2021 Young Lighter competition.

Following the initial entry stage, the judges have confirmed that the following young lighters will be going through to the next stage, where they will be required to develop their entry and submit a short video outlining their project.

Aluwaine Manyonga was named SLL Young Lighter 2020

The eight shortlisted lighters and their projects are:

- **Anesu A Shumba** – *Automatic light intensity control system*
- **Eby Vincent Mathew** – *Virtual light labs*
- **Kate Turley** – *Biodynamic lighting to support wellbeing in dementia*
- **Maria Englezou** – *Do we need to change the design of healthcare facilities rooms?*
- **María Teresa Aguilar Carrasco** – *Lighting optimisation in 24-hour work centres to promote a good circadian rhythm*
- **Mrinalini Kalla** – *Smart apartments with control systems to reduce carbon dioxide emissions*
- **Remedios María López Lovillo** – *Adaptive lighting control system – user-oriented*
- **Verity Rose** – *Drone lighting: the impact and the future.*

These eight will be further whittled down, with four being selected for the finals, where they will deliver a presentation in front of an audience and judges at an SLL event in November.

The Young Lighter of the Year competition is open to anyone with an interest in light and lighting. The winner will receive the SLL Young Lighter 2021 title and a cash prize of £1,000.

ANZ confirms 2021 seminar series

The CIBSE Australia and New Zealand (ANZ) Region annual seminar series is confirmed for September.

The series, titled 'Survival of the fittest – resilience now and into the future', will examine future trends in healthy building design for short- and long-term resilience.

Ten expert speakers from Australia, the US, the UK and New Zealand will showcase the latest research and case studies in healthy building design and operation, from electrification of buildings to the best ventilation practices for safe, healthy workspaces.

The programme, starting on 7 September, will be delivered as five weekly, two-hour sessions, presented live and online. The sessions include:

- Mega trends – health and wellbeing of buildings, with Jack Noonan, vice-president at the International Well Building Institute, and Sharanjit Paddam, actuary – climate and ESG risk at Finity Consulting
- Research into health and wellbeing of offices, with associate Professor Christhina Candido, director SHE Lab, University of Melbourne, and Dr Stephanie Taylor, infection control consultant, Harvard Medical School
- Say it, don't spray it – understanding the importance of aerosol movement for buildings, with speaker Simon Witts, principal engineer, LCI Consultants, and Matt Lensen and Richard Walsh, of Beca
- Embedding resilience into design, with Professor Tony Day, energy research consultant
- A case for excellence, with Jeff Robinson, principal and sustainability consultant at Aurecon.

● For the full programme and to book, visit **bit.ly/CJSept21ANZ**

CIBSE will seek to increase awareness by promoting Guide L

CIBSE updates its Climate Action Plan

Second review for publication informed by members, institutions and wider industry

CIBSE has updated its Climate Action Plan, mapping current and planned activities in the areas where it considers it has a duty and the ability to act.

CIBSE has been active for many years in promoting policies and measures to mitigate climate change, to adapt our buildings to the changing climate, and to establish the critical link between how buildings perform in operation and their carbon impact.

The Action Plan was first published in 2019 to increase efforts, and included a commitment to review the plan regularly – this is the second annual update.

It covers a range of areas, from CIBSE as a professional institution, to premises, events and dissemination, policy research, and competence and training. It includes the following actions and commitments:

- Contributed and signed up to the cross-industry climate action plan and coordinating workstream 7 on in-use performance
- Seeking to increase awareness of the CIBSE Code of Conduct – for example, the promotion of Guide L
- Implementing energy efficiency measures and monitoring our office performance
- A sustainability policy, covering activities, events, premises, staff and procurement
- Improvement plan for our offices for better efficiency, health and wellbeing of staff
- Regular reporting on zero carbon agenda in *CIBSE Journal*, blog, newsletter and website, and at events and online webinars
- Requirement for in-use performance data for CIBSE Awards – and a new data entry form launched for 2022 awards
- Continuing to work with the Royal Institute of British Architects to align sustainability criteria in our awards to enable them to feed into benchmark database
- New knowledge transfer partnership to update CIBSE weather files
- Contributed to the joint industry Climate Framework curriculum
- Commitment to introduce mandatory CPD on climate change and safety
- Commitment to review our corporate grade entry criteria and how they could better incorporate climate change competence.

The plan has been informed by input from members, professional institutions and the wider industry.

- **Read the updated Climate Action Plan in full at bit.ly/CJSept21NZ**

Automation problems target of digital engineering challenge

The Society of Digital Engineering 2021 challenge is inviting people to find a digital engineering solution to automation problems.

It aims to find and share automations that make designing and constructing built assets quicker, simpler and more accurate. Sharing these ideas and concepts should help and inspire others to create and share automations and smarter ways of working.

Visit **bit.ly/CJSept21SDE** for full details of the challenge. The deadline for submissions is 1 October. A selection of automations will be presented on 20 October, followed by a Q&A. The most popular presentations will be given a slot at Build2Perform on 16 or 17 November.

CIBSE Certification adds ISO14001 to suite of standards

CIBSE Certification is now UKAS-accredited to award ISO14001 Environmental Management Systems certification.

This adds to its existing accreditations for ISO 9001 *Quality Management Systems* and ISO 50001 *Energy Management Systems*, providing a one-stop shop for organisations looking for a single certification provider.

Andrew Geens, head of CIBSE Certification, emphasised the benefits of this: 'Any UKAS-accredited certification body is expert in the standards, but it is hugely helpful if the assessors also have a profound understanding of the sector in which the candidate organisation works.'

CIBSE Certification has developed its service to provide certification for a logical suite of standards, which are commonly held together by organisations working in the field of environmental management within the built environment.

ChapmanBDSP and British Land acted as witness organisations, going through the entire certification process and thereby allowing UKAS to thoroughly check CIBSE Certification's competence in inspection and validation. Both companies already work with CIBSE Certification for other accreditation.

For further details on this and the range of services provided by CIBSE Certification, visit **www.cibsecertification.co.uk**

New CIBSE blog: Meet the trainer

A new CIBSE blog, introducing CIBSE trainer David Butler, who delivers the Ductwork Design course, has just been published.

In it, Butler gives an overview of his work experience at BRE, talks about what motivated him to become a CIBSE trainer, and discusses what he's most looking forward to in this new role.

Asked what he would tell someone who is just about to start or considering working in the sector, he said that building services are key to making buildings healthy, comfortable and productive places to live or work, and stressed the importance of the role of building services in the context of climate change.

To read the blog in full, go to **www.cibseblog.co.uk**

New members, fellows, associates and licentiates

FELLOWS

Fisher, Jason Comber
United, Kingdom

Kesavaraman, Arumugam
Dubai, United Arab Emirates

Maruthayanar, Gita
St Albans, United Kingdom

Pasetto, Saverio
Much Hadham, United Kingdom

Silinski, Marcin
London, United Kingdom

Stojkovic, Milena
London, United Kingdom

MEMBER

Abdul Karim, Amer
London, United Kingdom

Adefajo, Adedeji
London, United Kingdom

Ahmed, Mustab
London, United Kingdom

Al-Janabi, Yousuf Ibrahim Yousuf
Basingstoke, United Kingdom

Alagenthiran, Brathepan
Surbiton, United Kingdom

Aldemir, Ozgur Kemal
London, United Kingdom

Allsop, Jack
Betchworth, United Kingdom

Aoun, Joey
London, United Kingdom

Attah, Chukudubem Stanley Ubaka
London, United Kingdom

Ayoola, Aderotimi
Croydon, United Kingdom

Balaban, Gabriela
Solihull, United Kingdom

Baltrukiewicz, Wojciech
Bristol, United Kingdom

Barritt-Mehta, Ross Michael John
Hoddlesden, United Kingdom

Bellamy, Marc
Upminster, United Kingdom

Bill, Michael McGregor
Glasgow, United Kingdom

Birch, William Daniel
Chalfont St Peter, United Kingdom

Bonfigli, Cecilia
London, United Kingdom

Bosley, Matthew
Abu Dhabi, United Arab Emirates

Bowerman, Felix
London, United Kingdom

Bowes, Jared
Colne, United Kingdom

Brenna, Silvia
Epsom, United Kingdom

Budin, Sam
London, United Kingdom

Chan, Ho Wing
Central, China

Chan, Tak Yin
Kennedy Town, Hong Kong

Chan, Hoi Ting
Sheung Shui, Hong Kong

CHENG, YEW LEONG
Kuala Lumpur, Malaysia

Cheng, Tsang Hee Michael
Ma On Shan, Hong Kong

Cheng, Chi Shing
Chai Wan, Hong Kong

Choi, Chi Ning
Tuen Mun, Hong Kong

Coetzee, Dirk Jacobus
Wicklow Town, Ireland

Cozens, Ben
Bowdon, United Kingdom

Crawford, Leslie John
Bangor, United Kingdom

Creed, David
Newcastle upon Tyne, United Kingdom

Cullinane, Maria
Cork, Ireland

Da Rocha Ferreira, Miguel
Gibraltar, Gibraltar

Davis, Thomas Stephen
Bristol, United Kingdom

Dela Cruz, Orben
Dublin, Ireland

Dharma, Anastasia
London, United Kingdom

Dinneen, David
London, United Kingdom

Dombey, Abigail
Brighton, United Kingdom

Donaldson-Balan, Monica
South Croydon, United Kingdom

Eburne, Oliver
Coventry, United Kingdom

Fallon, Peter
Manchester, United Kingdom

Ferrari, Juan
London, United Kingdom

Fonseca Correia, Nadia Diana
Horley, United Kingdom

Gallotta, Alberto
Cardiff, United Kingdom

Gibbens, Jonathan Michael
Roath, United Kingdom

Gill, Sabrina Kaur
Sutton Coldfield, United Kingdom

Gomez, Genesis
High Wycombe, United Kingdom

Gubats, Joe
Wolverhampton, United Kingdom

Haley, Alistair David
Coventry, United Kingdom

Halliwell, Jemma Louise
Manchester, United Kingdom

Hamilton, Rion Alexander
Holywood, United Kingdom

Hayes, Aaron
St. Albans, United Kingdom

Ho, Ting Fai
Tsuen Wan, Hong Kong

Holden, Liam
Southampton, United Kingdom

Honjigawa, Kiyomi Morag
Edinburgh, United Kingdom

Hunter, Lewis
Motherwell, United Kingdom

Hyde, Richard Anthony James
Hornchurch, United Kingdom

Iqbal, Arif
Noida, India

James, Paul
Thatcham, United Kingdom

Jerrard, Nicholas James
Ferndown, United Kingdom

Johnson, Steven
Newcastle upon Tyne, United Kingdom

Jolly, Suellen
Radlett, United Kingdom

Jones, Lewis
Leeds, United Kingdom

Jones, Rory
Cardiff, United Kingdom

Jordan, Rob
Wigan, United Kingdom

Jordan, Nicholas
South Shields, United Kingdom

Kelepouris, Apostolos
London, United Kingdom

Kelkar, Aditya Sadanand
Ballinteer, Ireland

Kluger, Scott
London, United Kingdom

Korda, Bronislaw
Musselburgh, United Kingdom

Kuo, Kuo Chen
Kowloon, Hong Kong

Kwan, Chung Ming Martin
Yuen Long, Hong Kong

Lai, Jane Iris Yan Kam
Balwyn, Australia

Lam, Kevin
London, United Kingdom

Lau, Tim Ki
Hong Kong, Hong Kong

Lau, Kai Pong
Hong Kong, Hong Kong

Lean, Kieran
Buckinghamshire, United Kingdom

Lee, Chak Ting
Tuen Mun, Hong Kong

Leonard, Simon
Blackburn, United Kingdom

Lewis, Robert Owain
London, United Kingdom

Lloyd, Stephen Timothy
London, United Kingdom

Lui, Hoi Shan
Tin Shui Wai, Hong Kong

Ma, Tsz Pui
Shau Kei Wan, Hong Kong

Ma, Ka Yan
Kowloon, Hong Kong

Maddison, Leon Zachary
Leeds, United Kingdom

Mahaei, Marjan
London, United Kingdom

Marshall, Robert Leslie
Staines Upon Thames, United Kingdom

Masterman, Lisa
Bristol, United Kingdom

McCarthy, Colm
Dublin, Ireland

Menu, Sebastien
Edinburgh, United Kingdom

Mercer, Charlotte Anne
Bristol, United Kingdom

Moelsted, Andreas Hoeier
Sydney, Australia

Monk, Timothy Phillip
Reading, United Kingdom

Murphy, Julie Anne
East Kilbride, United Kingdom

Myers, John
Dubai, United Arab Emirates

Nicolaie, Ionut
Edenbridge, United Kingdom

O'Connell, Brian
Co Cork, Ireland

O'Hagan, Eleanor
Singapore, Republic of Singapore

Papachristou, Georgios
Manchester, United Kingdom

Parshad, Chander Shekher
Shepperton, United Kingdom

Patterson, Lee
Ushaw Moor, United Kingdom

Pease, Patrick
Atlanta, United States

Piercy, Daniel
Stockport, United Kingdom

Priyan Sanjeewa Senarathna, Dissanayake Mudiyanselage
Rajagiriya, Sri Lanka

Recio Cristobal, Ana
Bristol, United Kingdom

Revesz, Akos
London, United Kingdom

Rius Artuso, Alejandro Anibal
Great Cambourne, United Kingdom

Robertson, Michael
London, United Kingdom

Robinson, James
Bristol, United Kingdom

Roskell, Paul James
Preston, United Kingdom

Rowse, James
London, United Kingdom

Royds, Rowan
London, United Kingdom

Sanchez Guedes, Rodrigo
Wembley, United Kingdom

Sanderson, David
Chester, United Kingdom

Santos, Ana Sofia Garcia dos
Croydon, United Kingdom

Sanz Montero, Alberto
London, United Kingdom

Senior, Stephen
Cheadle Hulme, United Kingdom

Sewell, Benjamin
London, United Kingdom

Sidovici, Silviu
London, United Kingdom

Sim, David
Dunfermline, United Kingdom

Singh, Sarvakam
Romford, United Kingdom

Smith, Caroline
Dronfield, United Kingdom

So, Jacky Ming Kei
Newcastle-upon-Tyne, United Kingdom

Spyrou, Maria
Welwyn Garden City, United Kingdom

Standley, Carl
London, United Kingdom

Stepto, Robert
Exeter, United Kingdom

Stretton, Daniel
Chiseldon, United Kingdom

Sudarmaji, Ananda Tika
London, United Kingdom

Sutton, Tom
Atherstone, United Kingdom

Tabatabaee Zavareh, Mohamad
London, United Kingdom

Thompson, Grant Lloyd
Bristol, United Kingdom

Thomson, James
Glasgow, United Kingdom

Thomson, Alan
Orkney, United Kingdom

Thorpe, James
London, United Kingdom

Tibabuzo Castro, Felipe
Glasgow, United Kingdom

Tierney, Cathal
Belfast, United Kingdom

Tilford, Adam
Luton, United Kingdom

To, Shu Pui
North Point, Hong Kong

Van Dessel, Megan
London, United Kingdom

Wai, Chung Yin
Sai Kung, Hong Kong

Waites, Adam
Newcastle, United Kingdom

Walsh, Matthew
London, United Kingdom

Ward, Samuel
Herne Hill, United Kingdom

Western, Will Werner
St Albans, United Kingdom

Whitaker, Arran Olivares
London, United Kingdom

Whittaker, David William
Newcastle Upon Tyne, United Kingdom

Wild, James Matthew
London, United Kingdom

Wilkinson, Matthew Anthony
Melton Mowbray, United Kingdom

Willey, Jayson John
Worcester Park, United Kingdom

Williams, Luke
St Helens, United Kingdom

Window, Scott
London, United Kingdom

Wood, David Alexander
Lundin Links, United Kingdom

Ying Sang, Chui
Ma On Shan, Hong Kong

Yip, Tsz Chiu
Kowloon, Hong Kong

Yu, Ka Fu
Hong Kong, Hong Kong

Yu, Chung Him
Hong Kong, Hong Kong

Zardis, Alexander Nicholas
Bristol, United Kingdom

ASSOCIATE

Attobrah, Akua Kyeiwaa
London, United Kingdom

Broome, Mark
Exeter, United Kingdom

Brown, Chris
Winchester, United Kingdom

Burton, Kate
Brighton, United Kingdom

Butterworth, Andrew
Oldam, United Kingdom

Carter, Danny
Harriestsham, United Kingdom

Chapman, Sean
Nottingham, United Kingdom

Collard, Jamie
Manchester, United Kingdom

Cox, Georgina
Ilford, United Kingdom

Eaton, David Simon
Doncaster, United Kingdom

Glenton, Joseph Michael
Hull, United Kingdom

Horgan, Kevin
Cork, Ireland

Hughes, Ryan
Heathfield, United Kingdom

Hydon, Jack
Coventry, United Kingdom

Jackson, Junior
Maidenhead, United Kingdom

Kubiszewski, Jakub Jan
London, United Kingdom

Nowakowski, Artur Sabastian
St Albans, United Kingdom

Oakes, Thomas
Dudley, United Kingdom

Richardson, Charlie
London, United Kingdom

Thomas, Hugo
St Albans, United Kingdom

Turner, Tris
Southampton, United Kingdom

Walker-Tully, Lucinda
London, United Kingdom

LICENTIATE

Barlow, Josef
Sutton-in-Ashfield, United Kingdom

Hale, Benjamin
Norwich, United Kingdom

Holt, Dominic
Merseyside, United Kingdom

Kerr, Johnny
Belfast, United Kingdom

Loughlin, Franklin
London, United Kingdom

Maskey, Payal
London, United Kingdom

McHaffie, Adam
Manchester, United Kingdom

Mousley, Charles
Liverpool, United Kingdom

Muyambo, Bongai
Derby, United Kingdom

Peterson, Ricardo
North Kensington, United Kingdom

Powers, Wayne
Birmingham, United Kingdom

Rhodes, Jordan
Clapham, United Kingdom

Scott, Duncan
London, United Kingdom

Watson, Alex
Leigh-on-Sea, United Kingdom

Wya, Marie
Bristol, United Kingdom

Setting standards

Standards are an essential tool of everyday life, underpinning everything from boiling a kettle to ordering products for a project. Hywel Davies explores the standards process and how CIBSE members can be involved

The UK has a performance-based system of Building Regulations. They set functional requirements that a building must meet; many readers know the requirement in Part F of the regulations for England, for *'adequate means of ventilation provided for people in the building. (F1(1))'* This sets out what must be achieved, not how. The devolved administrations use similar words and Scottish Building Standards are more explicit about the health of occupants.

The Approved Documents, or Technical Handbooks in Scotland, *'provide guidance about compliance with specific aspects of Building Regulations in some of the more common building situations. They set out what, in ordinary circumstances, may be accepted as reasonable provision for compliance with the relevant requirement(s) of Building Regulations to which they refer.'*

Following the guidance tends to a presumption of compliance with the requirement(s) covered by the guidance. But there is 'no obligation' if alternative ways to comply are available.

Whichever path they choose, designers will need to rely not just on formal guidance, but on relevant guidance, such as CIBSE Guides, and the 485 national or international standards published by BSI. But what are they and how are they made?

BSI Standards is the UK national standards body, recognised by government. It is the UK member of the European standards bodies CEN and CENELEC,[1] (not institutions of the EU) and, globally, the International Organization for Standardization (ISO) and the IEC, its electrotechnical counterpart.

BSI develops national standards and is the UK participant in the development of European and International Standards. More than 100 built environment committees work on product and installation standards as well as design standards such as Eurocodes. While the range of activity is broad, the process of writing a standard is relatively straightforward, if not well understood.

A draft is developed for review and comment by the committee and then for public comment. Anyone can submit comments. They must be submitted online or on a comment template and must be constructive, identifying concerns clearly and ideally offering alternative drafting for open, fair and transparent standards. Standards should not favour particular interest groups or members of some trade bodies over others.

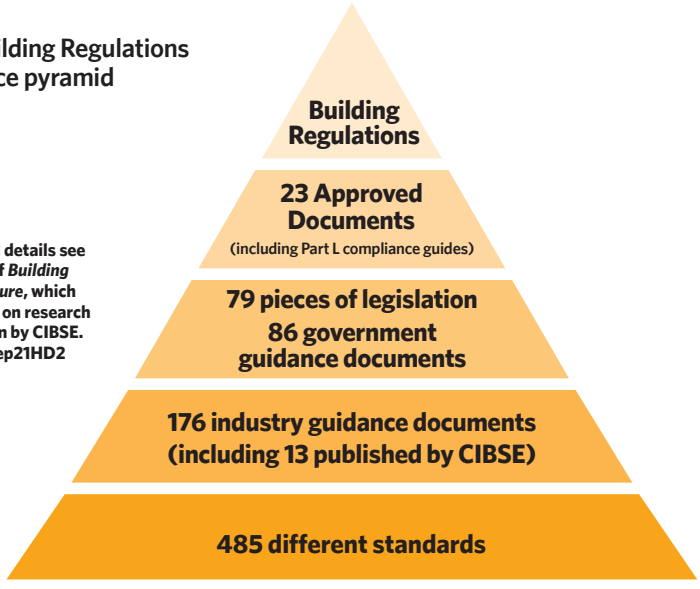
Those comments go to the committee, which must form a consensus on each one. A final draft is then published and a European or International (ISO/IEC) standard goes to a further formal vote on the final draft.

As well as providing guidance to Building Regulations and Standards in the UK, they also provide the basis for products to meet construction product regulations in the UK and Europe and are a key tool in trade agreements around the globe and increasingly relevant to UK exports.

Standards committee membership is open to all organisations with legitimate interests. Committees are listed on the BSI website[2] and CIBSE is represented on a number. We regularly advertise draft standards that are issued for comment[3] so that all CIBSE members can comment. There are several out now, so why not take a look?

DR HYWEL DAVIES is technical director at CIBSE and has been a member of, and chaired, British, European and International standards committees for more than 30 years
www.cibse.org

The Building Regulations guidance pyramid



For the full details see Table 6.1 of *Building a Safer Future*, which was based on research undertaken by CIBSE. bit.ly/CJSep21HD2

STANDARDS

The international definition of a 'standard' is a document, established by consensus and approved by a recognised body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context.

Note: Standards should be based on the consolidated results of science, technology and experience and aimed at the promotion of optimum community benefits.

References:

1 Comité Européen de Normalisation, or European Committee for Standardization, and CENELEC, the European Committee for Electrotechnical Standardization.
2 Apply to be a committee member, BSI **bit.ly/CJSEP21HD**
3 CIBSE Draft Standards Comment Hub **bit.ly/3sMkOyb**

Dampers: use the right product

There are two types of dampers that must conform to product standards and be appropriately tested, as Smoke Control Association member **Colin White** outlines

It has become apparent that there is some uncertainty about the different types of dampers for buildings. Common terms used are fire dampers (FD), fire and smoke dampers (FSD), and smoke control dampers (SCD), and, depending on their type, they will have their own test, classification and product standard.

FDs and FSDs should conform to product standard EN 15650, be tested to EN 1366-2 and classified to EN 13501-3, while SCDs should conform to EN 12101-8, be tested to EN1366-10 and classified to EN 13501-4.

So what is the difference between the different types of dampers? EN 15650 FDs are intended to maintain compartmentation where HEVAC ventilation ductwork breaches compartment boundaries, by closing and remaining closed in a fire condition.

EN 12101-8 SCDs are used in smoke and heat exhaust systems to control the movement and evacuation of smoke from within a building. SCDs open a path to evacuate smoke. Some open and some close. When open, they remain open, and close to maintain compartmentation – for example, in smoke shafts for evacuating smoke from a building.

Compliance with regulations is demonstrated by the manufacturer issuing a Declaration of Performance (DoP). However, as dampers have a variety of classifications – including fire integrity, insulation, smoke leakage and reliability – it has never been more important to interrogate each DoP to ensure performances claimed are covered by the performance guarantee promise of the DoP.

Sadly, there is still an array of hybrid products on the market based on a mix and match of inappropriate, and often incorrect, standards for the application intended. For example, FDs are sometimes altered when the thermal link is removed and a different motor is fitted – they are then not tested correctly, as required by EN 12101-8.

The latest version of the SCA *Guidance on smoke control to common escape routes in apartment buildings REV 4* recommends that any damper used in a smoke ventilation system should be tested to EN 1366-10, classified to EN 13501-4, and CE/UKCA marked to EN 12101-8. It is available at **www.smokecontrol.org.uk**

● **Colin White** is director of Smoke Control Association (SCA) member company Smoke Control Dampers

Climate action now

Following the latest IPCC report, Julie Godefroy looks at CIBSE's work on this critical issue to date – and the practical steps you can take to support it

I recently found a copy of my 2006 PhD thesis, the first pages of which quote the Intergovernmental Panel on Climate Change (IPCC) in 2001, stating 'there is new and stronger evidence that most of the warming observed over the past 50 years is attributable to human activities'. So, the organisation's latest report, this month, saying there is 'irrevocable evidence' for this should come as no surprise to anyone but the most ardent deniers. The report also paints a daunting picture of the scale of potential consequences and the action needed to avoid the worst of it.

There is much that CIBSE and many others in the industry have been working on, which can help us all act today and plan for years to come.

"Some companies have started to offer their clients a net-zero option on all projects, whether or not they have requested it"

CIBSE Climate Action Plan – 2021 update

In 2019, to increase its efforts on climate change, CIBSE produced its first Climate Action Plan, covering the areas in which we have a duty and the ability to act as a professional institution – obviously in the guidance and training we provide, but also in requirements from members, accredited courses, how we act as an institution, and so on. We committed to review the plan regularly, and we published the second annual update in August. This includes several important measures, including:

- Our move to an ethical investment fund
- New and upcoming guidance on topics including embodied carbon (the TM65 calculation methodology will be followed by additional guidance on areas such as heating systems, internal adaptation, heat pumps, electrical engineering, heat networks, and hot water)
- Ongoing development of our energy benchmarking platform; for the first time, this includes domestic benchmarks
- A new award to recognise work on assessing and reducing embodied carbon
- A new project data spreadsheet. This should facilitate entries to awards, and can be used outside of the awards by project teams that would like to share project in-use performance data with CIBSE and contribute to our energy benchmarking platform
- A commitment to introduce mandatory CPD on safety and climate change. We will work with our CPD panel on details and timing of implementation
- The creation of a working group next year to review our corporate grade entry criteria, and how they could better incorporate climate change competence
- Upcoming revised guidelines for the higher education courses we accredit, to put more emphasis on climate change and reflect the cross-industry Climate Framework. These guidelines, once approved, will be implemented along with the latest version of the Accreditation of Higher Education Programmes, AHEP4, with a transition period between January 2022 and September 2024.

The plan also includes additional actions that could be taken, and CIBSE is very interested in feedback on these options, as well as additional suggestions. For example, some companies have started to offer their clients a net-zero option on all projects, whether or not they have requested it. Have you tried something similar; if so, what impact has it had? If not, why? Should CIBSE support and incentivise this and, if so, how?

CIC Climate Action Plan

In 2019, the Construction Industry Council (CIC) sought to encourage collective action on climate change across built environment institutions. This resulted in Carbon Zero, a cross-industry climate action plan adopted in June 2021 by CIBSE and more than 25 other institutions, including the Royal Institute of British Architects (RIBA), Institution of Structural Engineers, Landscape Institute, Royal Town Planning Institute, and the Royal Institution of Chartered Surveyors (but not yet the Institution of Civil Engineers).

Many of its actions are already embedded in the 2021 CIBSE plan, with additional ones beyond the remit of any one single institution and relying on collaboration. We are committed to produce, by COP26, a programme for implementation of all actions.

How much carbon can we spend?

The severity of the consequences presented by the IPCC makes it clear that, along with the end goal (net zero), we need to think in terms of cumulative emissions, or carbon 'budgets': the sooner and steeper the emissions cuts, the less can be emitted in total. This doesn't mean we should take a short-term view; initial investment in retrofit is clearly required for buildings to need less energy, emit less, and be adapted to further changes in climate.

DR JULIE GODEFROY
is technical manager at CIBSE

It does mean that we need a clear understanding of capital carbon expenditure, and reasonable confidence of operational carbon savings and other benefits to justify that initial expenditure.

Two recent initiatives are advancing work on this issue: **Part Z** is a proposal that is gathering support from all corners of the industry for the regulation of embodied carbon in buildings. It proposes that this should be done through Building Regulations, with a 'pretend' draft Approved Document as an initial proposal of how this could be achieved.

The **UK Green Building Council's (UKGBC) draft zero carbon roadmap** offers a detailed assessment of measures required across the built environment to achieve net zero. This could provide a really valuable breakdown of energy use and carbon emissions for different building types, both new-build and retrofitted. From this, we could derive targets such as energy-use intensities, complementing and testing the ones already available from the UKGBC, the London Energy Transformation Initiative and RIBA, and, ideally, informing the government's upcoming operational rating scheme.

Another strength of the roadmap is that it includes total embodied carbon, including that emitted abroad and in international transport; this differs from the UK's legal target and Climate Change Committee budgets, which only include UK-borne emissions, so do not provide a complete assessment of carbon costs vs benefits.

This also means we should 'do it once and do it well', so projects won't need redoing or demolishing later on.

Meanwhile, permitted development rights for housing – seen as beneficial in the short term to encourage reuse – need careful consideration, on account of well-documented issues with the substandard housing they create, associated health and safety risks, and missed opportunities for energy and carbon improvements.

What you can do

We could always do more and do it faster, so please contact **technical@cibse.org** or **jgodefroy@cibse.org** if you would like to support activities in our Climate Action Plan, or if you have additional suggestions for how we could support your actions.

You can also support our work by sharing in-use performance data from your projects (this can be anonymous), contributing to future guidance and the evidence based on what is possible. We also have existing and planned workstreams where volunteers can make a real difference, including benchmarking and metrics for performance, electrical engineering, and low carbon heat.

Finally, it is clear that government action is required alongside industry leadership, including more ambitious regulations for the whole-life carbon performance of new and existing buildings. You can support existing industry calls for government action on:

- Operational carbon and wider building performance: **bit.ly/CJSept21BPN**
- Embodied carbon: **https://part-z.uk**

Hydrogen's role in a net zero future

With the government's decision on the use of hydrogen for heating expected in 2026, Max Fordham's Bill Watts discusses the options for decarbonising heating systems

Nobody said decarbonising heat was going to be easy.

Current discussion is whether it should be done with decarbonised electricity, preferably with a heat pump, or with decarbonised hydrogen that will replace the natural gas [methane, CH4] in the UK's extensive gas grid.

The government's recent backing of hydrogen for transport, energy storage and decarbonised industrial feedstock has kept this debate alive, but not answered it.

The thinking engineer's money is firmly behind the electrification of heat in buildings for very good reasons, not least that the whole system of renewable generation, electrical distribution and heat pumps is available to use today.

By contrast, making zero carbon hydrogen from methane and sequestering the CO_2 [blue hydrogen] – or, better, from renewable electricity and water [green hydrogen] – is still a cottage industry. The safety and viability of converting the gas distribution system in the grid and in buildings from CH_4 to H_2 is still work in progress.

I understand that developing a gas appliance to transition from methane to hydrogen is not that hard and many manufacturers have done the R&D on it. However, most people, including proponents of hydrogen for other uses such as transport, think simply burning it is a criminal waste of a precious resource.

Compared to a heat pump that may give you three times more heat than the electricity you put in, a hydrogen boiler might only give 0.5 units of heat per unit of electricity to make green hydrogen – a factor of six worse. Given this, installing gas heating and waiting for hydrogen in the grid is not a serious route to decarbonisation.

For the whole country to decarbonise, every home will have to move away from gas heating, not just clients who are concerned about climate change and are the thinking engineers' customers. A realistic timescale for this is 25 years, so we should not be thinking only about what is available now, but also what the future of energy generation and supply will look like.

"The thinking engineer's money is firmly behind the electrification of heat in buildings for very good reasons"

Providing enough zero carbon power to meet our current needs is no trivial matter. More green power is required. I believe that the UK thinks offshore wind will provide its power needs by extending further into deeper water. Perhaps this could be done – but it will be hard because of its intermittency.

I would like to know if climate change is also likely to exacerbate the intermittency of wind energy in the same way as rain and water supply. One hears about the storms, but prolonged bouts of hot stable air could reduce the availability of wind energy.

The solutions to intermittency of any resource is generally a choice of:

- Collect far more wind and solar energy than needed and waste the excess.
- Store excess production to use at times of low production. This is the obvious solution. Short-term electrical storage in batteries or physical systems such as pumped hydro/falling weights/compressed air schemes are viable for short term fluctuations over a day or two, but not months. For this, you need to have a store of chemical energy such as hydrogen.
- Collect from a wider area on the basis that somewhere is always in surplus to serve areas in deficit. This involves trading the resource with other areas that are in different weather systems or always have a surplus.

Finding the right mix is what the next 10 years will be about. Solar and wind fuel is free, and the costs are made up of the infrastructure to capture, store and distribute the energy.

Wind installations will generate power at 4p/kWh, but only if most of the power is sold and not wasted. An energy storage system will only earn its keep when it cycles power in and out.

Daily storage would produce 365 cycles, whereas monthly would only produce 12 cycles a year to pay for the installation.

BILL WATTS
is senior partner at Max Fordham

Number of units of electricity to get one unit of heat	
1	Direct electricity
0.3	With a good heat pump
2	To make 'green' hydrogen

None of the solutions are currently easy or cheap, which is where hydrogen comes in. The cost of renewably sourced hydrogen is in the power, water, the hydrolyser to split the water, and the cost of storage transport.

One of the past decade's success stories for renewables is the rapid fall in the cost of solar power as the market has expanded. In the sunniest countries, the cost of electricity is falling to 1 cent/kWh from commercial plants. There is a challenge to get renewable hydrogen down to $2/kg [which is 5 cents/kWh] in four years. With the current commercial focus from wealthy oil exporting countries to solar, this is possible. Costs are unlikely to stop falling as demand becomes global.

Having solar-produced hydrogen delivered to the UK at 3p/kWh or less is possible within 10 years. This would give us the flexible supply that natural gas does currently. We could make our own Great British hydrogen in a turbine in the Atlantic, but I suspect it would cost more than solar energy from the desert.

The alternative way to get power from other climate zones is with a power interconnector. China has completed 3,000km high-voltage direct current power lines to transport 12GW of power from the windy central plains to eastern population centres. They are keen to promote a global grid to move power around the globe.

In the UK, it is an uphill struggle to achieve the changes required to decarbonise heating systems, so the less hassle required, the better. As such, a simple change from natural gas to hydrogen (keeping the same boiler) has its attractions. All the engineering and health and safety issues surrounding this are still there, but the government research timetable will give a decision on hydrogen in heat by 2026.

In those three years, a third of the UK's boilers could have been replaced and will last a further 15-20 years. If we do pivot to hydrogen, they should be capable of being switched from natural gas.

Don't forget smoke ventilation systems

It is vital to adopt a thorough approach to servicing and maintenance of smoke ventilation systems to ensure optimum operational effectiveness. Applied Technology's Bradley Crisp outlines some key practical steps

As highlighted by the Smoke Control Association in July's *CIBSE Journal* ('Safety in operation'), smoke ventilation plays a critical role in mitigating the effect of fires – particularly in the early stages of a blaze – by keeping escape and access routes free from smoke to allow occupants to exit the building. Such systems are also important in providing a level of reassurance to occupants, and they are an integral part of building safety.

However, because they are only required in worst-case scenarios, there can be a tendency to fit and forget these systems. This forms part of a wider industry malaise when it comes to contingency planning, and it is important to note that there are a number of fairly straightforward steps to ensure the ongoing effectiveness of smoke ventilation.

"It is important to stress the responsibility that building owners have to ensure their systems remain operational"

Correct storage

It is important that, from the outset, smoke ventilation products are stored appropriately. When part of a larger project, fans that are not installed immediately upon delivery can often sit on site for several weeks, or even months. In these circumstances, it is vital that they are kept in the right environment to prevent long-term damage or a reduction in their performance.

A fan should be kept in a clean and dry area, free from corrosive fumes, vibration and dust. Temperature fluctuations should also be avoided, with special attention given to removing any shrink wrap used during transportation. This can act like a greenhouse, meaning it gets excessively hot in the sun, before becoming freezing cold at night.

Another practical consideration is to rotate the impeller monthly, which helps to prevent grease separation and damage to the bearings. The impeller should not be returned to the same position after rotation.

In cases where fans must be stored for more than two years, bearings and grease lines should be flushed and repacked with fresh grease. If in doubt, contact the fan manufacturer for specific guidance on how best to store smoke ventilation units.

Regular maintenance

After installing the system, regular checks should be carried out during the operational lifespan of the fan. Inspection of the equipment should take place every six months, including testing the AVs, spinning the impeller and checking the running current – although this is a general rule and specific applications may need a more regular approach. It is also worth noting that the parts surrounding the fan should be maintained to keep the entire system operating effectively.

Elta Fans' Applied Technology division, for example, has included an indicative maintenance schedule in its installation and maintenance manual. It recommends that motor bearings are replaced after 20,000 hours of operation or five years of service in normal, ambient conditions, whichever is earlier. Another crucial piece of regular maintenance is to run the fan monthly, as a precaution against grease separation.

Other areas of note include an insulation test (every three months), checking the tightness of fixings (every three years), and cleaning impellers (also every three years). Maintenance checks should be more regular in more arduous environments such as transport or marine, where there is likely to be vibration and shock.

Care should be taken to keep a maintenance record throughout the operational lifespan of the fan. Alongside following best practice, this will be required in the event of a warranty claim. All maintenance work must be carried out by the manufacturer's 'authorised representative'.

Don't fit and forget

One of the biggest challenges for contractors, engineers and anyone else tasked with installing a system is that, once it is in the possession of end-users, you effectively lose sight of it.

It is important to stress the responsibility that building owners have to ensure their systems remain operational. If smoke ventilation is not correctly maintained, they need to be aware that they risk becoming liable. It is up to everyone in the industry to raise standards by highlighting why, and how, to keep equipment in optimum condition.

BRADLEY CRISP
is senior industrial and smoke sales engineer at Applied Technology, a division of Elta Fans

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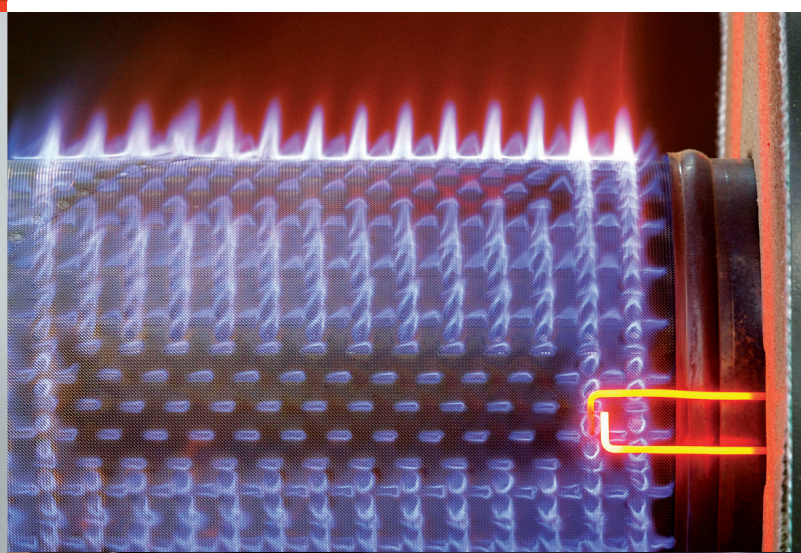

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CIBSE's 2021 Engineer of the Year, Sasha Krstanovic FCIBSE, took the bold decision to form a new consultancy at the height of the pandemic. She tells **Alex Smith** how she is using her knowledge and experience to help clients and communities work with designers to decarbonise their building stock

FOR THE GREATER GOOD

The past 18 months of the Covid pandemic has seen profound changes in the way we work, with many people reassessing their careers and taking on bold new challenges.

One of them was CIBSE's 2021 Engineer of the Year Sasha Krstanovic FCIBSE who left her job of 16 years at Aecom to start her own company in the midst of lockdown last year.

Krstanovic worked for some of the biggest building services engineers in the UK including Hoare Lea, BDP and Aecom before starting mstep with two partners, Cristiano Michelena and Fiona Esler. The fledgling building services consultancy works on new-builds, but mainly specialises in decarbonising existing building stock.

'I never thought I would say this so soon in the 21st century, but new buildings are easy to get to net zero. However, there is an energy-intensive network of buildings that need to be operated properly,' says Krstanovic.

Mstep's founding core values of equity, inclusion and responsibility are reflected in the work it is doing to decarbonise buildings in communities that don't have the finance – or knowledge – to improve their properties.

It is currently developing an assessment tool to help councils prioritise the decarbonisation of their building stock.

'Councils need help,' says Krstanovic. 'There are four million council homes in the UK. If local authorities are to hit net zero targets by 2030, then they will have to look at reducing carbon in their existing homes.'

Forward-thinking

Mstep stands for Mind, Skills, Tools, Environment and Planning, and it's no coincidence that the thinking comes first.

'We as engineers are inventors, thinkers, tinkerers,' says Krstanovic. 'It's a waste of talent if we always default to the way things have been done before. I really don't like lazy engineering, where we won't look at something if someone says it won't work.

'For example, engineers will specify fan coils because in tall buildings agents will say clients don't want anything else, but that's crazy,' says Krstanovic. 'We're the engineers, and we're meant to be suggesting what's better for the building, the owner and the world. It's a waste of talent if we don't.'

All four full-time mstep staff work from home, with Krstanovic based in her North London family home of more than 20 years that she shares with her scuba diver husband and 'techy/arty' younger child. Her eldest son is studying ocean science in Plymouth.

By her side on my visit were her two doting dogs Tia a Hungarian Vizsla and Zhuchka, a 'Serbian street dog'.

She is a keen supporter of flexible working and believes office space is too valuable in terms of carbon and energy for someone to 'be sitting in a chair all day writing emails'. Rather, she says, they should be reserved for creative collaboration and the exchange of ideas.

'I believe organisations will get the best out of people if they support their lifestyle, whether that be working nine to five in the office, working from the beach or anything in between.'

She believes Covid has accelerated the move to more flexible working though she believes construction was becoming more receptive to home working even before the pandemic. At Aecom, where Krstanovic was a director, a Freedom to Grow plan gave 70,000 staff the opportunity to work where they liked.

Flexible working is particularly beneficial

CURRICULUM VITAE

- **August 2021:** HS2 design panel
- **August 2020:** Founder, mstep
- **December 2019:** Director, the Equilibrium Network Group
- **2018:** Trustee and board member of Higher Education Design Quality Forum
- **March 2004 to August 2020:** Director, Aecom
- **1992-94:** Bachelor of Engineering (BEng Hons), mechanical engineering, Imperial College London
- **1986-1991:** Bachelor's degree, mechanical engineering, University of Belgrade

Interests

Krstanovic is a keen diver and director of the London Diving Centre, where she manages the social media channel. She says diving brings her closer to the environment and has made her aware of the responsibility of humans to protect the oceans.

Mstep founder Sasha Krstanovic is a keen advocate of flexible working

to women and families, says Krstanovic, who has long been a champion for women working in construction (see panel 'Mentoring').

A collaborative approach

The judges at the Building Performance Awards recognised Krstanovic's progressive, far-sighted approach to multidisciplinary collaboration and learning. 'Sasha's view that the challenges we face as an industry must be tackled not only with skills, but with a completely different mindset, is very refreshing and inspiring,' they said.

Krstanovic says her experience working in large consultancies has taught her the value of a collaborative, open approach to design, where multiple disciplines all contribute to a project from the earliest stage. She says this is where engineering thinking can have the greatest impact.

'I've been told by engineers that the concept stage is green and fluffy but, just because the concept has no straight lines, doesn't mean that a great deal of thought hasn't gone into it. That's where we have the opportunities to deliver healthy, safe and efficient buildings,' she says.

> "We're the engineers, and we're meant to be suggesting what's better for the building, the owner and the world. It's a waste of talent if we don't"

'Someone asked me recently "how do you ensure renewables don't break the budget?" The answer is you sit down with the design team, discuss the brief and its challenges, and then test options while being deeply honest with each other. The budget will move round to meet the requirement of the brief.'

Krstanovic believes you can only input successfully at the early stage if you have knowledge of the whole design process and understand the input of other disciplines. That way, trust can be built between team members.

'You need to establish trust with an architect that you are asking only for the space you need, and that you won't be the person recklessly pulling ductwork through their work of art,' she says.

Partnership working extends to the mstep office, too, says Krstanovic. 'No-one's decision is more important than anyone else's. There's no hierarchy. We agree by consensus.' »

"I'm a hippy. I like to be at the centre of the world's peacemakers. Working with the UN is a massive honour"

MENTORING

The support Sasha Krstanovic was given at the beginning of her career has made her keen to help the next generation of engineers. Two of her most prominent supporters were former BDP director and chairman of Environmental Engineering Bob Spittle and Hoare Lea consultant Paddy Conaghan. She says Conaghan's belief that engineering should always delight has stayed with her. She also cites Aecom fellow Ant Wilson and Stanhope's Peter Williams as having major influences on her career.

Krstanovic currently mentors one male engineer from Aecom for iMechE chartership, and a woman she met through Regen Women in Renewable Energy (ReWire). 'It's really important to learn a lesson and pass it on and it's also an opportunity to be present in the minds of new engineers and understand how they think. I learn at least as much from them as they learn from me,' she says.

She is a CIBSE volunteer mentor helping women at the mid-stage of their career and where mentoring is not available internally at companies. She is also a director at the Equilibrium Network, which connects senior females and is focused on stopping the attrition of women in the construction industry.

Mothers are seen as a liability in business and being overlooked for promotion, says Krstanovic but she believes they make the best project managers because 'parents of small children are the best managers in the world'.

Despite feeling lucky to be living in a time where people understand the value of families, Krstanovic still says too much female talent is being lost. 'Women leave the industry because they've heard that stupid joke too many times, or heard something offensive too many times. The pay gap is also still an issue,' she says.

Krstanovic thinks more senior leaders should become mentors. 'Historically, it was thought that if you were very senior you shouldn't be mentoring junior people, because you should be doing your job,' she says. 'I think that's rubbish.'

» She says services engineers are now much more closely involved in early design than at the start of her career when they weren't bought into the process until Stage B or C – too late to integrate sustainable design.

She believes the education system is helping by increasingly integrating engineering with other disciplines.

'It's getting better, and there are now good multidisciplinary courses that get architects to work with engineers and structural services early on,' says Krstanovic, who has taught at Nottingham and Loughborough universities.

Positive POEs

She is a keen proponent of post-occupancy evaluation and believes all buildings should have a feedback mechanism. While at Aecom she co-created the Better Buildings Group, which led to new design standards that include sustainability and build performance checks in reviews at each stage of the project.

'Post-occupancy evaluation is a brilliant thing. It's a learning opportunity and offers the chance to fix issues. The best buildings I have been involved in are the ones I still go back to today,' says Krstanovic.

'I would like to see a world where it's not sold as a separate big package – it's not easy for someone to approve several thousand pounds to sniff around your building,' she says. 'It needs to be woven into a process a lot earlier.'

Krstanovic is keen that buildings using new technology are closely monitored. 'With new technology, if the building fails, new products will be blamed. Often there is no aftercare, and no-one to asks if things aren't working,'

With her experience working collaboratively on project briefs, it is unsurprising that some of mstep's work is on the client side, including a prestigious project advising the UN on its Geneva office retrofit.

'Everyone understands the value of project managers and architects on the client side, but now people are also beginning to understand the value of engineers informing the brief,' she says. 'Architects stay with their concept to the end, otherwise elements get changed on site, and nobody wants to sign off the project. We should be more like that. There needs to be an engineer from beginning to end to make sure the concepts don't get diluted,' she says.

The work with the UN chimes with mstep's founding values and it is also committed to UN Sustainable Development Goals (SDGs) 'I'm a hippy. I like to be at the centre of the world's peacemakers,' Krstanovic says, smiling. 'Working with the UN is a massive honour.' In line with the SDGs, mstep has been working with community energy groups to decarbonise existing housing stock.

It is collaborating with not-for-profit community group Power Up North London (PUNL) and is looking at creating a development assessment tool, which will enable councils to make informed decisions about the buildings they should tackle first.

It is using information from display energy certificates to help create the tool, which mstep says will enable councils to make decisions about 70% of their stock, without having to spend money on individual surveys.

With an accurate energy assessment of stock, Krstanovic says councils can prioritise tenants affected by fuel poverty and groups such as PUNL will be able to attract private-sector funding and apply for grants.

Krstanovic is keen to make a difference in her new venture, particularly to those with no means of decarbonising their building stock.

'You have to put your knowledge where it is useful, for the greater good,' she says. 'Even if something else might be more interesting and better paid.' **CJ**

'You have to put your knowledge where it is useful, for the greater good,' says Krstanovic

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Reconnecting communities post-Covid was one of the key themes of this year's ASHRAE summer conference. **Tim Dwyer** reports on the Society's global aspirations and why cybersecurity and interoperability are key to getting connected

GLOBAL REACH

Each year, the summer ASHRAE meeting provides the prime opportunity for the incoming president to make their mark as they launch their year in office with an inaugural address. President Mick Schwedler's theme for his 2021-22 term is 'Personal growth. Global impact. Feed the roots.'

Following a year during which many have been isolated, with communications and networking confined within a virtual world, Schwedler spoke of a re-emerging community where professional and personal friendships are made, maintained and developed, and where theories and experiences are exchanged.

He focused on how his personal development, and the individual threads that have made ASHRAE, could each be tracked back to two or three influential people who directly fed the roots of development. His challenge to the community was to 'reach out' and feed the roots of the future, so that their knowledge and experiences may inspire and inform the next generation of engineers.

Despite the continued constraints of the pandemic, the meeting attracted more than 300 presentations across the various sessions. Here are just a few examples from the host of presentations that echoed Schwedler's theme for developing skills in communication – in these cases, both personal and digital.

'Global impact' would appear to be a key expectation of the work of a new ASHRAE Task Force for Building Decarbonisation (TFBD) that has been formed by outgoing president Chuck Gulledge and incoming president Schwedler.

As one of the many seminars presented online, key players in the task force, and past ASHRAE presidents Don Colliver and Tom Phoenix, provided an introduction to this recently constituted,

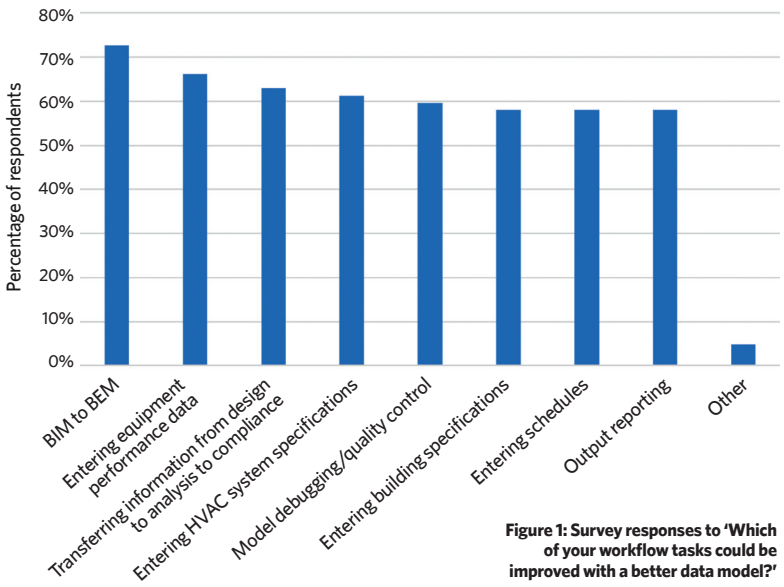

Figure 1: Survey responses to 'Which of your workflow tasks could be improved with a better data model?'

15-strong group and its working groups, which have been established with more than 100 global volunteers.

Underpinning its goal to reduce greenhouse gas emissions are three pillars: energy efficiency; switching to cleaner energy sources; and shifting to electricity produced with low carbon energy sources. The working groups' early activity will be to identify current sources of knowledge and expertise within ASHRAE and other organisations around the world.

The working groups will consider operational and embodied carbon; building performance and equipment standards; building-grid communications; and research, training and education. Key outputs of the task force will be to develop and promote knowledge and understanding that can be used, on a global scale, to influence and inform industry stakeholders and, presumably, the international audience of legislators and governments.

Minimising IoT risks

Networking and communication of a rather different sort was at the heart of seminar five. This considered the impact of the proliferation of equipment with embedded factory-installed internet of things (IoT) controls that can intelligently control themselves throughout their operation, with minimal input from a supervisory controller or building management software.

Presenter Patrick Villaume, of Patterson-Kelley, manufacturer of commercial boilers and water heaters, provided a primer in connecting building appliances to 'smart' systems, and emphasised how this technology has opened buildings to potential risks in security.

He was clear that embedding IoT equipment can provide important benefits, including data collection, automation, observation, intelligent controls processes, increased building efficiency and equipment life – and, critically, happier occupants – through the more consistent automated control of the internal environment.

But he pulled no punches in listing the risks to the level of security on the controlled device, as well as the wider system, which includes risking the safety of data, the appliance, and the building itself.

He noted that manufacturers of some appliances, such »

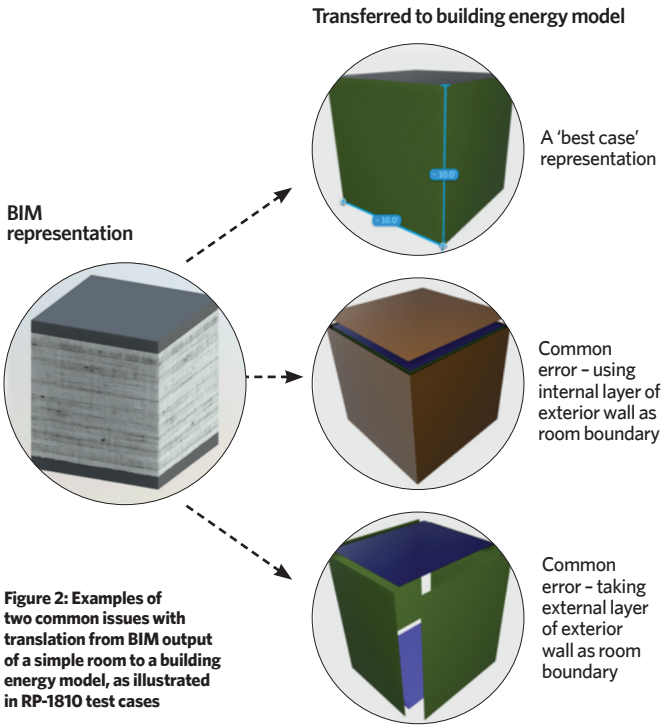

Figure 2: Examples of two common issues with translation from BIM output of a simple room to a building energy model, as illustrated in RP-1810 test cases

» as boilers, effectively 'firewalled' elements of control that could not be overridden by remote connections – such as a flame failure device – to block inappropriate access.

Similar techniques are used to limit the level, or granularity, of data that can be downloaded from a device unless it is being accessed locally.

Where the device itself does not include such facilities – for example, in low-cost, ubiquitous sensors – they should be connected through a gateway device that is specifically protected, such as through a digital firewall.

Villaume concluded that building operators must be aware of the potential for cybersecurity risk by knowing how the items in the facility interact with the building. They should know if a device must be connected to the outside networks to function properly and understand if devices have built-in protection, or if additional protection is required external to the device.

Improving software interoperability

The recently completed ASHRAE research project RP-1810 *Development of reference building information model (BIM) test cases for improving usage of software interoperability schemas* provided the basis for the three presentations of seminar 15.

This research project has developed a series of standardised cases for testing the output from BIM software to ensure that data can then be appropriately used by building energy modelling (BEM) software. Stephen Roth, of Carmel Software, referred to the output of a recent survey of, predominantly US-based consulting engineers, energy modellers and researchers (undertaken by IBPSA-USA – see **bit.ly/CJSep21TD1**), which showed that the transfer of information from BIM to BEM was considered to be the workflow task that could do with most improvement (see Figure 1).

Roth focused on the issues involved with flow of information from BIM to BEM software tools that include geometry misrepresentation and information deficiencies, as illustrated in Figure 2.

In the same seminar, Weili Xu, of BuildSimHub, reported on the importance of the accessible web-based software tool for simple data validation and basic model checking that had been developed as part of the project. He introduced the different types of validation test cases that are required to successfully streamline the flow of building information from BIM to building analysis software tools.

The project has initially developed 19 test-case documents, which have been chosen to represent areas that have proved challenging in the BIM to BEM transfer process, such as: atria; rooms inside rooms; concave-shaped zones; and window frames.

These have been developed as a set of tests that assess the ability to create well-formed gbXML, an open schema developed to facilitate transfer of building data stored in building information models to engineering analysis tools.

Software designers can use the test cases to create gbXML files that will then be uploaded to the web-based validator to provide feedback on the validity of the files. The current set of cases and more detailed information are available to view at **data.ashrae.org/1810rp**.

Virtually interesting

There were several sessions at the conference that encompassed personal communications skills, including a lively discussion chaired by ASHRAE Communications Committee vice-chair Karine LeBlanc.

This virtual 'meet up' discussed how to keep virtual meetings engaging, explored different ways to present, and considered how to minimise Zoom fatigue and maintain networking when working in a virtual environment.

As well as providing some helpful practical examples during the session, LeBlanc highlighted a useful document, freely downloadable from the ASHRAE website, which provides guidance for holding virtual meetings. Although it is written to support ASHRAE meetings, it contains an excellent general resource for hosting any virtual meeting.

The 20-page PDF document is available from **bit.ly/CJSep21TD3** and gives an example of how free dissemination of information can make a significant contribution to the presidential aim of feeding the roots. CJ

■ Continuing his theme of outreach, ASHRAE President Mick Schwedler recently participated in a CIBSE #WeChampion webinar on presentation skills, where he spoke on 'Present to win' – visit **bit.ly/CJSep21TD4**

Outgoing ASHRAE president Chuck Gulledge

ASHRAE President 2021-22 Mick Schwedler

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A SHARING SOCIETY

A pioneering energy network in London aims to use waste heat and integrated grid power to reduce carbon emissions and tackle fuel poverty in a series of connected buildings, as **Andy Pearson** finds out

The Green Smart Community Integrated Energy System (GreenSCIES) in the London Borough of Islington is intended to use waste heat and integrate grid power to help reduce carbon emissions by up to 80% compared with current, conventional systems. The energy network should help reduce the cost of low carbon heat to residents and tackle fuel poverty in the borough. The vision is that GreenSCIES will be rolled out over a significant area of Islington, so it can supply low carbon heat to more than 10,000 residents in 3,500 homes, along with up to 70 businesses.

Following a feasibility study led by London South Bank University, the focus now is on developing the design and commercial delivery packages for the New River area part of Islington to test the concept. Silver EMS, a heat network specialist and MEP consultancy, is delivering a RIBA stage 2+ design for the New River scheme. It is working with Cullinan Studio, which is developing the architectural design of the scheme, and other partners that are providing specialist support services.

'Ultra-low temperature 5th generation heat networks present a major opportunity to decarbonise whole areas where there are large heating and cooling demands that can be shared across an ambient loop,' says Phil Jones, of Building Low Carbon Solutions, who led on the development of the GreenSCIES concept design. 'This is potentially a major solution for reaching net-zero smart local energy systems (SLES) in cities by integrating infrastructure like heat networks, heat pumps, thermal storage electric vehicles (EVs) and PVs.'

> "This is potentially a major solution for reaching net zero SLES in cities by integrating infrastructure"

Bi-directional flow

The New River scheme will include three council-owned residential blocks, two university campuses, a theatre, primary school, library and, crucially, a data centre. When complete, this section of the scheme alone is expected to save more than 5,000 tonnes of CO_{2e} annually. The layout options for the network under consideration, including the pipework route, connected buildings and energy centres, are shown in Figure 1.

Fundamental to the scheme is a two-pipe ambient loop district energy network. This will allow low-grade thermal energy to be exchanged between buildings requiring heating and cooling. The loop is formed from two pipes: one warm, one cold (Figure 3).

'The design will permit bi-directional flow within the pipes, to allow energy exchange to take place between heating and cooling customers at different times and in different locations, depending on where demand is at any given time,' says Dr Anthony Riddle, technical director of Silver EMS. 'Circulating pumps will be located across the network at customers' energy centres, facilitating the bi-directional flow concept and enabling the network to be readily expanded as customers are connected in the future.'

An existing data centre will provide the primary source of waste heat for the New River scheme. It will be connected to the ambient loop through a heat exchanger substation. 'This will recover heat from the

GREENSCIES PROJECT TEAM

The consortium includes the following partners:

Building Low Carbon Solutions
Carbon Data Resources
Carbon Descent Projects
Cenex
Consortio
Cullinan Studio
E.ON
Grid Edge
Hanger 19
London Borough of Islington
London South Bank University
Operational Intelligence
Repowering London
Silver Energy Management Solutions
Transport for London
West Midlands Combined Authority

Three of the buildings that will be in the New River scheme ambient loop from clockwise: City University, Spa Green Estate and Sadler's Wells Theatre

return of the chilled water primary circuit, before returning it to the data centre chillers,' says Riddle. Heat recovered from the data centre will be distributed by the warmer of the two pipes. Initially, this will be at about 15°C but the network and heat exchanger substation will be designed to accommodate increases in heat recovery temperature in line with anticipated enhancements to efficiency of customer cooling systems.

A series of dedicated decentralised energy centres will connect each heating customer to the ambient loop through packaged heat pump systems coupled to large-capacity thermal stores. Cooling customers, including the data centre, will connect to the loop through dedicated decentralised energy centres containing heat exchanger substations.

Cooled water leaving heating customers' heat pump evaporator circuit heat exchangers will be returned to the data centre and other cooling customers through the cooler of the two ambient loop pipes. It will provide cooling at a temperature just sufficient to meet customer requirements. At first, this will be around 10°C but the heat pumps, the ambient loop network and cooling customer heat exchanger substations will be designed to accommodate increases in heat recovery temperature in line with anticipated enhancements to efficiency of customer cooling systems.

Balancing loads

To maximise both the economic and carbon benefits of using an ambient loop, it will be important to balance the heating demand with the cooling load across the network. It is also key to maintain the temperature of the cold loop at a low enough value to meet the cooling requirements of the data centre and other customers. 'This presents an interesting control challenge for the network, a critical objective being to prevent uncontrolled mixing of the warm and cold pipes so as to avoid diluting the quality of cooling delivered to the cooling customers,' Riddle says. Optimisation of the hydraulic and control concepts are ongoing and will be carried out by the end of this year, once the preferred network route has been established. Hysopt »

» software will be used to assist in this process.

When it is not possible to balance short-term heating and cooling loads across the network, the plan is to use an aquifer thermal energy storage (ATES) system to supplement the shortfall. This will also provide a means to store surplus energy inter-seasonally.

Three bi-directional borehole pairs will transfer energy between the ambient loop and the warm and cold sides of the ATES system. Heat transfer will take place across a heat exchanger substation. The hydro geology of the aquifer is being modelled by Agua Enodo. Preliminary results show the ATES is viable with varying degrees of efficiency. As yet, no trial boreholes have been drilled.

'Through a combination of inter-seasonal storage and operational setpoint control of various distributed assets within the network, the intention is to allow the future scheme operator to vary the temperature difference between the warm and cold pipes, particularly when demand is high. This will reduce pumping energy requirements during these periods, cutting the carbon penalty of delivering heat and coolth,' says Riddle.

To ensure an uninterrupted supply of coolth, the scheme will be configured so that one of the heat pumps is able to operate as a water-cooled chiller at times when demand for heat is low and the ATES has been depleted or it is more cost-effective to generate coolth using the chiller as opposed to discharging the ATES (shown as A-loop chiller in Figure 2).

In this mode, the heat pump will condition the cold side of the loop through its evaporator circuit, but heat rejected from the condenser circuit will be discharged to the aquifer. 'This will reduce reliance on customer heat pumps and improve financial returns,' says Riddle. 'A number of techniques and options for doing this are under consideration in the ongoing concept development.'

'The aim is for the network to be capable of operating seamlessly and automatically in a number of operating modes to cater for varying load conditions and for future expansion of the network and data centre, which could significantly increase the amount of heat available,' says Riddle. Islington Council will be the biggest user of waste heat. As the ambient loop becomes established, other customers with heating loads will be able to use waste heat from the data centre and those with cooling systems will be able to reject waste heat into the network.

Pipe routes are still being established through site surveying and utility mapping. A big advantage of the loop being at ambient temperature is that the pipework will be at a similar temperature to that of the ground and outside air. This helps limit external pipe diameter requirements and minimises heat losses. Architect Cullinan Studio has investigated running pipes above ground in key locations to avoid the complications of having to bury it at complex crossings within Islington's utility-congested streets.

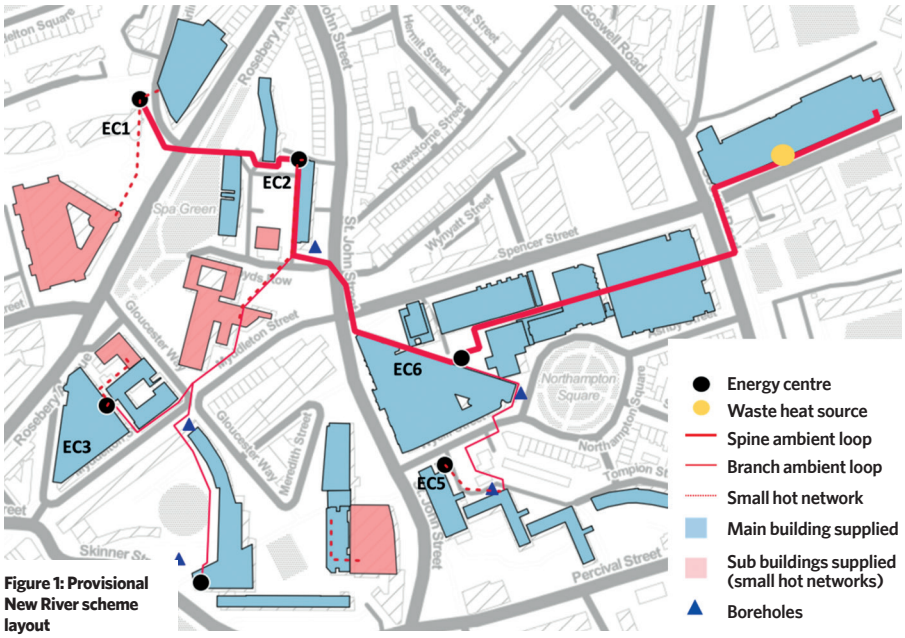

Figure 1: Provisional New River scheme layout

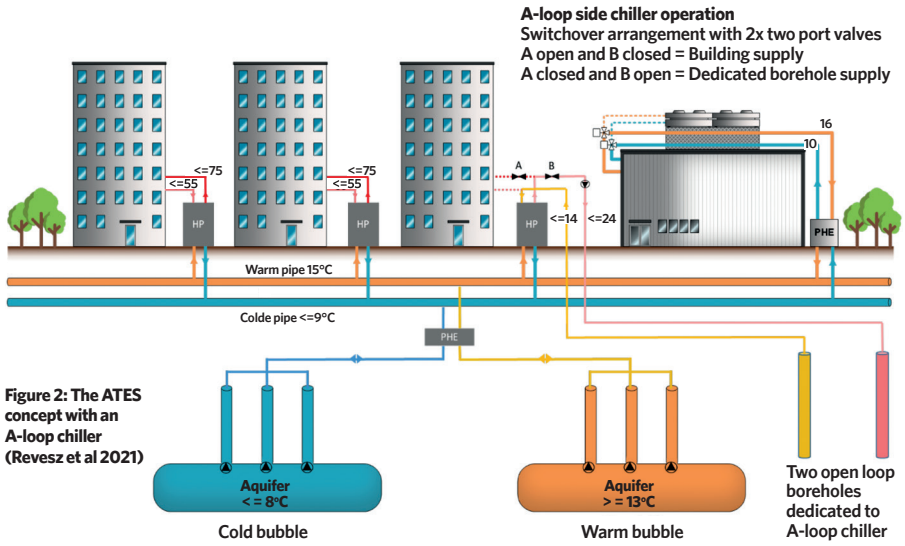

Figure 2: The ATES concept with an A-loop chiller (Revesz et al 2021)

Branch connections will link smaller customers to the main decentralised energy centres connected to the loop. The heat pumps will typically be specified to generate at up to 75°C to meet the needs of the existing heating and hot-water systems of connected buildings.

'The heat pumps will be specified to have the ability to operate at lower temperatures so that, over time, generation temperatures can be relaxed on a building-by-building basis as owners invest in improvements to the fabric and/or to space heating and domestic hot water distribution systems,' says Riddle.

The scheme is being designed to fully displace fossil fuel requirements for space heating and domestic hot water. 'However, the intention is that buildings with existing heat-generation assets will retain these for back-up purposes in the early years,' explains Riddle.

The thermal stores have been based on techno-economic optimsation carried out by Carbon Decent (see Table 1: 'Thermal store capacity'). The heat pumps will charge the thermal storages when grid electricity prices are at their lowest, either overnight or during the day when there is surplus electricity production on the system.

When the price is lowest should also coincide with low carbon content in the grid. Thermal stores will allow heat pumps to operate continuously for a longer period of time, rather than cycle on and off, which will help maximise operational life. Although heat »

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» pumps will be specified with variable speed compressors and drives, they will typically be set to run at constant load, charging the thermal stores as they do so. This simplifies hydraulic control of the ambient loop.

The techno-economic proposition of flexible operation of the assets has been investigated through techno-economic modelling led by Chris Dunham (Carbon Descent). It has shown that, as well as making significant carbon savings, the concept can deliver affordable heating to residents and competitively priced cooling and EV charging.

A number of heat pump models and refrigerant types are being considered based on coefficient of performance (COP) and capital cost. LSBU's Heating and Cooling Team, led by Graeme Maidment and Akos Revesz, carried out a detailed investigation comparing the life-cycle performance of a number of different heat pump units.

'The intention is to retain flexibility in the design and keep the accompanying technical specifications relatively loose to ensure that, when the scheme goes to market, supply of the heat pumps will not be confined to particular technologies, manufacturers or refrigerant types. It will also be important to future-proof the designs to allow a range of latest generation refrigerant technologies to be implemented safely and cost-effectively over the life of the network,' says Riddle.

Various configurations in the energy centres are being assessed, including using multiple heat pumps operating with condensers in series to reduce the temperature increase required by each individual heat pump to improve operating efficiency. LSBU found that by arranging multiple heat pumps with condensers and evaporators in series COP could be increased by up to 30%. This arrangement has the benefit of being able to take a heat pump out of operation and still run the remaining units. The performance benefits of connecting the heat pumps in series needs to be offset against the additional capital cost and the increased requirement for plant space.

Plant space is a major challenge when retrofitting the energy network to existing buildings. In general, there is insufficient space in the plantrooms of most buildings to accommodate the additional requirements, which is why the scheme has gone down the route of constructing the new energy centres. To minimise the space required by the thermal stores, the use of phase change material (PCM) thermal storage is also being considered.

The distributed energy centres allow the installation of local hot networks to give heat to smaller customers without the need to connect to the loop. This has benefits where there are space limitations or where the connected loads are too small to warrant additional investment.

It is in the energy centres where the heat network is integrated with building-mounted PV systems and EV charging points. The decentralised energy centres effectively become the hub of a 'micro-grid'. These could also incorporate grid electricity storage provided by the batteries from connected EVs. This will enable the system to respond to electricity grid demand and tariffs. AI will be used to help flex electricity demands from heat pumps and electric vehicle charging in response to price signals from the grid and the intermittent output of solar power.

Implementing schemes like this, with its economic, community, and environmental benefits will be critical if we are to reach the target of net zero carbon for existing buildings.

'GreenSCIES will contribute to London's zero carbon ambition by decarbonising the local energy system in Islington as part of its Net Zero Carbon Vision 2030,' says Revesz, technical lead at GreenSCIES, who says the project is looking at scaling up the concept. 'We strongly believe that the implementation of schemes like this could provide a roadmap to help towns and cities across the UK and elsewhere achieve net-zero targets on time.' CJ

Table 1: Thermal store capacity

Buildings	Annual heat demand (MWh)	HP capacity (kW)	Thermal store capacity (m^3)
Theatre	2,182	900	110
LBI Estate 1	2,718	600	100
University Campus 1	1,946	900	95
LBI Estate 2	4,534	900	140
LBI Estate 3	3,338	900	130
University Campus 2	8,665	2,600	210

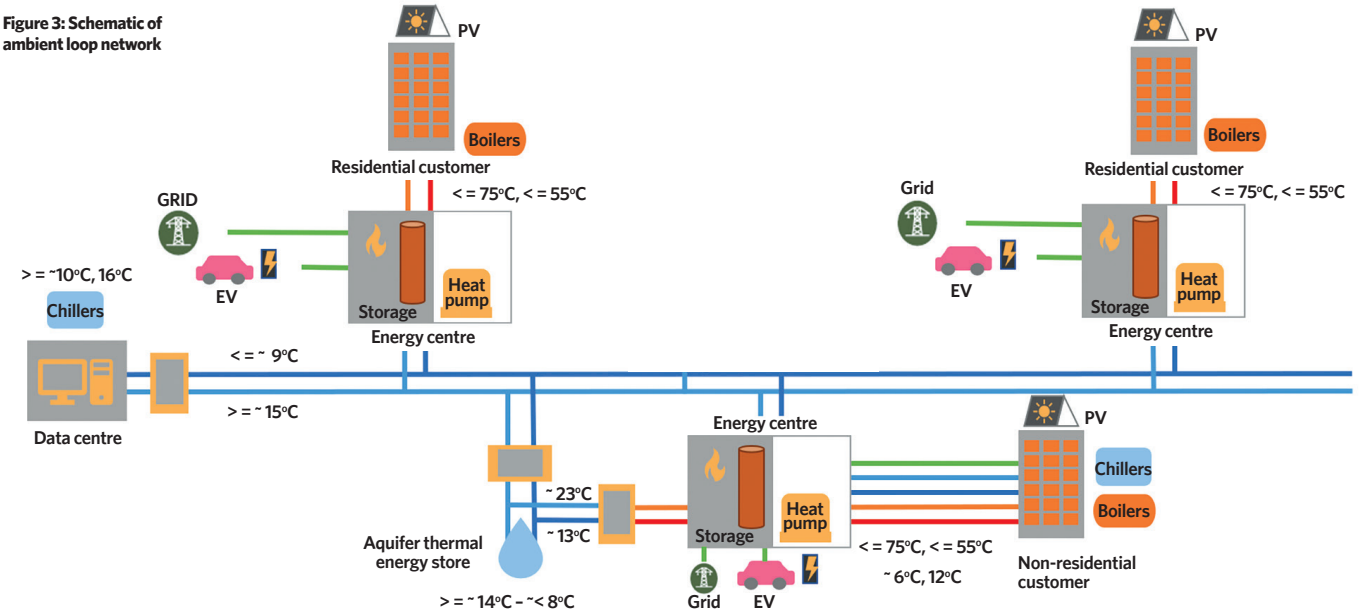

Figure 3: Schematic of ambient loop network

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SCHOOL SAVINGS

Decarbonisation funding is helping UK schools kickstart their journey towards net carbon zero. Barker Associates' **Tom Deacon** explains how data is helping his firm save 1,170 tonnes of carbon in 130 education projects

Government funding helped school decarbonisation projects

Launched in September 2020, the government's Low Carbon Skills Funds (LCSF) and Public Sector Decarbonisation Scheme (PSDS) together formed the most significant single injection of funding by government into the decarbonisation of the public estate.

Through both PSDS and LCSF, Barker was able to help more than 60 education academy trusts and individual schools to successfully secure funding for the identification of decarbonisation projects, technical solution development and their physical implementation.

At £1bn, this was a staggering investment by the Treasury. The funding came from the BEIS and was administered by Salix Finance In the short term it was designed to boost the UK economy through the pandemic and, at the same time, invest money in tackling climate change – kickstarting the Prime Minister's 10-point plan for a green industrial revolution.

No time to lose

The timescale for delivery was extraordinarily ambitious – projects approved in early January 2021 had to be completed by the end of March 2021. This would require real innovation in delivery approach and, from a technical standpoint, it was imperative that the money was carefully directed towards projects that would have the most impact.

LCSF has enabled many public sector organisations, often for the first time, to commission energy assessments, decarbonisation site audits and technical feasibilities – prompting data collection and identifying the ways they could invest in their estates and save energy.

PSDS has enabled delivery of selected projects at a significant scale. Now complete, the projects supported by Barker are set to deliver an estimated 1,178 tonnes in carbon savings and £1.4m in revenue savings per annum. A drop in the ocean perhaps – but a step in the right direction.

There is a lot to be positive about. But how do we, as engineers and buildings professionals, make sure that these projects are making a real difference – especially when delivering projects at the pace required to tackle the climate emergency? The lessons learned through this process are summarised below:

A data-led approach is key

For some time, the industry has been helping clients to understand their building energy consumption problems. Even with this data, the barrier has been their inability to fund the required actions.

The LCSF and PSDS funds have provided public sector clients with an opportunity to unlock solutions to these problems. Securing professional support to survey sites in detail allowed them to identify technical solutions that could be implemented and ultimately determine their own unique roadmap to decarbonising their estate. For many, this is the first time they will have been able to commission such activities. Having clear information on which to base investment decisions is one of the essential first steps to turning ambitions into concrete actions.

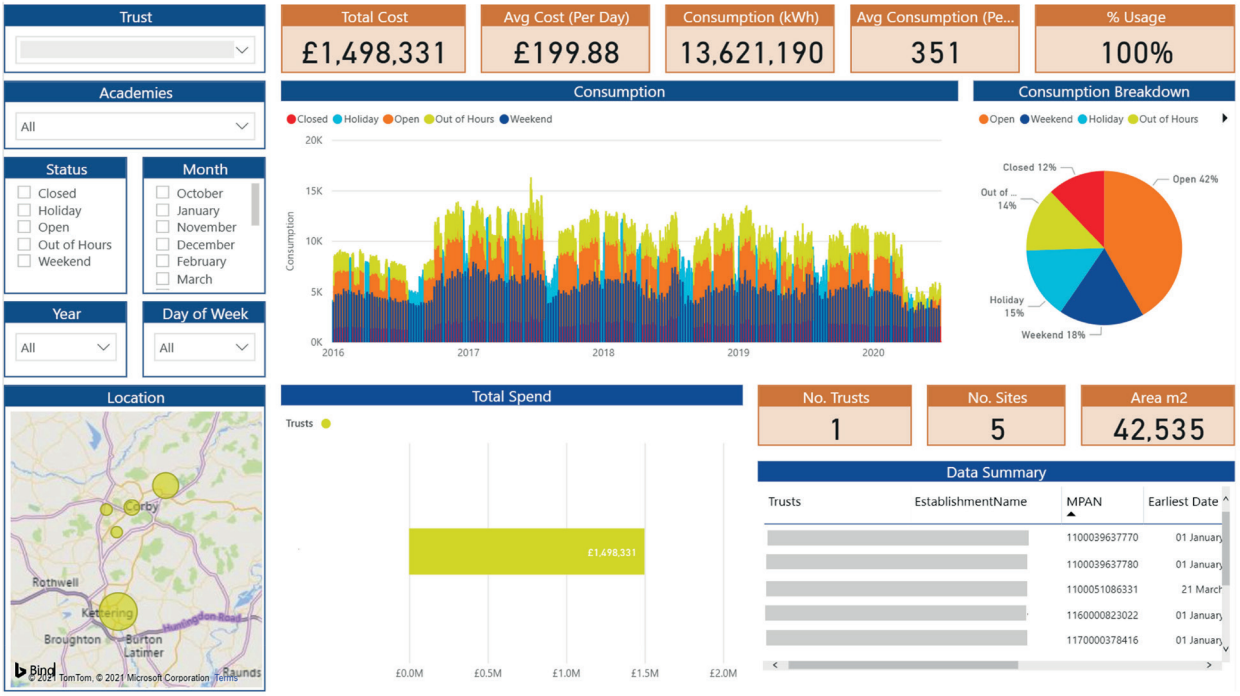
Monitoring the outcome

In our experience, the true value comes when clients can aggregate the potential carbon and cost savings data across their entire estate and take a strategic view. Only then are they able to make the right decisions and drive best value.

Through assessing energy savings opportunities at scale, it quickly became apparent that the small things really do matter. Low-cost and easy interventions such as installation of valve jackets, localised radiator controls, pipework insulation and low energy hand dryers individually had excellent £/tCO_2e savings potential. These modest interventions, when tackled at scale, can make big inroads into carbon emissions, and should not be overlooked.

Even when working at pace, it was vital to take a long-term view and avoid installing 'fit and forget' technology. A critical part of the delivery plan was providing metering and monitoring technology alongside the projects themselves with the aim of giving clients better insight into building energy usage patterns.

By integrating both hardware and software monitoring solutions into PSDS-funded projects, it has enabled



Dashboard showing performance of existing schools. Understanding of energy use is key

clients to monitor the return on investments made and supply essential data to inform their next steps on their decarbonisation journey.

For many public sector clients this is the first time they have been able to see, in real time, how their assets are performing – and how they can decarbonise even further. As technology advances, this data will be essential.

In summary, LCSF and PSDS has enabled a step change in public sector action on the climate emergency for those organisations benefiting from the funding. Through smart use of data and technology it has been possible to tackle priority projects at pace.

Over the course of the next 12 months, we intend to use the data we continue to capture to shape and evolve decarbonisation implementation plans further.

What is clear is that there is a huge need and appetite in the public sector for further decarbonisation. Technology must develop quicker, become cheaper and further funding support will be required so the momentum does not dip.

There is so much more we need to do and engineering solutions will increasingly be at the heart of this. CJ

TOM DEACON is a partner at Barker Associates

Table 1: Barker-led low carbon skills fund in number	
Total number of viable energy-saving projects identified	6,000
Total carbon saving potential identified (tonnes per annum)	2.13 million
Total estimated financial savings potential (£ per annum)	£280m

Table 2: Barker-led public sector decarbonisation in numbers	
Total number of individual energy saving projects delivered	130
Total value of PSDS Projects	£8.8m
Total carbon saved (tonnes per annum)	1,170t
Total estimate financial savings (£ per annum)	£1.38m
Number of light fittings changed	26,800
Quantity of PV panels installed	9,000

Table 3: Technologies deployed through Salix funding	
LED lighting and controls	AHU optimisation
Increased building fabric insulation	Air source heat pumps
Mechanical pipework insulation	Building automation/BMS controls
Window replacement, secondary glazing and solar control film, and solar PV panels	Smart radiator valves
	Smart showers and taps
High-efficiency boilers	Pump replacement and controls optimisation
Fan/pump controls	Smart metering and remote monitoring

The upfront carbon of retrofitting an existing office is a fraction of that in a new-build, but this is not yet recognised in net zero targets, says JLL's **David Bownass**, who puts forward his recommendations for operational energy and carbon targets

UPFRONT ON CARBON

Net zero carbon (NZC) retrofit is more complex and expensive than new build. It's also the largest part of the market requiring improvement if the UK is to reach its 2050 NZC goal.

Retrofitting existing office buildings has a significant benefit over building new NZC offices; the upfront carbon of the retrofit is a fraction of that in a new build. Upfront carbon is carbon in construction & materials (embodied carbon is everything except operational carbon [energy & water] & circular economy.)

Conversely, reducing energy demand in existing buildings is more difficult. These differences are not recognised in the application of current NZC office guidance. The new build NZC office operational energy target of 55kWh·m^{-2} per year gross internal area (GIA) and upfront carbon (design target C rating) of 600kgCO_2·m^{-2} targets are the same for retrofit and new build.

Carbon emissions are the same irrespective of their source, a kilogram of upfront carbon is the same as a kilogram of operational carbon.

A more pragmatic approach to NZC retrofit is required. Our research suggests NZC retrofit can be constructed to alternative operational and upfront carbon targets while achieving the same whole life carbon (WLC) outcome.

Our recommendation, for broader market discussion, is that NZC retrofit should have an operational energy target of 80kWh·m^{-2} per year (GIA) with an upfront carbon target of 258kgCO_2·m^{-2}. This provides the same WLC outcome and acknowledges the differences between retrofit and new build, while improving the financial business case and encouraging more NZC retrofit activity.

The aim of the article is to start a conversation about appropriate retrofit NZC targets. Retrofitting existing stock is the 'NZC priority', given that most buildings in the UK today will still be in use in 2050.

The UK Green Building Council (UKGBC) and London Energy Transformation Initiative (LETI) NZC guidance is geared towards new build, although currently it is also applied to existing buildings. This is understandable because, historically, the construction market has focused on new build, but in future this will not be the case.

Current UKGBC and LETI guidance is just the start of the NZC journey and further guidance will no doubt follow to cover different building types, WLC and, hopefully, existing buildings. It's also possible that energy use intensity (EUI) targets may change if the projected UK renewable energy-generation capacity increases markedly. LETI acknowledges this, and considers current EUI targets are 'indicative and should be refined in future'.[1]

LETI recognises the existing building challenge and states: 'We will not be able to retrofit existing buildings to the same levels of fabric efficiency (as new build) so we need to accept they will need to take a disproportionate share of the (renewable energy) budget.'[2] This is useful, but doesn't quantify a proposed increase in EUI for NZC existing buildings.

The need for further work on the NZC requirements for existing buildings is acknowledged and may even be planned. Meanwhile, the market doesn't stop, and the requirement for further clarification is acute, as existing building NZC business cases must be justified.

Existing buildings retrofit issues

Retrofitting existing buildings to NZC is more difficult and, proportionally, more expensive than new-build NZC, which makes the retrofit business case more challenging. The reasons for this include:

- The value of a building when it is complete and in operation is influenced primarily by its rent streams. As NZC buildings are new to the market, evidence of any premium associated with these inputs for a building that has had a significant NZC cost to retrofit is not

readily available, although JLL is considering how greater returns can be reflected based on current data.[3] Going forward, a growing discount for high-carbon buildings will no doubt form part of the sale transaction discussions.

- *The costs and benefits of tighter standards for new buildings* (Currie & Brown 2019), a report for the Climate Change Committee, states as a key finding that 'the costs associated with achieving higher standards via retrofit are from five times to more than 10 times higher than achieving the standards in a new building.
- In a multi-let building, the retrofit work may need to be phased to match different lease-expiry dates. Equally, landlord plant and equipment changes are likely to impact all tenants.
- Roof space for new MEP plant and equipment or renewable energy generation may already be used.
- Many buildings have significant heritage and planning constraints, prohibiting significant changes to the building façade and interior.
- Façade performance for many older buildings is likely to be poor, and may need significant upgrade or replacement. Replacement is expensive and disruptive.

There is more than one way to mitigate some of these issues and promote more NZC retrofit work, but an obvious contribution would be to determine a fair EUI for retrofit.

Fortunately, existing buildings have a significant benefit over new build. Only the upfront carbon in the new NZC retrofit work is considered, so the existing foundations, structure, walls, façade, fittings and furniture are, essentially, upfront carbon 'free'.

Alternative EUI targets for existing office buildings

The LETI 2030 NZC targets for new office buildings are an operational energy EUI of 55kWh·m^{-2} per year (GIA) and upfront carbon (design target A rating) of 350kgCO_2·m^{-2}. The EUI performance is consistent with the current LETI 2020 target; however, the 2020 upfront carbon (design target C rating) is 600kgCO_2·m^{-2}. A limit of 600kgCO_2·m^{-2} of upfront carbon is very testing for new build and, arguably, undeliverable currently. The 2030 upfront carbon target assumes a significant 50% reused content, implicitly suggesting new build will be retrofit with new-build additional floors or a building extension. To ensure our alternative EUI target proposals are robust, we will use the LETI 2030 EUI and upfront carbon targets.

The LETI Embodied Carbon Primer guidance provides details on the anticipated WLC of the ultra-low energy new commercial building – that is, NZC 2030 (Table 2, column A). The simple breakdown is: materials and construction (A1 to A5) 38%; operational energy (B6) 28%; maintenance (B1 to B5) 32%; and disposal (C1 to C4) 2%. The same guidance also gives a breakdown of the materials and construction (A1 to A5), with around 81% allocated to substructure, superstructure and façades, with finishes and MEP at 19%. This is based on a new build and, as we transition from 2020 to 2030, the vast majority of the targeted upfront carbon savings will come from the substructure, superstructure and façades, rather than finishes and MEP.

Although NZC targets and the breakdown of WLC percentage allocations are presented definitively, in reality, there is huge variance in the figures in the supporting information and, at best, these should be considered as indicative.

If we assume that a NZC building retrofit is likely to involve the full replacement of the MEP systems, new finishes throughout, and a range of internal layout changes, we could budget for 150kgCO_2·m^{-2}, or 25% of the 2020 upfront carbon target. This would seem reasonable given the LETI guidance currently suggests 19% for MEP »

» and finishes alone. If we then conservatively assume that all the project upfront carbon saving to 2030 comes from the substructure, superstructure and façades, the retrofit upfront carbon allocation at 2030 would remain 150kgCO_2·m^{-2}, or around 43% of the 350kgCO_2·m^{-2} NZC upfront carbon target – a saving of 57% of the upfront carbon target.

Returning to the ultra-low energy new office building WLC allocations for materials and construction, operational energy, maintenance and disposal: if the assumed NZC building retrofit saves 57% of the materials and construction budget, this can equitably be reallocated to the operational energy budget without detracting from the WLC target. This would increase the operational energy budget from 28% to 49% (57% of 38% is around 21%). The impact on the EUI value would be an increase from 55kWh·m^{-2} per year (GIA) to 96kWh·m^{-2} (Table 2, column B).

The WLC impact of a building achieving the 2030 NZC EUI and embodied carbon targets of 55kWh·m^{-2} per year (GIA) and 350kgCO_2·m^{-2} is equivalent to an EUI of 96kWh·m^{-2} per year (GIA) and upfront carbon of 150kgCO_2·m^{-2}.

The higher EUI takes advantage of the inherently low upfront carbon involved in an existing office building retrofit without sacrificing the project's WLC, while providing a much more affordable retrofit. This approach would also reduce the need to replace existing façades.

While the broad approach of trading a lower upfront carbon value for a higher EUI value seems reasonable, the actual details would require a more comprehensive evaluation. Equally, it soon becomes apparent that the evidence base for a lot of the existing NZC guidance is limited, and more evidence from progressive, delivered and operational NZC buildings is required, particularly retrofitted NZC buildings.

The LETI carbon in operational energy evaluation appears to be based on an annual emissions carbon factor of 70gCO_2·kWh^{-1} representing average carbon content of the Grid over the next 30 years, an estimate that no doubt will change over time. A NZC building will be supplied with 100% renewable electricity, which has minimal carbon content, so the balancing of EUI with upfront carbon becomes more nuanced.

Recommendation

Perhaps the real question is: what is the equitable renewable energy-generation capacity available for existing office NZC retrofits? The LETI Climate Emergency Design Guide top-down calculations Figure A1.1 (page 119) provides some guidance (Table 1). These are reported in net internal area (NIA) so allowing a 20% reduction in the conversion of NIA to GIA the 2050 available office generation capacity would be 79kWh·m^{-2} per year (GIA) for renewable plus nuclear and 68kWh·m^{-2} for renewable only.

Table 1: Top down modelling results

	Community renewables scenario available generation 2030 (kWh/m²·yr)		Community renewables scenario available generation 2030 (kWh/m²·yr)	
Building type	**Renewable energy only**	**Renewable energy plus nuclear**	**Renewable energy only**	**Renewable energy plus nuclear**
Domestic	27	29	37	43
Industrial (without processes)	27	30	38	44
Office	62	67	85	99
Retail	49	53	67	79

LETI Climate Emergency Design Guide, p119 Renewable Energy Allocated to Use Type, NIA figures

Table 2: NZC WLC breakdown and targets using three different scenarios for upfront carbon and operational energy

	Upfront carbon allowance		
	A 350kgCO_2.m^{-2}	B 150kgCO_2.m^{-2}	C 258kgCO_2.m^{-2}
Whole-life carbon components			
Materials and construction (A1 to A5)	38%	17%	28%
Operational energy (B6)	28%	49%	38%
Maintenance (B1 to B5)	32%	32%	32%
End-of-life disposal (C1 to C4)	2%	2%	2%
Operational energy allowance (GIA)	55kWh·m^{-2}	96kWh·m^{-2}	75kWh·m^{-2}

The projections are based on the National Grids, Future Energy Scenarios (FES) 2018. The recent FES 2021 publication uses slightly different scenarios, and it is difficult to determine a direct comparison with the 2018 community renewables scenario. However, on p116, Electricity Generation, it states: 'the proportion of renewable generation increases across all scenarios, with offshore wind expected to provide the backbone of our electricity supply in 2050'. A more precise answer would require more investigation, but it seems that the LETI top-down calculation values may reasonably be increased. Equally, if the new build NZC EUI is 55kWh·m^{-2} per year (GIA) and the community renewables capacity 68kWh·m^{-2} per year (GIA) then the potential increased EUI for existing office buildings could marginally exceed 68kWh·m^{-2} per year (GIA) while still balancing out.

The cost impact of the EUI threshold position is significant so any change in generation capacity mix and reporting in GIA not NIA (GIA and NIA can vary from 75% to 85%) is important and may best be addressed through a regular industry update. Meanwhile, acknowledging the cost implications and the trajectory for increased renewable energy generation a pragmatic EUI for NZC office retrofit may be 75kWh·m^{-2} per year (GIA). An EUI of 75kWh·m^{-2} per year (GIA) would have a maximum retrofit upfront carbon limit of 258kgCO_2·m^{-2}.

In both cases, these limits appear practical in terms of retrofit delivery, sensibly within our resource capacity and a lot closer to providing business case financial viability.

This approach equally applies to all the other building types but, to kick start the NZC office retrofit conversation, rebalancing the requirements to an EUI of 75kWh·m^{-2} per year (GIA) and limiting upfront embodied carbon to 258kgCO_2·m^{-2} (Table 2, column C) would be my suggested starting point. CJ

DAVID BOWNASS is head of UK net zero design consulting at JLL

References:

1 LETI Climate Emergency Design Guide, page 118.
2 LETI Climate Emergency Design Guide, page 44.
3 JLL, Valuing Net Zero & ESG for Offices.

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ON TARGET

Ilke Homes has vowed to manufacture zero carbon homes at zero additional cost by 2030. **Andy Pearson** speaks to ilke's Nigel Banks about the services strategy and the manufacturing efficiencies that will enable it to hit its goals

By 2030 ilke Homes will only manufacture homes that are zero carbon, with zero energy bills that will be made at zero additional cost. That's the claim being made by the modular housing manufacturer at the launch of its Zero range of homes. It's a bold declaration: currently the cost premium for an ilke Zero home, with zero bills, is in the region of £10-15,000. 'The challenge for us is to get that additional cost down to zero in the next nine years,' says Nigel Banks, director of special projects.

Ilke Homes has been manufacturing modular homes at its Yorkshire factory since the company's inception three and a half years ago. Its modules are hybrid construction, built using a galvanised steel frame with structural timber sheathing. These are manufactured in various sizes for assembly in a series of configurations to produce a range of house sizes and styles from two to five bedrooms.

A typical two-storey home is formed from two modules, one for each floor. A separate roof module is available for when a roof has not been incorporated into the top-floor module.

In addition, ilke is working to extend its offering with the development of a range of modular apartments set to be launched soon.

The modules arrive on site fully finished and ready to be craned into position; internally, kitchens and bathrooms are plumbed and tiled, rooms wired and decorated, even the carpets have been fitted. Externally too, the modules are finished: a variety of cladding options available, including brick slips; the only area not clad is a small horizontal strip either side of the junction between modules, left clear to allow the module frames to be joined by ilke's assembly team.

'Zero carbon homes are what we've been doing from day one,' says Banks. Ilke Homes built a series of prototype homes in London in 2017; these were all-electric homes complete with solar photovoltaics (PVs), battery electric storage, and a heat pump housed within a highly insulated envelope. The company's newly launched Zero homes range builds on its experience and the lessons learned from having now completed five zero carbon sites.

Banks says the homes are low energy and have been designed to eliminate fossil fuel dependency by generating enough electricity on site to reduce their operational carbon emissions (the energy used for heating, hot water, lighting, and to power fans and pumps) to zero over the course of a year.

'This is the same method used in the current Building Regulations (Part L 2013 – SAP9.9), the proposed new Building Regulations (Part L 2022 – SAP10), the 2025 Future Homes Standard and the latest London Plan,' he says.

To achieve zero carbon emissions, ilke has used a fabric-first

"We set the fabric at a high standard from day one because we didn't want to have to alter the specification significantly with every regulation change"

Factory-built modules arrive on site fully finished and ready to be craned into position

approach to minimise the energy needed for heating by incorporating highly insulated walls, roof and floors. Windows are double glazed, openable and incorporate trickle vents. Banks explains: 'In terms of carbon emissions, it is more cost-effective to add solar PV than it is to use triple-glazed windows'.

According to Banks, the ilke Homes' highly insulated fabric makes the homes 'around 20% better [insulated] than current Building Regulations'. He 'expects' the fabric to meet the thermal performance uplift proposed for the 2022 revisions to Part L of the Building Regulations; and to 'exceed' the regulation changes planned for 2025, when all new homes will need to reduce emissions by at least 75% with the use of fossil fuel-based heating banned.

Ilke properties have 20% better insulation than current Building Regulations

'We set the fabric at a high standard from day one because we knew Building Regulations would be changing and we didn't want to have to alter the specification significantly with every regulation change'.

The Zero homes feature continuous mechanical extract ventilation (cMEV), rather than mechanical ventilation with heat reclaim (MVHR). This was down to their customers' experience of different technologies in new homes. 'The feedback from our early houses was that our clients did not want MVHR for reasons of noise, maintenance and because they were turning them off. Instead, we use cMEV and an airtightness of between 3 and 5$m^3 \cdot h^{-1} \cdot m^{-2}$ @ 50 Pascals,' Banks says.

Having minimised heat loss, emissions are further reduced through the use of energy-efficient LED lighting, water fittings and cMEV system. It is, however, ilke Home's use of electric air source heat pumps (ASHPs) as standard to heat the homes and provide hot water that position the housebuilder at the forefront of low energy housing provision.

'ASHPs use a third of the energy of a gas boiler,' says Banks. 'We've redesigned the house around heat pumps, including providing space for a hot-water cylinder, incorporating radiators sized for low-flow temperatures, and installing pipework to deal with the flowrates with [larger] bend radiuses to limit pump losses,' he adds.

The homes are also fitted with integrated roof-mounted solar PVs to generate electricity to power the heat pump and help the homes achieve zero carbon more cost-effectively. Banks says the cost of PVs has now dropped to the point where it can be cheaper to use them for the roof finish if they displace more expensive roof finishes.

According to ilke Homes, a typical conventional new-build house would be expected to have energy bills of 'around £900 a year'. To meet its 2030 target, the firm is looking to achieve zero energy bills. This includes energy use not covered by Building Regulations, such as that used for »

The interior of a factory-built ilke home

» cooking and to power devices such as televisions.

Ilke Homes' use of an ASHP reduces the cost of energy by eliminating the need for a gas connection and its associated standing charge. It also enables ASHP to charge the hot-water cylinder at times when electricity tariffs are lower, which also helps to minimise costs. However, to get to zero, Banks says additional PVs are required as is electric battery storage.

The battery enables occupiers to avoid buying electricity when it is expensive and to sell excess power generated by the PVs back to the grid at the most profitable time. 'Our modelling has shown that to get to zero energy bills you need: smart controls to take advantage of variable electricity tariffs; more solar PV to increase electricity generated; and battery storage to [enable occupiers to] maximise the self-use of PV-generated power,' Banks explains. 'And, when you are exporting, the battery enables you to export at those times that will give you a higher export tariff.'

Banks says the housebuilder has a range of sites in the pipeline containing large numbers of zero carbon homes. These will enable the firm to optimise the use of PVs, battery storage and their controls in time for 2030. 'As the costs of energy change, our zero bills target may get harder or easier to achieve, although as the output from solar PV technology gets better and ASHP performance improves that should make the journey easier'.

Embodied energy

Along with targeting zero carbon and zero bills, ilke Homes is also looking to future-proof its buildings by targeting embodied carbon too. 'Our embodied carbon figure is lower than that of a traditionally constructed home,' he says. 'Cradle-to-handover emissions are currently 261kgCO_2·m^{-2} per year, which is already below the RIBA 2030 target and LETI stretch goal for residential buildings,' says Banks. 'We're targeting a 75% reduction in the whole-life carbon emissions of our homes by 2030.'

Perhaps the biggest challenge ilke has in delivering its zero goals is to do so at zero additional cost. 'Zero cost means no additional build costs compared with traditional construction,' says Banks.

To achieve this, it is bringing the productivity, efficiencies and continuous improvements in manufacturing to its housebuilding facility. It aims to exploit advances in manufacturing processes to improve its efficiencies combined with an increase in its use of robotics.

This, combined with expected reductions in the cost of key components such as solar panels and batteries, should help ilke move ahead on its journey to achieving its zero additional cost target. CJ

ILKE HOMES' FIVE STEPS TO ZERO COST

Ilke Zero Homes is taking a five-pronged approach to achieving its target of zero additional build costs (compared with traditional construction):

1. Design for ease of manufacture – modules are designed for speed and ease of assembly on its factory production lines. It has subsequently tweaked the design of its ground-floor module to incorporate heat pump technology. This includes the addition of a hot-water cylinder, resized radiators for low-flow temperatures, minimal pipe runs and maximum pipe bend radii to limit pump losses.
2. Materials – the cost of solar panels has dropped considerably. Today a solar panel costs the same as a high-quality roof tile. By integrating the panels, ilke Homes can omit the cost of the equivalent area of roof tiles.
3. Labour – unlike traditional housebuilders that use subcontract labour extensively, ilke Home's team are directly employed. This eliminates layers of overhead and margins and means workers have a better focus on the product, design and, critically, processes and quality standards.
4. Processes – according to Banks, the construction industry has seen the lowest rise in productivity of any sector in the UK whereas, in manufacturing, productivity has rocketed. Ilke Home's modules are assembled in a modern manufacturing environment. 'Working in a warm, dry factory with the right tools, following the right processes, transforms productivity,' says Banks.
5. Continuous improvement – ilke Homes has a team of manufacturing engineers working continuously to refine its operating procedures to improve quality, performance and productivity, and to lower costs.

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NEW BALANCE

UPS systems in data centres have the potential to become valuable energy hubs and stabilise electricity grids, says Vertiv's **Arturo Di Filippi**

The balance of power in energy grids is shifting. The proportion of our power supplied by fossil fuels is declining and increasing from renewable sources such as wind and solar power. In some parts of the world, such as the European Union, renewables have overtaken fossil fuels to become the main source of electricity.[1]

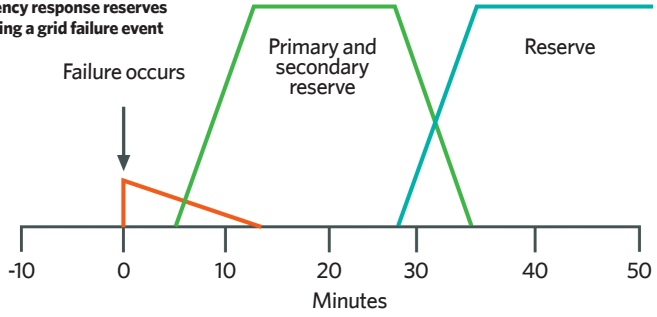
That is good news for the planet, of course. However, the decommissioning of large power plants and the intermittency of renewables is creating challenges for energy grids. One of the biggest challenges is maintaining the stability of energy supply when there is a disconnect between supply and demand.

System frequency changes when there is a mismatch in the energy added to the system by generators (supply) and the energy taken off by consumers (demand). When supply is higher than demand, frequency rises, and vice versa. Such frequency variations caused by momentary imbalances are higher and more frequent with increased intermittency of supply.

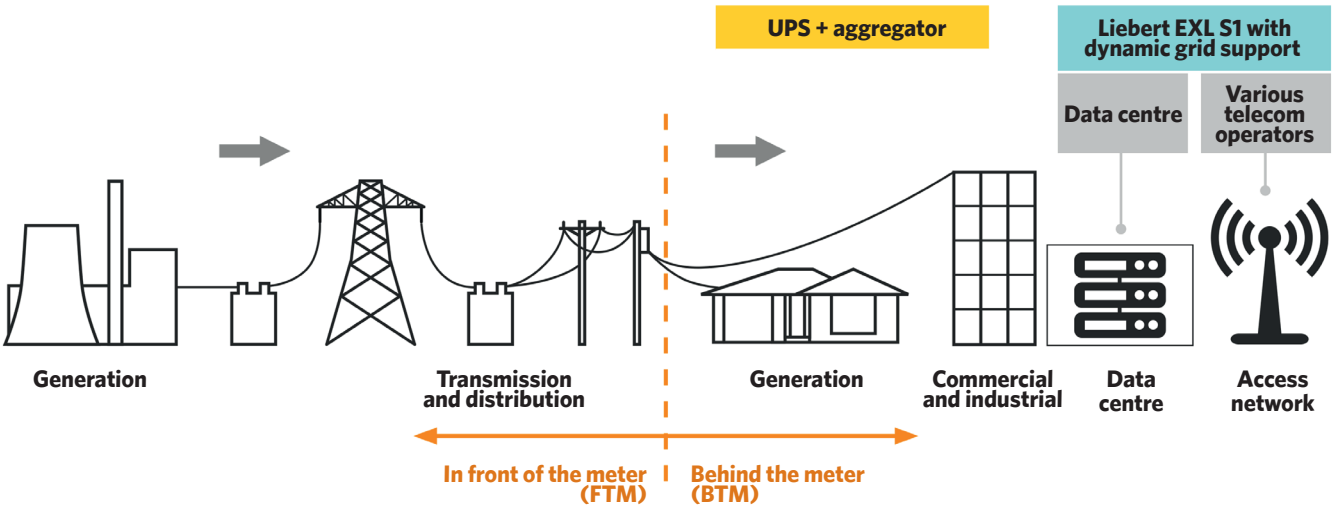
Traditional frequency regulation may not be able to provide fast enough response to keep the frequency within specified limits. Faster reacting frequency containment reserves are needed to provide a quick response to sudden frequency variations and to increase or reduce the electricity demand within a few seconds.

Data centres and other types of critical infrastructure have a key role to play in this shifting energy landscape, and are the »

Generic representation of frequency response reserves following a grid failure event



"Data centres and other types of critical infrastructure have a key role to play in this shifting energy landscape"



"One of the biggest challenges is maintaining the stability of energy supply when there is a disconnect between supply and demand"

» ideal candidate to implement grid balancing services. This is because of the presence of assets such as battery energy storage, which could be maximised to generate new revenue streams as well as cost saving opportunities, and ultimately alleviate grid infrastructure constraints.

Data centres can provide grid or energy-balancing services using two types of energy device – 'behind the meter' (power used on site, on the energy user's side of the meter) and 'front of meter' (energy on the grid or utility).

The European market programmes for balancing services vary for each country, depending, for example, on how fast the additional power is required from data centres (typically, from within 0.5 seconds of a power event to a couple of minutes) and how long the power is required for (from seconds to minutes).

As explained in a recently published white paper (*How to maximise revenues from your data centre. Energy storage system with grid Interactive UPS*), the most lucrative in energy-balancing services are for 'fast frequency' response, requiring active power to be adjusted within 500 milliseconds to one second time frame in reaction to over- and under-frequency detection. In this situation, the UPS would need to discharge/recharge the batteries for an average period of five minutes.

As well as helping to stabilise energy supply, contracting out UPS backup power systems that stand idle most of the time could make financial sense.

Some experts reckon that one megawatt of flexible load and related battery backup could earn a data centre as much as €100,000 (£85,075) in revenue every year – or millions for a data centre company with multiple multi-megawatt data centres.[2]

The grid-balancing market is at an early stage but has potential. For the past few years, Vertiv has run grid-balancing pilot projects with data centre operators and includes grid-balancing features in its data centre technology.

As intermittent renewables continue to challenge conventional electric power generation, new energy storage services are required to help meet sustainability goals, generate revenue and reduce energy bills. Ultimately, this will alleviate grid infrastructure constraints, increase use of renewable power sources, and provide data centre operators with a new source of income. A win-win for all involved. CJ

ARTURO DI FILIPPI is global offering manager for smart power at Vertiv

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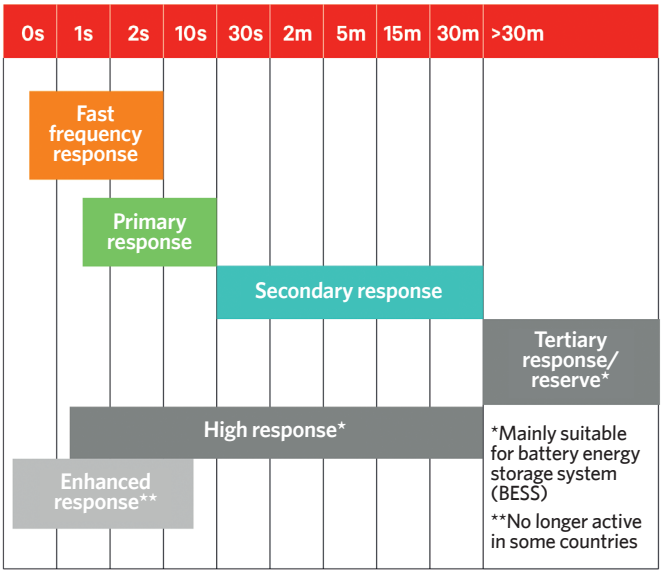


Example of schematic of frequency response programmes in the UK

Instantaneous low temperature systems, a pathway to reduce carbon in commercial domestic hot water usage

By Biatur Mandia, MEng

This module explores some of the key factors that successfully decrease carbon emissions in Domestic hot water systems (DHW). The CPD is focused on a low-temperature system powered with Hydrogen blends. A practical example is utilised to further explain the benefits of such systems.

Introduction

Domestic Hot water (DHW) plays a significant role in the total energy used in buildings. While the energy used for space heating or lighting has decreased over the past years, the energy used for DHW has increased considerably in the last 20 years. This can be attributed to new patterns in hygiene and comfort. For instance, the yearly DHW consumption per capita in Denmark has increased from 10 m^3/year to 15 m^3/year over the last 20 years [1]. Therefore, it is important to evaluate changes to how the hot water is supplied to improve the efficiency of the system.

Low Temperature Domestic hot water system

Low-Temperature DHW systems operate in the range of 40° to 55° Celsius. This presents several key benefits that help to reduce the carbon emissions of the system, and therefore, contribute to achieving the net-zero target by 2050.

Benefits	Challenges
Savings in energy consumption KW h	Hygiene Legionella
Low Heat loss	Comfort Temperature
Low-risk Scalding	Design & Implementation

Table 1; Benefits & challenges of Low-Temperature Domestic Hot Water (LTDHW) systems

On the other hand, low working temperatures present important challenges due to hygiene and reduced comfort. The hygiene requirements are associated with the control of Legionella, a potentially fatal form of pneumonia. Specific guidance for the control of hot water systems is provided in the Health and Safety Executive Approved Code of Practice (ACOPL8) and its associated regulations, HSG274 Part 2. ACOP L8. Some key guidelines are summarised in table 2.

Legionella Requirements	Comfort recommendations
Storage >60	Shower > 40
Recirculation pipe >50	Kitchen Sink > 45
(55 for vulnerable people)	Waiting Time < 10 s

Table 2; Legionella and Comfort requirements for Commercial DHW systems [2] for Both UK and EU

The legionella safety requirements differ in situations. These largely depend on the volume of water required during peak times. Generally, household applications have low water volumes and can be more flexible in terms of temperature range and safety requirements. These applications often do not need recirculation and storage when instantaneous heaters are employed.

Commercial applications have high volumes of hot water. These require high working temperatures to satisfy the recirculation requirements.

The consumption of a commercial DHW system can be categorised as follow.

- Energy to heat the water
- Energy to reheat secondary return (recirculation)
- Pump energy

A lot of research is investigating the feasibility of having low-temperature return systems. There is a growing interest that instantaneous water heater could soon reduce the outlet temperature to 50°. Instantaneous heaters are considered "low risk" for legionella by the H&S executive and new guidelines are due to be published on the CIBSE Knowledge Portal [3].

A successful low-temperature DHW system was implemented at Great Ormond Street Hospital. This was achieved by having a rigid disinfection process in place. Copper-silver ionisation measures were used to clean the water of the system. The working temperature was set to 43° and no legionella issues were found [4].

Practical Example: Recirculation of a low-temperature DHW system powered by hydrogen

In the proposed example, hot water is utilised on-demand, and thus, eliminating the need of storing high-temperature water, as for ACOPL8. The system is adjusted to include copper-silver ionisation which further reduces the risk of legionella. The working temperature is set to 43°. In the proposed system, the legionella risk was minimised by eliminating any major water storage. The appliance can supply temperatures in the range of 42-45 degrees without affecting the efficiency of the water heater. This approach can be considered as the first step towards Lean Energy and the elimination of hot water storage often referred to as waste or "Muda" in Lean Japanese principles [5].

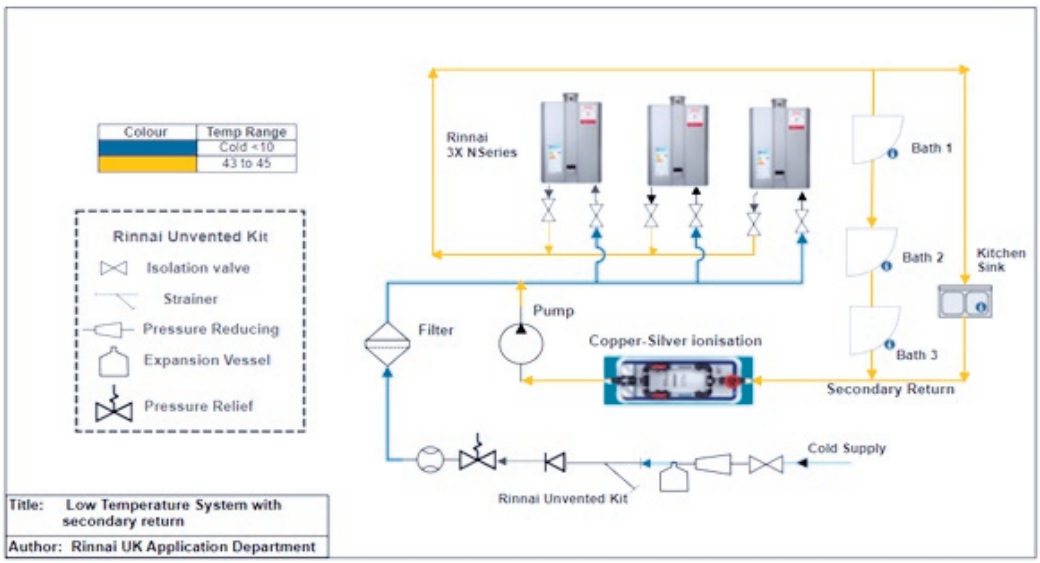


Figure 1; Low-temperature system for Commercial Applications

The working principle of the system is shown by the schematic diagram in figure 1. The water heater is powered by the hydrogen & Natural Gas blend. This reduces the carbon emission of the appliance. The heater also modulates the heating input according to the desired outlet temperature. For instance, if the heater has a gross heating output of 58.3kW and a 13:1 turn down ratio, this can potentially modulate down the heating to 4.4kW, thus enabling massive savings in the secondary return system (recirculation) while still providing the desired temperature. The heating process is optimised and programmed using a high-tech processor and PCB; performance charts are programmed to operate the appliance at maximum efficiency. Advanced control strategies can enable significant energy efficiency improvement of the DHW production systems and generate carbon savings [6].

Heat loss savings of Low-temperature system vs High Temperature

The energy losses in supplying domestic hot water can be categorised into two main groups:

- Energy loss in the heating process
- Energy loss in the distribution and storage.

Low-temperature DHW can reduce the amount of heat loss of the system. The following analysis shows the heat loss savings of a pipe distribution network.

Recall: Heat Loss in a pipe

The general formula for calculating heat loss in a non-insulated pipe can be shown as follows.

$$Q = 2 \pi K L (t1 - t2) / \ln (r2 / r1)$$ Ref [8]

Where:

K = the heat transfer coefficient of the pipe material;
t1 = Temperature inside the pipe;
t2 = the outside temperature of the pipe;
L = the length of pipe;
r1 = inner radius of the pipe;
r2 = outer radius of the pipe;
ln = natural logarithm

Figure 2; Heat Loss Formula

Analysis

Consider the formula from the heat loss

Equation 1 $$Q = \frac{2 \pi K L (t1 - t2)}{\ln (r2 / r1)}$$

It is assumed that geometric and material properties remain constant. The same system is used at two different temperatures, high (55) and low (43). All the other parameters in equation 1, except for t1, are constant, and can therefore be represented by a constant, as shown in equation 2.

Equation 2 $$\frac{2 \pi K L}{\ln (r2 / r1)} = a$$

Substitute Eq 2 into Eq 1. $$Q = \frac{2 \pi K L (t1 - t2)}{\ln(r2 / r1)} = a (t1 - t2)$$

Substitute the temperature values of the two systems, High-temperature 55° and low-temperature 43°. The ambient temperature is 15.

$$Q1 = a (55 - 15) = 40a \qquad Q2 = a (43 - 15) = 28a$$

The Heat loss savings in a pipe when operating a low temperature compared to a high temperate can be found as follow.

$$\frac{Q1 - Q2}{Q2} (100) = \frac{40 a - 28 a}{40a} (100) = 30\%$$ savings in Heat loss – Indicative value

Carbon savings of the proposed system

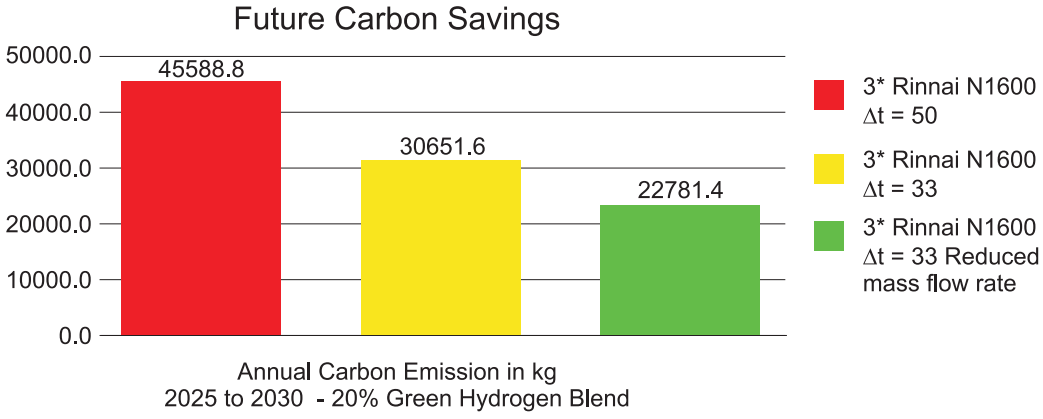
The following example considers a business case for a small/medium size application. The analysis shows the savings in carbon when a low-temperature system powered by hydrogen blends is employed. The savings in heat loss previously calculated were also added in the analysis. The hydrogen blend was assumed to start in 2025. The results have shown carbon savings in the range of 33% and 50% compared to a high-temperature system. The exact value would depend on the mass flow rate of the proposed system and other parameters.

Low-temperature systems are effective ways to reduce the carbon footprint and Hydrogen is currently undergoing unprecedented political and business momentum. Gateshead has become the first UK community to receive hydrogen blends via the public natural gas network.

This growing trend is very likely to continue over the next years. The carbon savings of the proposed system are considerate and as a comparison, these equate to the annual average carbon emissions of 20 cars. With thousands of commercial buildings in the market, such implementation would have a very positive impact on the environment and our future.

Figure 3; Carbon Saving Low-temperature system vs High-temperature system

Specification	3* Rinnai N1600 Δt = 50	3* Rinnai N1600 Δt = 33	3* Rinnai N1600 Δt = 33 Reduced mass flow rate
Max Heat Input (kW)	175	115.5	72.6
Max heat output (kW)	168	111	69.6
Efficiency (Gross)	96.00%	96.00%	96.00%
1st hour flow rate @ 50°C rise (l/hr)	2880	2880	1800
Storage/Cylinder (L)	0	0	0
Continuous flow rate (l/hr)	2880	2880	1800
Peak usage periods (hr)	1	1	1
Number of peak usage periods	3	3	3
Heating consumption (kW)	175	115.5	72.6
Storage loss (kWh)	0	0	0
Secondary return system			
heat loss per hour (kW)	10	7	7
Efficiency curve	95.00%	95.00%	95.00%
Input for secondary system (kW)	10.5	7.3	7.3
Secondary system operating time (hr)	21	21	21
Reheat of secondary return (kWh/day)	220.5	154.7	154.7
Consumption per peak period (kWh)	175	115.5	72.6
Total consumption per day (kWh)	745.5	501.23	372.5
Consumption per week (kWh)	5218.5	3508.6	2607.7
Annual consumption (kWh)	271362	182450.2	135603.4
Gas price (£/kWh)	0.045	0.045	0.045
Running annum cost (£)	12211.3	8210.2	6102.1
Annual Carbon emission in kg 2022 to 2025	56986	38314.5	28476.7
Annual Carbon Emission in kg 2025 to 2030– with 20 % Green Hydrogen	45588.8	30651.6	22781.3
Percentage annual Carbon savings (Ref to option 1 - high temp)	0	32.77%	50.03%



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CFC ban averted climate catastrophe

Worldwide treaty stopped global temperatures rising by 2.5°C

The 1987 ban on ozone-depleting chemicals averted a climate catastrophe, according to new scientific research.

The Montreal Protocol targeted chlorofluorocarbons (CFCs) in particular and, without the treaty, the Earth and its plant life would have been blasted by much higher levels of ultraviolet radiation. Global temperatures would have also risen by an extra 2.5°C by the end of the century, according to the research by an international team of scientists.

CFCs are potent global warmers themselves, but the damage they do to the ozone layer would have released additional amounts of CO_2 that remains locked into plants and vegetation.

Former UN Secretary General Kofi Annan said it was 'perhaps the single most successful international agreement'.

The scientists estimated there would be 580bn tonnes less carbon stored in forests, other vegetation and soils, and an extra 165-215 parts per million (40-50%) of CO_2 in the atmosphere without the ban.

WATERLOO'S AIR PRODUCTS CHOSEN FOR THE SPINE

The Royal College of Physicians occupy The Spine

Waterloo's air distribution products have been specified in The Spine building in Liverpool's Knowledge Quarter.

Seven floors of the £35m office building, designed by architects AHR to meet the Well Building Standard, will become the new northern home of the Royal College of Physicians.

Through workshop sessions with the design team, the CS-F linear slot diffuser was chosen as a consistent visual approach for the majority of the building.

Ciat chiller installed at Northern Ireland hospital

An ultra-low noise Ciat chiller operating on lower global warming potential (GWP) R-32 refrigerant has been installed at Craigavon Area Hospital in Northern Ireland.

The use of R-32 in the Aquaciat Power LD 2000R chiller reduces its environmental impact of its refrigerant by two-thirds, according to the manufacturer.

The 550kW unit was also equipped with the additional acoustic insulation option around the compressors to minimise disturbance at the hospital's trauma and orthopaedic department.

The chillers are based on quiet-running scroll compressors, fully optimised for use with R-32. They feature two refrigerant circuits, powered by eight compressors, offering some resilience in the event of a breakdown, the manufacturer said.

Refcom Elite celebrates 25th anniversary

The Refcom Elite scheme is celebrating a quarter of a century of helping refrigeration and air conditioning companies demonstrate their business and technical credentials, and promoting higher professional standards of refrigerant management.

The scheme traces its origins back to the original Refcom, which was set up in 1996 by a group of contractors who wanted to demonstrate their commitment to responsible refrigerant handling.

In 2006, government officials at Defra approached Refcom to help it set up a framework for a mandatory company certification scheme to ensure compliance with the new European F-Gas regulation. The Elite scheme was used as the framework on a 'low cost, light touch' basis. After the establishment of the mandatory register in 2009, it remained a voluntary scheme for companies who wanted to go above and beyond simply achieving regulatory compliance, and demonstrate higher professional standards.

The scheme was conceived and launched by members of the HVCA – now the Building Engineering Services Association (BESA) – and the first members in 1996 were drawn from the Association's Refrigeration and Air Conditioning group. It now has more than 300 members and was extended in 2019 to include distributors and wholesalers.

Ventilation and AC markets set to grow

The UK market for ventilation and air conditioning products is expected to grow to £1.33bn by 2025, according to the research organisation AMA.

It grew steadily between 2016 and 2019, before a sharp decline in 2020 caused by the Covid-19 pandemic. However, the UK's ambition to achieve net zero carbon emissions will help the industry rebound, the AMA report said.

The Future Homes Standard, due to be introduced by 2025, will require all new-build homes to be future-proofed, which will increase demand for low carbon and energy efficient HVAC technologies, according to the report. Changes to Part L of the Building Regulations will also have a positive impact on residential sales, it added.

The 2015 Ozone Depleting Substances Regulation, which banned the use of R22 refrigerant to service or maintain existing air conditioning equipment, has already made significant changes to the non-residential sector, the research concluded.

CO_2 refrigeration packs launched

Ultra Refrigeration has developed a CO_2 refrigeration pack with heat recovery for the comfort heating and air conditioning requirements of convenience stores.

The firm's Integrated Power Pack (IPP), based on Bitzer's Ecoline CO_2 reciprocating compressors, has been installed in four Lincolnshire convenience stores. The system captures heat from the high-temperature discharge side of the pack by passing hot gas through a compact contraflow heat exchanger, transferring heat to a water-based heating system. Hydronic fan coils provide comfort heating and cooling for the stores and adjoining warehouse facilities.

Hot water is also used to supply the over-door air curtain at the main entrance, which operates constantly during opening hours, saving up to 14kW of electrical energy, the manufacturer said.

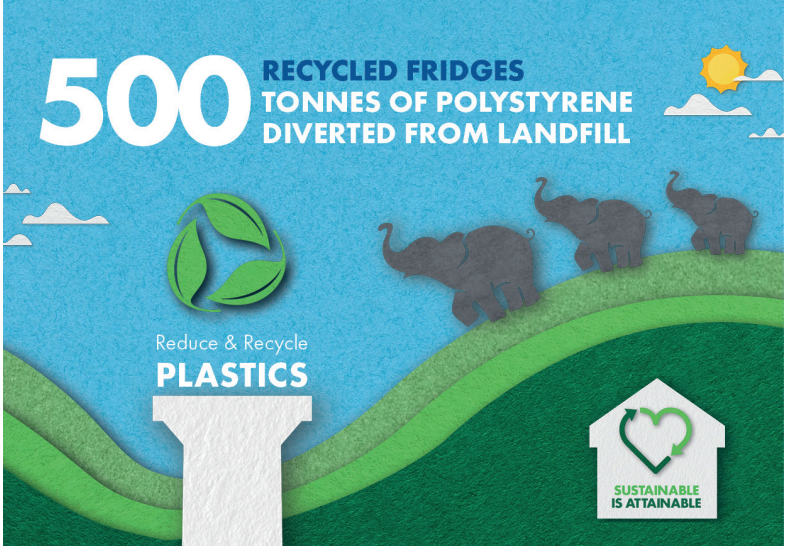
The IPP systems deliver a total of up to 90kW of heating and 40kW of comfort cooling, although the design is scalable and can be configured for larger applications.

Panasonic adds AHU kit to PACi NX range

Panasonic Heating & Cooling Solutions has added a new air handling unit (AHU) kit for its successful PACi NX Series designed for commercial applications. The manufacturer says the PACi NX range achieves very high SEER/SCOP efficiency values and energy labels up to A+++.

The new AHU kit (PAW-280PAH3M) provides air conditioning and fresh air for the PACi NX Series. The system comes with Panasonic's efficient CONEX Controller with Bluetooth built in.

The IoT remote controller is compatible with the Panasonic H&C Diagnosis App for analysis and troubleshooting.



Vent-Axia reuses 63,000 fridges for its products

Recycled material used for rigid ducting accessories

Vent-Axia has revealed that it has recycled materials from 63,000 fridges to make high impact polystyrene for its rigid ducting accessories, as part of its ongoing sustainability strategy.

The ventilation products company says it is taking action to reduce its environmental impact as part of a group-wide initiative.

It says it wants to reduce carbon emissions in its supply chain and work with suppliers who are committed to reducing their carbon footprint.

As a result, it has eliminated 630,000 single-use plastic poly bags from its supply chain per year and recycled 77 tonnes of plastic shrink wrap per year.

Vent-Axia says there are three pillars to its sustainability strategy: reducing and recycling plastic; reducing impact on the environment; and making energy efficient products that reduce energy use.

Environmental initiatives include the recycling of 180 tonnes of cardboard and 90 tonnes of wood (pallets) and the purchase of 3.5 tonnes of recycled packing material.

Vent-Axia is also designing its products to be modular to reduce plastic waste. For example, the company's Lo-Carbon Revive fan has modular components so if a social housing provider needs to replace a fan, a new spare part can often be used to extend the life of the fan and avoid the whole unit ending up in landfill.

In the past year, 640 Revive fans have avoided going to landfill in this way, says Vent-Axia.

Vent-Axia and its wider sister companies are also diverting 200 tonnes of PVC from landfill by ensuring 100% of its PVC ducting is made from recycled sources.

'We want to show that being sustainable is attainable, not only for us but for the wider industry. We're on a sustainable journey towards reaching net zero and Vent-Axia is taking real, quantifiable actions to achieve this,' says Lena Hebestreit, marketing manager at Vent-Axia.

A new CIBSE guide aims to equip specifiers and facilities managers with the knowledge to safely and effectively select air cleaners. Cundall's **Ed Wealend** summarises the contents

A NOVEL APPROACH: AIR CLEANING DEVICES

In July, CIBSE published the new *Covid-19: Air cleaning technologies* guide as part of its series *Emerging from lockdown*. The world of air cleaning devices is extremely complex. This guide aims to help engineers and building managers to assess whether an air cleaning device might be beneficial, and whether the device they are considering is fit for purpose and, above all, safe.

The guide gives a brief introduction to removal mechanisms for SARS-CoV-2, a summary of the existing guidance related to the different technologies employed for air cleaning, and several tools and worked examples to help specifiers determine the potential impact of an air cleaner introduced into a space. Chief among these is the Relative Exposure Index Calculator. This article gives a brief introduction to the topics covered in the guide.

Government statutory guidance on Covid-19 safety should be followed at all times. Air cleaning devices should not be used as a substitute for adequate ventilation.

Old approaches to a new problem

Devices that clean the air have existed for many years. They range from the well known, such as mechanical filtration, to more novel and less studied methods, which employ a variety of catalysts, ionisers, electrostatic or other techniques to physically or chemically alter particles passing through them.

Historically, many of these devices were marketed for the removal of chemical pollutants, such as volatile organic compounds (VOCs) or particulates, with less of a focus on pathogens. With the emergence of Covid-19, attention has turned to how these devices can be applied to reduce infection risk, particularly from airborne particles carrying SARS-CoV-2.

As SARS-CoV-2 is a relatively new virus, there is not a large body of research on the specific effectiveness of any technology for application against it. However, organisations including the World Health Organization (WHO) and the Scientific Advisory Group for Emergencies (SAGE) have reviewed the literature that does exist and made recommendations based on the best available evidence. The new guide summarises these recommendations.

There is also a lack of guidance on the specification and selection of air cleaning devices, especially in commercial settings such as

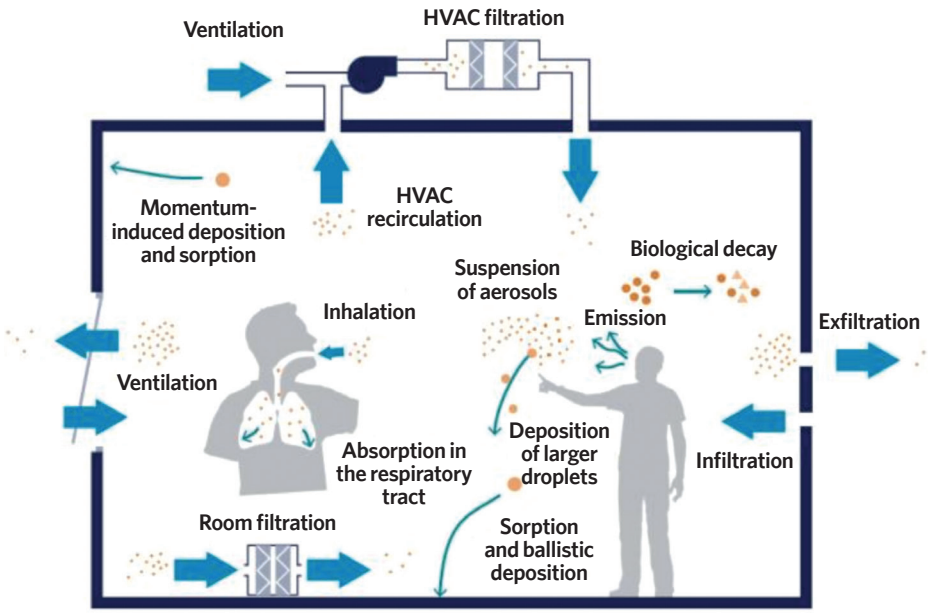
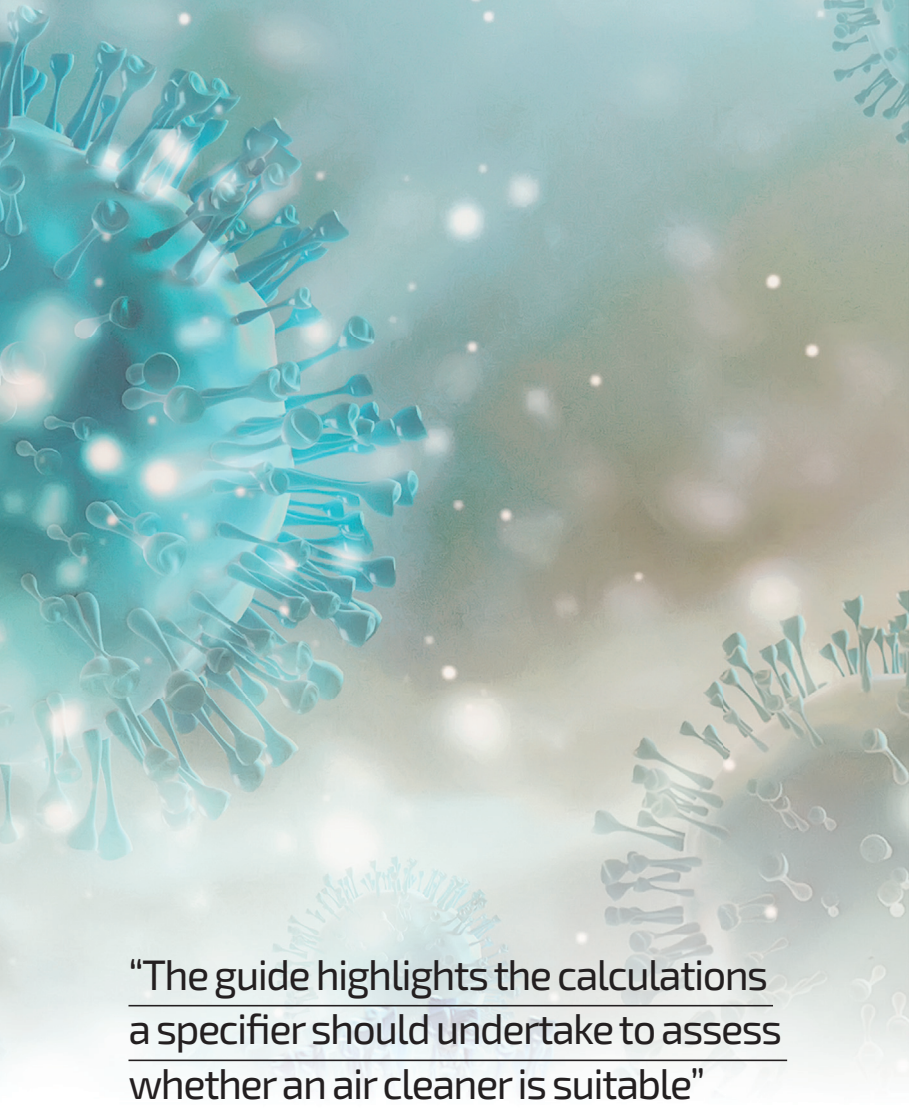


Figure 1: Single-zone mass-balance model of virus transport via exhaled aerosols[1]



"The guide highlights the calculations a specifier should undertake to assess whether an air cleaner is suitable"

offices. The suitability of air cleaning devices is determined by several factors, including the existing provision of outside air, the level of occupancy, the location of the device, its removal efficacy, and how much air passes through the device over time. The guide highlights the calculations a specifier should undertake to assess whether an air cleaner is suitable for a space.

On top of these physical factors, the internal chemical environment is extremely complex. Many of the novel technologies rely on chemical reactions as a cleaning mechanism, with some capable of generating pollutants that are harmful in themselves, including ozone and other VOCs.

Having a full understanding of the risks, however small, and the long-term maintenance requirements of any technology placed in a building is key to ensuring long-term occupant safety. Flowcharts containing questions suppliers should be able to answer are included, to help non-specialists navigate this complexity.

It is worth noting that the guide does not address the use of ultra-violet germicidal irradiation (UVGI). The authors acknowledge that UVGI can be extremely effective against pathogens and is well proven, particularly in healthcare settings. The safe application of UV technologies, however, is an equally complex and specialist science, and it was decided that it would be best served by a guide of its own. References are provided to existing guidance on UVGI.

The guide was created following a thorough review of the existing science and guidance on air cleaners, drawing on expertise from the world of air quality, chemistry, biology, ventilation and mechanical engineering. While it doesn't examine the detail of specific technologies, the authors hope it is referenced thoroughly enough to serve as an entry point to allow those seeking deeper knowledge to find it.

Safety first

The Covid-19 pandemic created an urgent need for safer indoor spaces. Despite this, the drive towards healthy air must be undertaken in a way that not only deals effectively with airborne viruses, but also does not lead to unintended health impacts.

The market for air cleaning devices includes an extremely wide range of products, technologies and prices, with consumer devices available from less than £100. As an industry, it is lightly regulated, particularly in terms of the chemistry of the devices, where thorough testing is expensive. As a result of this, it is difficult for the non-specialist to determine what health impacts any device could have.

In general, the recommendation is to err on the side of caution. SAGE Environmental Engineering Group and others, including ASHRAE and the Environmental Protection Agency, caution against using devices that produce ozone, ions or other chemicals without independent evidence for their safety and efficacy, as the by-products created by these technologies may act as respiratory irritants.

The guide includes a flowchart of questions for the specifier to ask potential suppliers. While trying not to rigidly favour any particular technology, more established technologies such as mechanical filtration, »

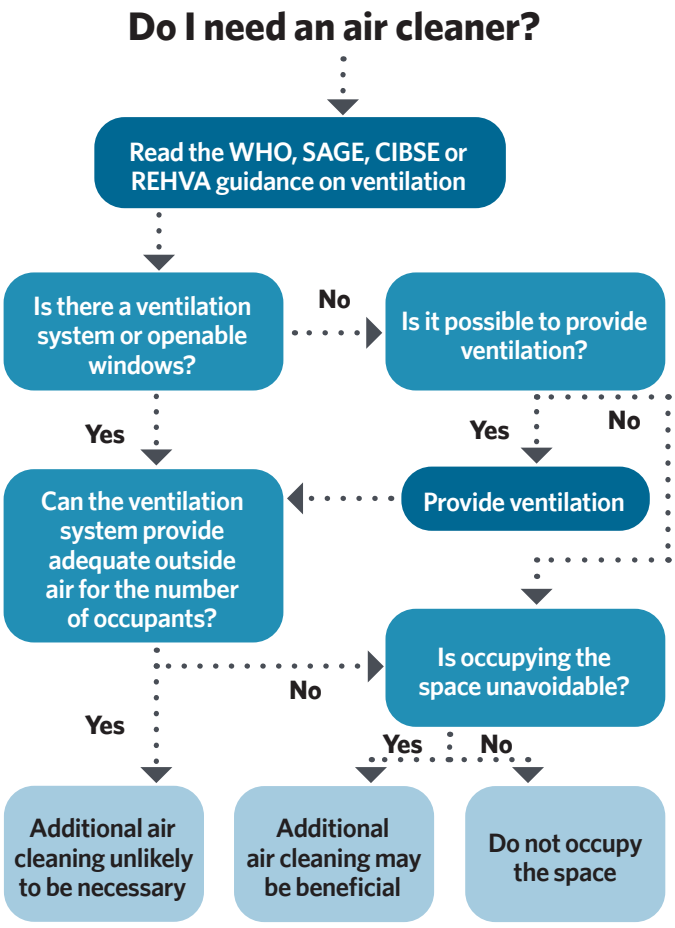


Figure 2: High-level flowchart for assessing suitability of portable air cleaner as part of Covid-19 mitigation strategies

» which are relatively inert from a chemical perspective, are simpler to specify.

From a ventilation perspective, the guide describes the methods that specifiers can use to translate a manufacturer's claims into a robust assessment of performance:

Equivalent ventilation rate (eqACH)

In simple terms, this metric is used to measure the amount of air treated by a device in terms of the equivalent air changes per hour of clean air. Ventilation should always be the first choice, but in spaces where this is not possible, this metric can be used to assess the ability of a device to clean the air.

The clean air delivery rate (CADR)

The CADR is a commonly used metric that can be useful for comparing devices and for comparing the impact of dilution through ventilation. In the absence of this test-derived data, the guide provides a method to estimate the CADR from a product data sheet.

> "The long-term energy implications of any air cleaning device should still be at the forefront of everyone's minds"

The relative exposure index (REI)

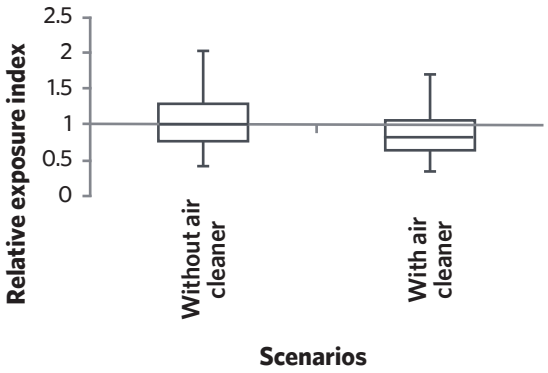
Developed by Benjamin Jones *et al*,[2] the REI is used to highlight types of indoor space, respiratory activity, ventilation provision and other factors that increase likelihood of far-field exposure to SARS-CoV-2.

The guide is accompanied by a simple yet powerful spreadsheet tool, which enables specifiers to assess the impact of different interventions on a space, including ventilation, breathing rates and the introduction of an air cleaning device. An example is shown in Figures 3a and 4a.

Consider a typical UK classroom with ventilation of 5L·s^{-1} per person. Adding an air cleaner that can provide the equivalent of 1ACH (calculated using the method in section 8.2) will reduce the median Relative Exposure Index by 18%, as shown in Figure 3a

	Without air cleaner	With air cleaner
Room width (m)	7.42	7.42
Room length (m)	7.42	7.42
Room height (m)	2.7	2.7
Number of occupants	32	32
Breathing rate	Children sitting	Children sitting
Respiratory activity: breathing	75	75
Respiratory activity: talking	25	25
Respiratory activity: vocalising		
Occupation time (hours)	7	7
Air change rate (ACH)		
Ventilation rate (L·s^{-1} per person)	5	5
Ventilation rate (L·s^{-1})		
Air cleaner equivalent ventilation rate (ACH)		1
Air cleaner equivalent ventilation rate (L·s^{-1})		
REI	1.012	0.829
Median REI improvement		18%

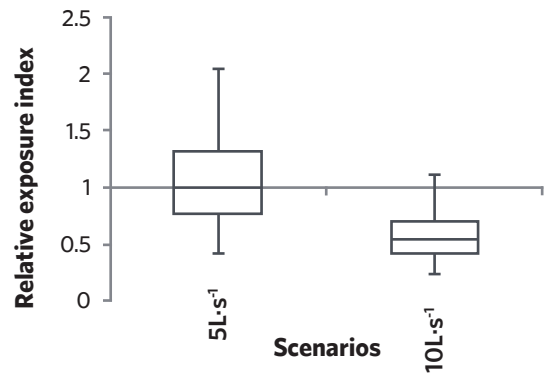
Figure 3a (left): A sample calculation using a ventilation rate of 5L·s^{-1} per person and an air cleaner ventilation rate of 1ACH; and Figure 3b (below): The resulting box whisker plot



Alternatively, the outside air ventilation rate in the classroom could be increased from 5L·s^{-1} per person to 10L·s^{-1} per person, which would reduce the median REI by 46%, as shown in Figure 4a

	5L·s^{-1}	10L·s^{-1}
Room width (m)	7.42	7.42
Room length (m)	7.42	7.42
Room height (m)	2.7	2.7
Number of occupants	32	32
Breathing rate	Children sitting	Children sitting
Respiratory activity: breathing	75	75
Respiratory activity: talking	25	25
Respiratory activity: vocalising		
Occupation time (hours)	7	7
Air change rate (ACH)		
Ventilation rate (L·s^{-1} per person)	5	10
Ventilation rate (L·s^{-1})		
Air cleaner equivalent ventilation rate (ACH)		
Air cleaner equivalent ventilation rate (L·s^{-1})		
REI	1.012	0.543
Median REI improvement		46%

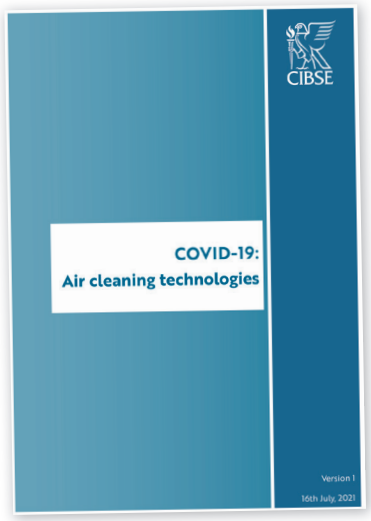
Figure 4a (left): A sample calculation using ventilation rates of 5L·s^{-1} and 10L·s^{-1} with no air cleaner; and Figure 4b (below) the resulting box whisker plot



An air cleaner is for life, not just for Covid

Responsibility for maintenance and operation of any devices should be identified at the outset. The likely users of the devices should also be educated on the correct operation of these. Studies have shown that the effectiveness of devices in practice is linked to issues including thermal comfort and noise, so ensuring building occupiers know what they are for – and how they work – is key.

Devices based on mechanical filtration should follow standard industry practice on filter replacement and safe disposal. The long-term performance of novel air cleaning devices is not well studied. Again, it is recommended that specifiers err on the side of caution and ask for clear, concise information on how to maintain any device, including replacement intervals of any operating parts.



Left: CIBSE's new *Covid-19: Air cleaning technologies* guide

Healthy people and a healthy planet

The guide has largely taken a relatively short-term look at the application of air cleaners. This was on the basis that the current pandemic will, hopefully, be brought under control in a reasonable period and that their use will be temporary.

While it is not covered explicitly, the long-term energy implications of any air cleaning device should still be at the forefront of everyone's minds. All air cleaning devices either use energy directly or increase the consumption of existing systems – for example, increasing the grade of filters in a ventilation system.

As such, the specification of air cleaners, especially those intended to be permanent, must look at the potential longer-term energy consumption of the devices. This should ideally form part of a wider assessment of methods to reduce infection risk and improve air quality, including increasing ventilation where possible.

Any measures should be combined with approaches that mitigate energy consumption, such as demand control. **CJ**

■ *Covid-19: Air cleaning technologies* is available to download now from the 'Emerging from lockdown' section of the CIBSE website at **bit.ly/CJSep21Air**

■ **EDWIN WEALEND** is the head of research and innovation at Cundall and co-author of the guide alongside **CHRIS IDDON** and **DZHORDZHIO NADZHIEV**

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UPWARD TREND

In a summary of his winning paper at the CIBSE Technical Symposium, Ventive's **Tom Lipinski** discusses the evidence available for the best methods for ventilating buildings in a 'Covid-conscious future'

It is hard to write about Covid-19 and cover new ground, but one area that seems to have been almost entirely neglected is airflow dynamics. In the pandemic, ventilation was initially ignored as people followed the World Health Organization's (WHO) unfounded fomite theory,[1] despite mounting scientific evidence against it.[2]

When the WHO finally admitted that airborne transfer was a possibility (almost nine months after 239 scientists wrote an open letter urging it to accept the airborne route)[3] it continued to insist that aerosol transmission was rare, and fomites were key to the spread of infection.[4]

Professor Cath Noakes changed her Twitter handle from #hands #face #space to #ventilate to encourage people to start taking ventilation seriously. Still, unanswered questions remained: is it about air changes per hour? Does how we ventilate matter at all?

We see air changes per hour (ACH) requirements – 10L·s^{-1} per person, or 15L·s^{-1}, or as much as 210L·s^{-1} per infected person, for example – thrown around with authority, yet we don't see much of a discussion about how breath spreads indoors and whether some ventilation methodologies manage this better than others. Interestingly, this debate took place years ago following SARS-CoV-1, with intriguing outcomes.

The fact many super-spreader events happened in settings with good or adequate ventilation should have raised alarm bells immediately. The Skagit Valley Chorale practice that resulted in 53 infections (out of 61 attending) and three deaths, had a modern, forced-air heating and ventilation system installed that was running at 0.7 ACH during the event, designed for occupancy of up to 180.[5]

The call centre in Seoul, where 94 out of 216 employees were infected, had a functioning, positive pressure HVAC system in place, delivering a recommended airflow rate.[6] This inconsistency should have been spotted earlier, but this was happening while the WHO was peddling its unhelpful fomite theory.

How do we ventilate?

There are two main ventilation methodologies (when

> "We need to take a closer look at how we ventilate buildings, especially with high occupancy. Thinking just in terms of ACH is way too simplistic"

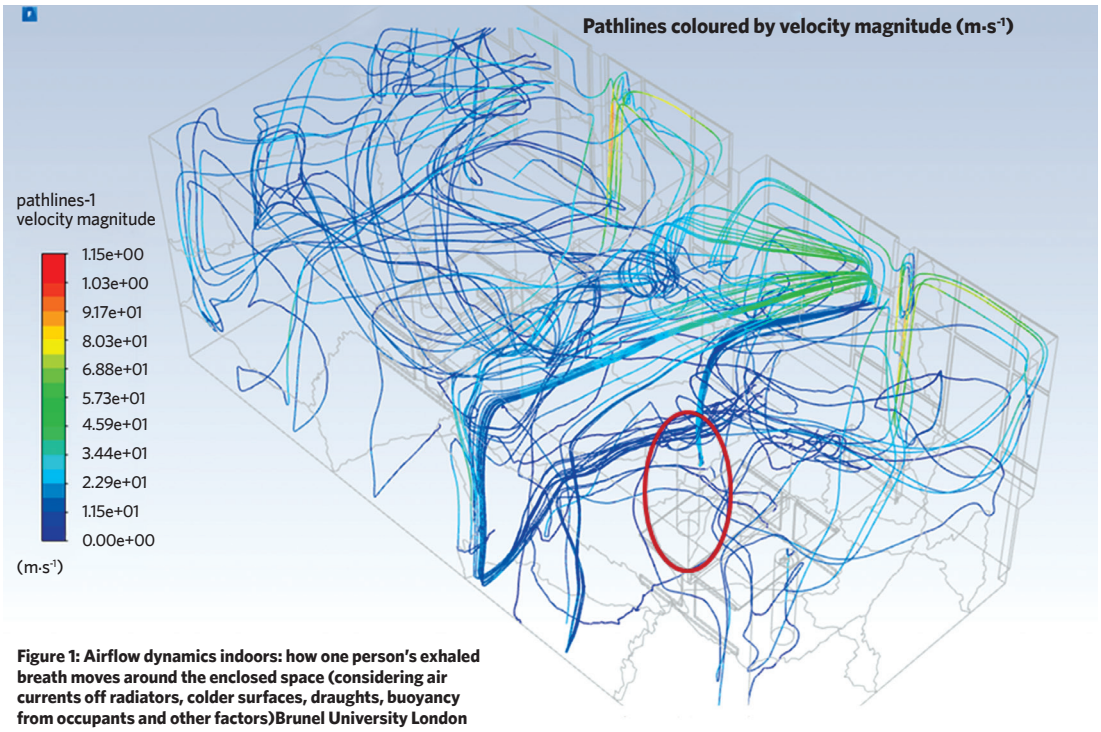

Figure 1: Airflow dynamics indoors: how one person's exhaled breath moves around the enclosed space (considering air currents off radiators, colder surfaces, draughts, buoyancy from occupants and other factors)Brunel University London

Displacement ventilation in a typical office

Green arrow: Cool fresh air at least three to four degrees lower than room temperature floods the room
Yellow arrow: Body heat plume (100W of heat is enough to move air)
Red arrow: Exhaled air that initially follows the ejection trajectory (we exhale at an average velocity of 3.5m·s^{-1}) and then bends upwards as soon as buoyancy force is larger than ejection force (happens within around one metre)

For people wearing masks, the exhaled air follows the trajectory of the heat plume (because of the low discharge velocity). They will still leak virus since these are not surgical masks. The air escapes around the nose and ears (assume there are sizeable façade-mounted grilles: one at low level (intake), one at high level (for exhaust)).

it comes to airflow dynamics): mixing ventilation and displacement ventilation. Each has had dominance at some point in the past. Despite displacement ventilation previously having a dominant position, it has lost some popularity. This may be because developers have worked out they can save 2% on the build cost if they pack building services into the ceiling void.

You might be old enough to remember sockets, as well as air vents punctuating the carpet under your desk – that was when displacement ventilation ruled.

The objective of mixing ventilation (always mechanical) is to ensure that everyone gets the same quality air, wherever they are in the room. It's not all fresh though, it is mixed with the room air so everyone in the room breathes elements of other people's exhaled air.

Displacement ventilation, however, (frequently natural) adheres to the rules of physics, using buoyancy (warmer air rising) to facilitate the removal of stale air. Displacement ventilation needs considered design and architect and engineer to work together, which can be hard.

Mixing ventilation is much easier to implement and manage, needs ducts and fans; and is less demanding on the actual space, opening sizes and the layout.

Most importantly, the way we ventilate seems to matter a great deal when it comes to pathogen spread indoors – not least when considering the impact of coronavirus.

History

None of this, especially with the infection spread in mind, is new. In 2010 Hua Qian *et al* published a paper titled *Natural ventilation for reducing airborne infection in hospitals*.[7] The researchers conducted real-life tests of various methods used in a hospital ward, complete with thermal manikins and tracer gas (sulphur hexafluoride) to measure air exchange rate.

The authors observed that downward ventilation systems could not produce a unidirectional airflow pattern, since thermal plumes of manikins induced mixing and disturbed pollutant removal, while a higher location for exhausts resulted in more effective pollutant removal from the ward. They concluded that natural buoyancy-driven displacement ventilation was much more effective at removing pollutants than a top-down mixing one.

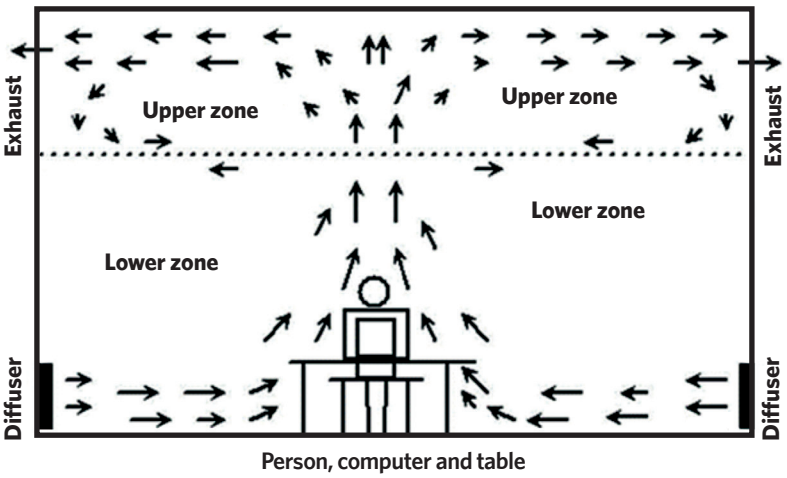

Figure 2: Example of displacement ventilation

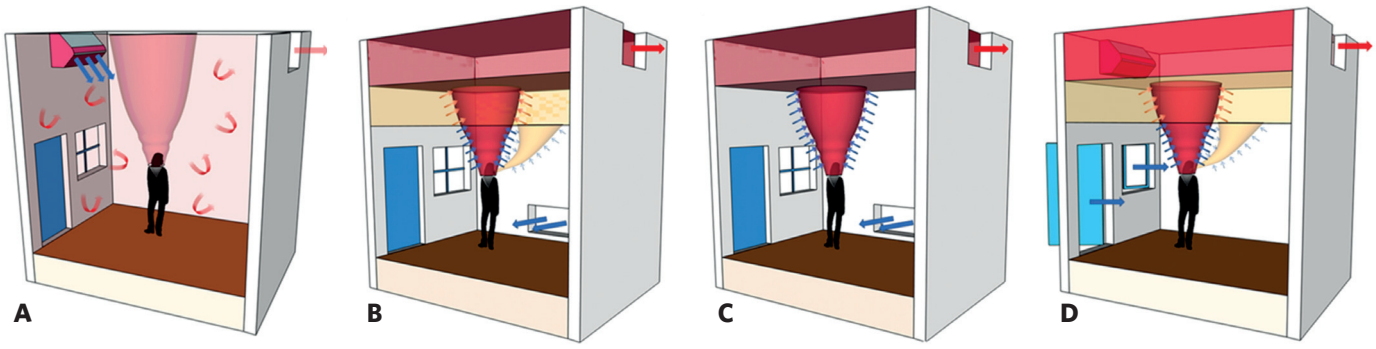

Figure 3: Illustration of ventilation flows with the various flow elements such as the body plume, exhaled breath, inlet flows, stratification and arrows indicating entrainment and mixing[13]

In 2011, two further papers were published, collating performance data for mechanical, natural and hybrid ventilation systems and attempting to quantify the difference between displacement and mixing ventilation with regards to effectiveness at removing pathogens. Amir Aliabadi *et al* concluded that a vertical, upward-type displacement ventilation that introduces fresh, cool air near the bottom of the room is far superior to top-down mixing ventilation, as the buoyant force takes the warm and polluted air (possibly containing airborne pathogens) close to the ceiling and subsequently the exhaust for removal.[8]

Yonggao Yin *et al* managed to conduct comparative tests (again, in a hospital ward) and arrive at a numerical evaluation: 4ACHD > 6ACHM (displacement ventilation with 4ACH removed tracer gas and fine aerosols much more effectively than the mixing type ventilation with 6ACH).[9] If any exhaust was located at low level, (ventilation flow against buoyancy) the pollutant concentration at breathing zone would be even worse than when using a mixing type of ventilation. The paper concluded that for the best result for pathogen removal, all exhausts must be located at high levels, preferably closer to the pollutant source with fresh air delivered low.

Back to the present

Several studies published in 2020 and 2021 arrived at similar conclusions. One focused specifically on the mixing ventilation in hospitals and established that even at 12ACH (equivalent to 120L·s^{-1} per person) the top-down mixing ventilation failed to remove virus pathogens from two-person wards.[10]

A team at the University of Cambridge found that mixing ventilation systems disperse airborne contaminants evenly throughout the space. These contaminants may include droplets and aerosols, potentially containing viruses.

The conclusion was that displacement ventilation, which encourages vertical stratification and is designed to remove the polluted warm air near the ceiling, is the most effective at reducing the exposure risk.[11]

A University of Oregon study concluded that recirculating or mixing airflow has the potential for high spread of coronavirus-infected droplets within densely occupied spaces, even with just one person exhaling the virus droplets. Apart from the recirculation, transmission appears to be facilitated by the type and velocity of turbulent airflow designed to reach deep into the occupied space.[12]

Conclusion

We need to take a closer look at how we ventilate buildings, especially with high occupancy. Thinking just in terms of ACH is way too simplistic. We spent the past few decades sealing office windows and fitting positive pressure, mixing ventilation into ceiling voids – I believe we were going in the wrong direction.

The question is how can we adapt existing buildings to a Covid-conscious future? Not every building can be naturally ventilated – although, surprisingly, many can – and not every HVAC or every space can be easily converted to displacement ventilation (supplying air slowly at low level and extracting at high level).

> "Displacement ventilation needs considered design and architect and engineer to work together, which can be hard"

Those hard-to-adapt spaces may need to transition to lower occupancy levels or to more individual setups (less open plan) accommodating more flexible working arrangements. This means that working from home might not always lead to a reduction in office space requirement – and lower estate costs. CJ

TOM LIPINSKI is founder and technical director at Ventive

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Air flow (m^3/s)

40
34
28
25
22
19
16
14
11
5.5
0

D-AHU
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0.21 m^3/s
up to 40 m^3/s

D-AHU
Modular R

0.13 m3/s
up to 6.95 m3/s

D-AHU
Modular P

0.13 m^3/s
up to 4.16 m^3/s

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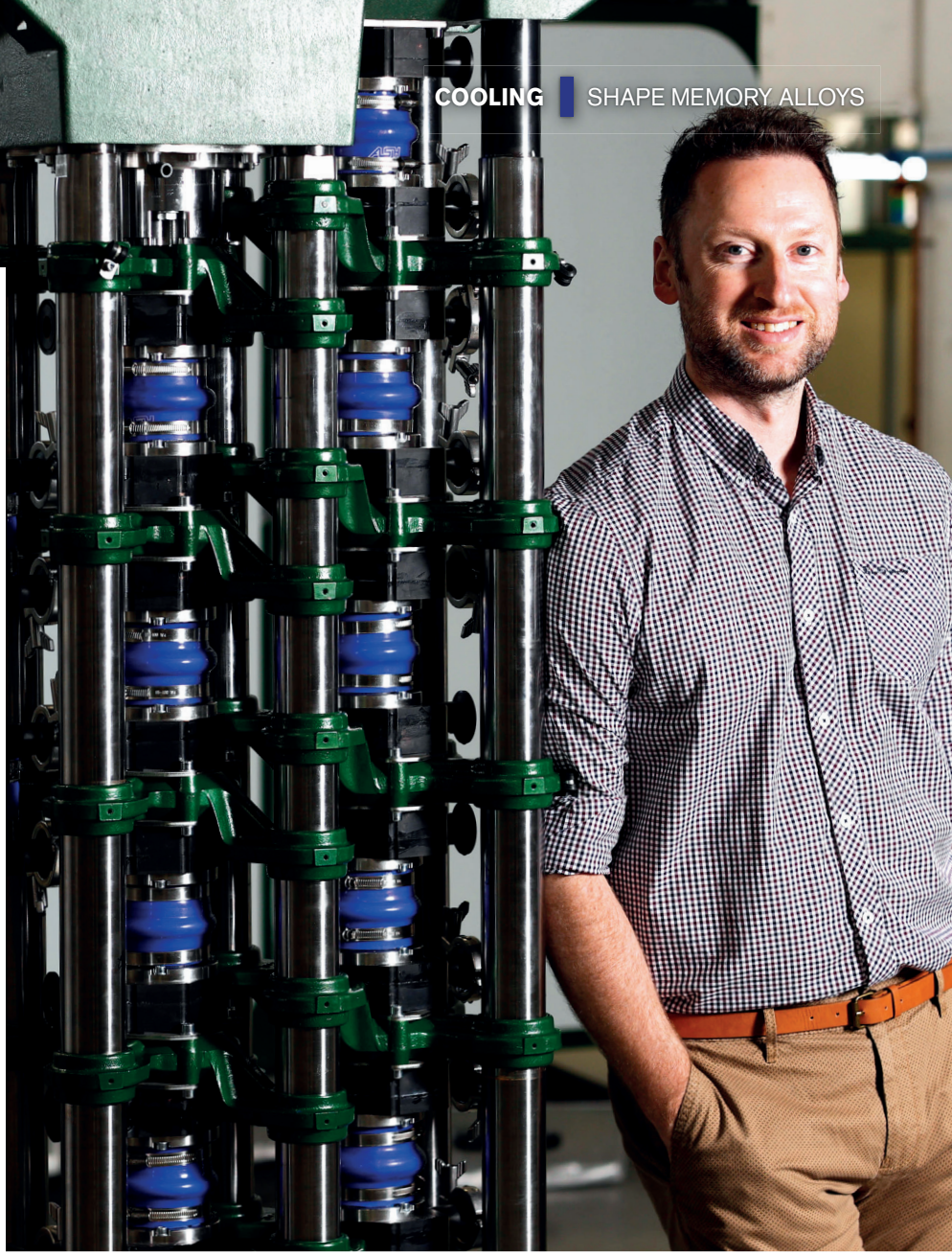
TAKING SHAPE

A shape memory alloy technology could be a GWP-free, cost-effective successor to vapour compression refrigeration. **Liza Young** finds out more



O'Toole refers to the system as a 'solid-state heat pump'

To help limit global warming, improvements to the efficiency of cooling systems must be made alongside the transition to low global warming potential (GWP) refrigerants. This is the warning from the International Panel on Climate Change (IPCC), which published findings last month from the first part of the research that will make up its Sixth Assessment Report.

Aiming to meet this challenge is Dublin-based company Exergyn, which is developing a zero-GWP alternative to traditional vapour compression refrigeration.

Currently undergoing trials, the shape memory alloy (SMA) technology is a solid-state alternative refrigeration system, where alloys are compressed to release heat and then the cycle is reversed for cooling.

According to its developer and the company's managing director, Dr Kevin O'Toole, the technology is retrofittable, and doesn't employ traditional refrigerants with their risks, such as flammability.

O'Toole says low-volume production could start in three years and predicts it will revolutionise the cooling industry.

How it works

The system – which O'Toole refers to as a solid-state heat pump – is based around an alloy core, comprising stacks of SMA 'plates' that are, typically, a compound of nickel and titanium, and a hydraulic piston provides the compression. As the stacks are compressed, the heat transfer fluid – in this case, water-glycol – passes through little channels within the material, heating or cooling during load release.

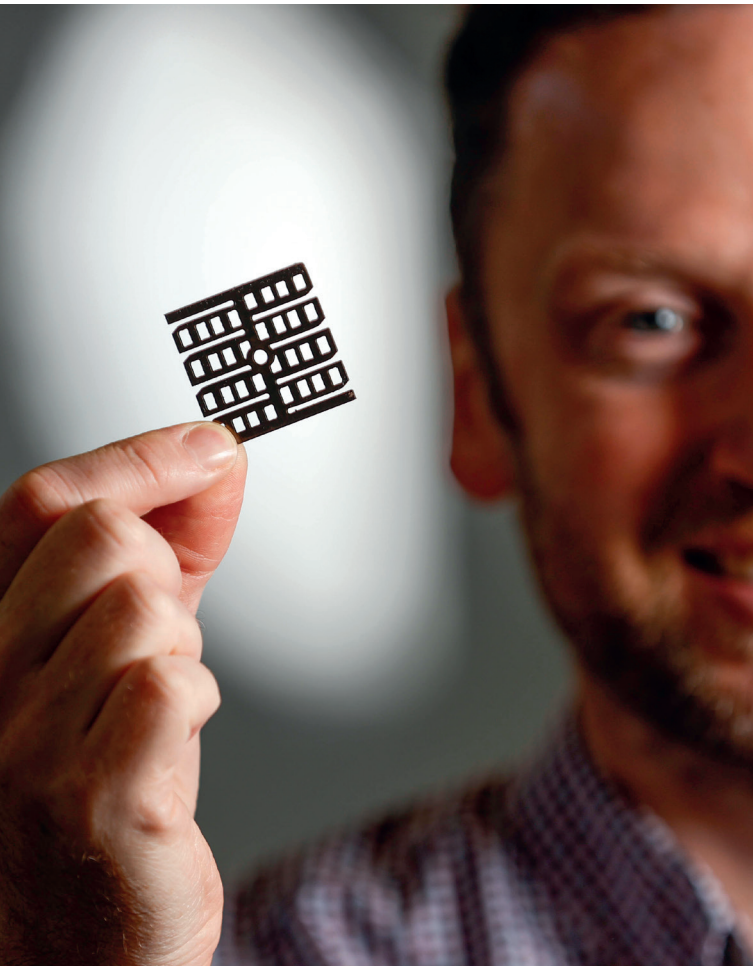
O'Toole says nickel titanium has a couple of unique effects – a shape-memory effect and a pseudoelastic (superelastic) effect. 'Put simply, it means the material has two distinct phases – called austenite and martensite – almost like two materials in one,' he says.

When an external force is applied to the material, it changes its phase from austenite to martensite, releasing a large amount of heat. 'It's similar to a refrigerant gas going from a liquid to gas phase but, in this case, it's solid to solid. As we take the load off it, it absorbs that heat back into itself,' says O'Toole, a mechanical engineer by trade, with a PhD in SMA applications.

Each 10-15-second cycle has four stages that involve: compressing the material and releasing the heat; pre-cooling; taking the load off and absorbing the heat to get free cooling; and then pre-heating. 'The four stages happen every 90 degrees of a cycle, and we typically have four or eight cylinders – or stacks – of this material operating over a cycle, so we have a constant heating capability on one side and a constant cooling capability on the other,' says O'Toole.

He says the nickel-titanium ratio determines the activation temperatures at which the SMA changes phase. The HVAC application, for example, can produce cooling or heating in a window between -25°C and 70°C. But this can be altered with adjustments to the alloy and by adding trace amounts of several other elements such as copper, cobalt, chromium or vanadium. 'In a lot of ways, the SMA world is like an untapped reservoir,' he says.

Exergyn's HVAC prototype unit has a 60kW capacity but, because »



The alloy core comprises stacks of SMA 'plates' that are, typically, nickel and titanium

A moving core – rather than a stationary heat exchanger – avoids scaling

» of its modular nature – the alloy stacks and balance of plant can be retrofitted into where the typical vapour compression loop would be in an HVAC system – O'Toole says it can be scaled up to large-scale applications without loss of performance.

Compressing the material – rather than subjecting it to tension – has allowed the team to run 70 million cycles, which is equivalent to 40 years of operation in a heat pump.

Materials and efficiencies

One of the technology's benefits is that there is a high commonality of components between systems, says O'Toole. 'The interchangeability of stacks means that, if I wanted to make a refrigeration or district heating system, I can take out the stack optimised for refrigeration and put in the heating stack.

'Of course, in refrigeration, we'll be running a slightly different heat transfer fluid, so it's not as simple as just slotting things around. But the principle is that we can design something that looks very similar across the board,' says O'Toole.

The components, he says, are readily available; the company uses off-the-shelf hydraulic pumps, valves, steel and heat treatments.

The materials for the alloys – nickel and titanium – are ubiquitous, adds O'Toole. 'Every electric vehicle in the world has nickel in the battery, and every golf club in the world has titanium – it's common stuff.'

Because the SMAs are not for medical purposes such as braces and prosthetics – which is the technology's origins (see panel 'Origins') – low-grade materials can be used, says O'Toole. 'And it doesn't matter if there are some surface nicks or inconsistent finishes because we're not inducing a crack on the material, so it's not going to fail,' he says.

A moving core – rather than a stationary heat exchanger – avoids scaling, and any build-up is 'blown off' as the core moves and expands and contracts, says O'Toole. 'Because they're non-reactive you could, in theory, put an additive into the fluids and flush it out as part of regular maintenance. We haven't run our systems for five or 10 years in non-accelerated mode yet but, to date, we haven't noticed any scaling because performance stays the same,' he says.

The perfect blend of the alloy core is a constant work in progress. As well as its Dublin-based large-scale test facility, Exergyn has a research laboratory in Prague, Czech Republic, where Dr Jan Pilch is tasked with researching the most effective element blends, stabilising them and making them operate at high performance for millions of cycles.

Without this, O'Toole warns the performance starts to drop off after around 40,000 cycles, as gradual degradation destabilises the material into something commercially unviable. 'With the process we've developed – between Jan's work on the microstructure, and our work on the heat transfer and operation – we can maintain less than 10-12% loss over millions of cycles. It's improving all the time; we have a »

ORIGINS

SMA technology has its origins in biomedicine – SMAs have been used for decades for dental braces and heart stents.

O'Toole says: 'SMAs have been around since the 1960s and, in the 1990s, the first outlet for SMA was biomedicine, with a significant proportion of an already small community going into research because that's where the money was.'

This presented a gap in the market for O'Toole: 'When we started 10 years ago, we were initially looking at waste heat to power applications, where you're applying heat to the material to create power, as opposed to putting force on the material to create heat and cooling.

'In 2017, because of the momentum behind project phasedown [of high-GWP refrigerants], we looked at it in reverse. This was the turning point in the company. But all the work we did in the preceding years laid the foundation for us being able to do that.'

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» conveyor belt with new blends coming online roughly every six months, and we're hoping to bring the developmental process in-house in the next few months,' says O'Toole.

'If we come up with a new blend, because of our commonality of components and modular core, we can swap in a new stack and get the benefit,' he says. 'So, if the stack is more efficient – which can come through moving more heat around, or a reduction in the amount of load needed to apply to the material – you can swap in that core and start compressing it in the same sequence.'

Their latest iteration of the nickel titanium blend has a material coefficient of performance (COPmat) of 27-30, says O'Toole. 'It's what we do on the microstructure combined with the chemical blend that gives us constant improvements.'

In the future, more gains will be made with improved material, says O'Toole. 'If you're moving more heat around with less energy in, you use less material, which is a direct saving on the amount of SMA that goes in. SMA makes up 30% of production costs of the system so, the less you use, the better, which comes down to more efficient materials.'

Other parameters – such as the heat transfer fluid used and how fast the cycle is operating – can also be tweaked to get further performance improvements and cost reductions, says O'Toole.

'Moving the current 10-second cycle to a six- or eig ht-second cycle will also have a direct proportional change on the amount of metal in the system because, if you use smaller cores, everything comes down proportionally, bar the controls system,' he says.

To ensure the performance is high and cost is kept to a minimum, Exergyn is working with a third-party multinational company in the cooling industry (an internet search reveals Carrier).

It is expected that the next generation of the current 60kW system will be tested at a customer's site for the first time.

> "Compressing the material – rather than subjecting it to tension – has allowed the team to run 70 million cycles, which is equivalent to 40 years of operation in a heat pump"

To the future

As part of a Disruptive Technologies Innovation Fund grant the company won two years ago, Exergyn is currently working with Dublin City University on a comprehensive life-cycle assessment (LCA) of the technology.

At the start, O'Toole says the LCA is going to be higher because more nickel and titanium is being brought into the market, so there is going to be more mining. 'But there will come a point where you can start recycling the material because it doesn't evaporate at the end of its life. But we don't know what the end of life is because we've run the equivalent of 40 years and it hasn't failed,' he says.

The main barrier, says O'Toole, is not closed-mindedness towards the technology, but that people don't understand it. 'People have been working with vapour compression for 100 years, and we come and say this lump of metal is going to do that, and do it cheaper. We have to explain how the system works to get people to come round to it, in conjunction with the legislative changes,' he says.

His vision is that the SMA technology replaces vapour compression systems because 'I don't see a "golden refrigerant" at the moment that ticks all the boxes,' he says. 'A GWP of 1 is still infinitely more than zero.'

Some lower-GWP refrigerants have toxicity and flammability issues, which means 'more stuff has to go into your system to protect it', says O'Toole.

'Being GWP-free and non-leaking, our technology circumvents that. So, by hitting the efficiency and cost and size targets, we're hoping to make this a no-brainer retrofittable technology that coincides with the rollout of new [F-gas] regulations,' he says. 'Something's going to have to change and, if you go to the legislators and present a viable alternative, it's possible that this could explode.' But not literally, he hastens to add. 'It's coming to the right time, and we will push that message out there and, if all the stars align, it could revolutionise cooling.' CJ

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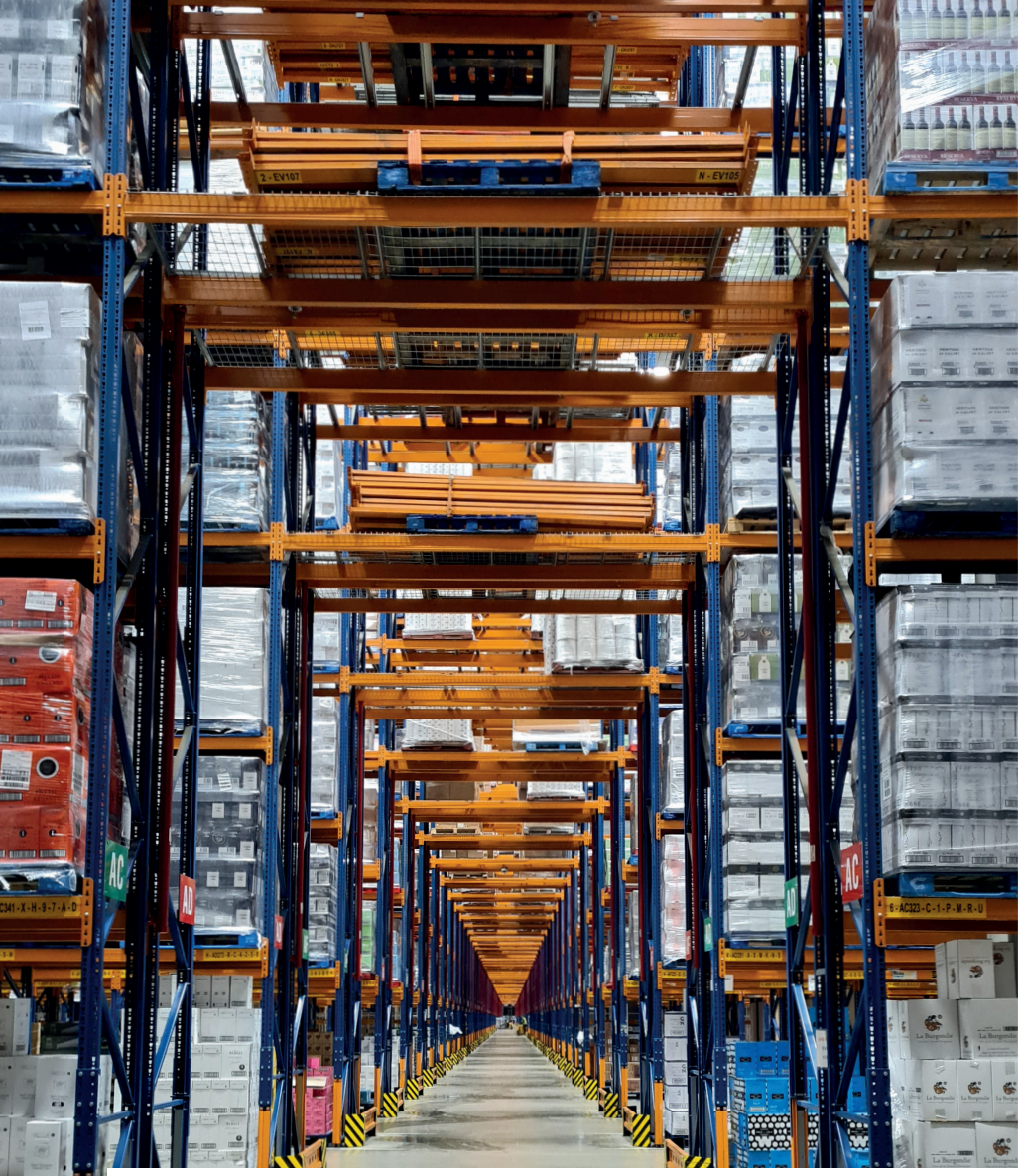


EVERY LITTLE HELPS

By analysing the real-time indoor environment of a Tesco distribution centre in Ireland, Symphony Energy was able to fine-tune air handling units to cut energy use in ventilation and heating by almost two-thirds. Director **Tom Ascough** explains why a predictive control system was key

When it comes to building energy use, it is best to just assume that many buildings have a performance blind spot.

This was the approach to Tesco's distribution centre in Donabate, Ireland, when Skyline Electrical introduced Symphony Energy to the onsite building services team. This ambient and dry goods warehouse, north of Dublin, is Ireland's largest building by volume – extending more than 0.5km in length – and, originally, was the third-largest building in Europe.

The operation of the building's heating and ventilation system had already been commissioned properly. The 14-year-old warehouse was being heated by just one of its two high-pressure, direct gas-fired induction air handling units (AHUs) – saving 50% in fan power. The system was also set to minimum fresh air, thereby minimising the air heating load. It appeared that gas heating and ventilation power consumption was likely to already reflect best-practice operation.

Most clients have cleared the low-hanging fruit before they come to Symphony Energy. We almost invariably need to take a first-principles engineering sweep through the building before getting a blip on our radar for energy-savings potential. It is never a one-size-fits-all approach, and each building will require a bespoke solution.

We considered that a positive way forward was to link the control of the AHU systems to a cloud-based, weather-optimised, predictive control system. Depending on the analysis of intelligent algorithms that control space temperature, CO and CO_2, a slight shift in the temperature-control band can allow the accumulation of a thermal reserve within the warehouse fabric and contents during the most favourable outdoor weather conditions across a 24-hour period.

As the weather becomes less favourable (as predicted) over the following 24 hours, the stored heat, in combination with AHU control, will reduce the heating load while maintaining acceptable conditions.

The two existing AHUs were each controlled by space-temperature and CO_2 sensors. However, it was not clear how even the temperature distribution was throughout the space. Symphony installed a matrix of Modbus temperature sensors spanning low and high levels at three cross-section locations. These were at the centre and close to each end of the 77,000m² building. It revealed only modest variations in space conditions.

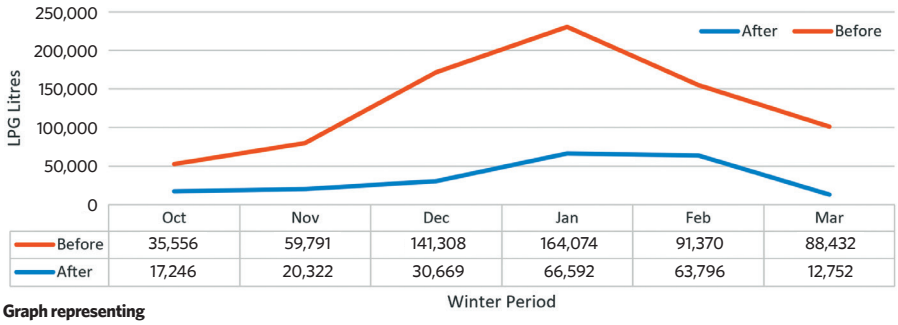
Nevertheless, this investment in data was then deployed to allow the AHUs to sometimes operate for the sole purpose of temperature destratification without the need to fire up the gas burners. It also identified opportunities to select optimally which AHU was in operation and, in so doing, minimise the amount of gas consumption and operation of AHUs.

Understanding the system

Before deploying any new control algorithms, it was necessary to understand the existing system. A process of reverse engineering, in combination with analytic software, allowed the control sequences to be mapped. This helped identify what was working well and where improvements could be made. A process of control was determined and deployed that facilitated more efficient operation of the direct gas-fired burners.

By fine-tuning in real time, it mapped this process to optimise the operation of the »

Tesco Ireland national distribution centre gas use: before vs after



	Oct	Nov	Dec	Jan	Feb	Mar
Before	35,556	59,791	141,308	164,074	91,370	88,432
After	17,246	20,322	30,669	66,592	63,796	12,752

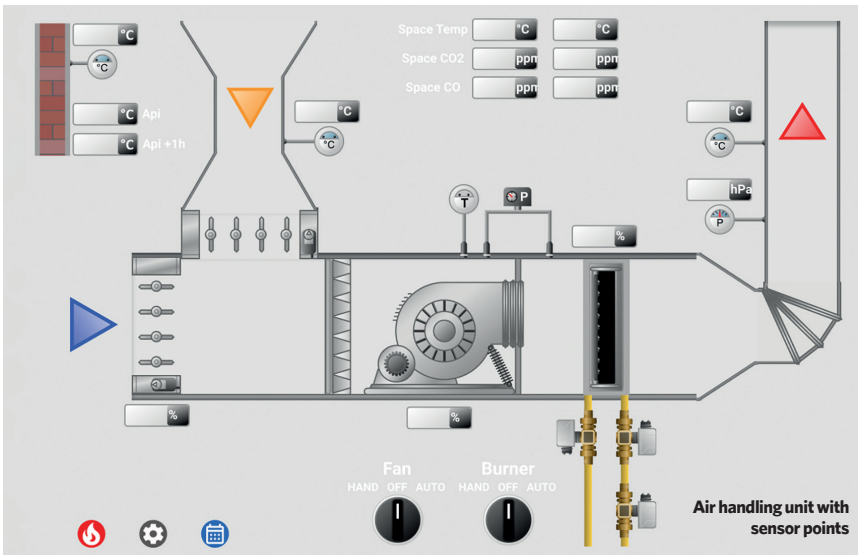
Graph representing consumption of gas before and after the energy-saving project

» AHUs, so they could effectively overcome the buoyancy of the heated air and transfer it from high level to ground level while minimising the operating time for the AHUs – all while maintaining even and steady space environmental conditions.

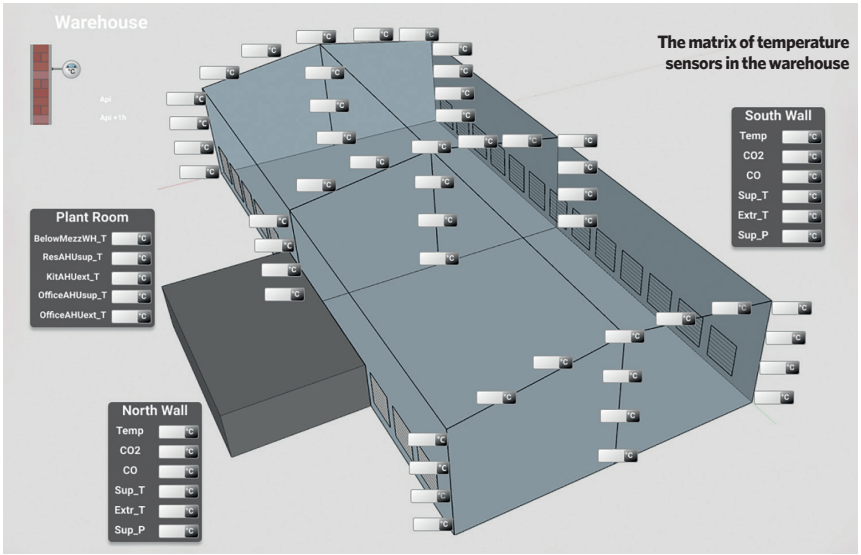
The control optimisation works were undertaken in a live environment without impacting the 24/7 operation of the distribution centre. The smart nature of the energy-savings solution can now be developed for predictive maintenance alerts and future machine learning.

Overall, the energy-savings results have far exceeded expectations in what had appeared to be a well-commissioned facility, to produce an energy-use reduction of more than 60%. The wealth of data collected and analysis undertaken has encouraged the client to consider the opportunities to accelerate future ambitions for heat pump solutions.

Optimising future system designs with low carbon solutions could deliver further emissions reductions and, potentially, realise significant space savings and reduced maintenance and life-cycle renewal costs, while maintaining acceptable internal environmental conditions.



Air handling unit with sensor points



The matrix of temperature sensors in the warehouse

Energy and cost savings

This data-driven solution has provided a very important component to achieve a highly cost- and energy-efficient path towards net zero carbon by 2050 for a national distribution centre.

Since this control technology was deployed, in October 2020, there has been a saving of 63% on electricity used for ventilation and 64% in gas consumption (using 2019 consumption data as a baseline figure). This represents a total carbon emissions reduction of 873 tonnes up to March 2021. CJ

TOM ASCOUGH MCIBSE is a director at Symphony Energy

FREE COOLING AND HEATING

A simplified example of the methods that the Symphony Cycle employs to reduce energy consumption is using the traditional chilled water circuit to move heat between zones, without actively cooling or heating the water with boilers or chillers.

So, for example, consider a building operating in the 'shoulder' seasons where a zone, such as internal offices serviced by fan coils, requires cooling while another zone, such as a factory bay, requires heating by an air handling unit (AHU).

Additional, or augmented, sensors and the cloud-based control algorithms override the normal control process. While the chiller remains off, the AHU cooling coil chilled water valve is opened – otherwise this would normally be closed when the AHU is in heating mode.

The chilled water pumps circulate the water between the AHU cooling coil and the fan coils in the office zone. As water passes through a fan coil unit, it is warmed as it cools the recirculating room air. This warmed cooling water would normally return to the chiller. Instead, the warmed water is circulated through the AHU cooling coil. The incoming, outdoor air is warmed by the coil and the water leaving the coil is, consequently, cooled and is returned to the fan coil units to provide cooling.

The result is to provide 'free cooling' and 'free heating'.

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This CPD will consider the increased focus on efficient air conditioning operation, explore inspection and reporting methodology offered by CIBSE guidance, and suggest how raising awareness of systems function can provide more frequent, informal opportunities to uncover inefficiencies in operation.

As the impact of climate change[1] becomes increasingly evident across the globe, with unseasonable weather patterns driving droughts and storms, and scenes of uncontrollable fires and flooding become more common, there is growing public concern[2] that action is needed. In just over a month's time, high-level negotiations will take place at the 26th Conference of the Parties (COP26) of the United Nations Climate Change Framework Convention in Glasgow, that will set trajectories for long-term change. This will further heighten public awareness and undoubtedly accelerate governmental activity. This is, of course, not news to the building services community who – partly driven by regulatory requirements (such as the Energy Performance of Buildings Directive) – have already seen significant reductions in the potential environmental impact of buildings, equipment and consumables. However, increased public – and client – awareness of both climate change and the need for well-ventilated spaces is likely to further raise interest in inspecting and maintaining air conditioning systems.

Analysis undertaken, and reported in the detailed paper by Hitchin *et al*,[3] that was produced from extensive research and modelling in 2014 – and is illustrated in Figure 1 – predicted that the largest realisable energy savings would be from adopting integrated minimum performance requirements for buildings and systems. These may be enacted through the demands of building regulations and standards, and require realistic simulations to optimise the building and system at the design stage. The second largest potential saving was predicted to come from better operational practices deriving from inspections and energy audits. This was closely followed by the minimum performance for equipment that has been driven by the various global 'ecodesign' standards, resulting in manufacturers producing higher performing equipment such as the variable refrigerant flow (VRF) system shown in Figure 2.

Across the whole of the UK (and the EU) there are statutory obligations and duties of care relating to the operation and maintenance of air conditioning systems. As outlined in the recently published guidance material[4] for the Energy Performance of Buildings (England and Wales) Regulations 2012 (amended in 2020 to incorporate into post-Brexit non-EU dependent regulations), the air conditioning system inspection by an accredited air conditioning energy assessor is designed to improve efficiency, reduce energy consumption, reduce operating costs and reduce carbon emissions. 'Air conditioning' in this context is considered as being where refrigeration is used to provide cooling for the comfort of the occupants of the building and is for systems in buildings that have an effective combined rated output of at least 12kW. The 2012 revision to CIBSE TM44 – *Inspection of air conditioning systems: a guide to EPBD compliance*, was originally written to meet the compliance needs of conducting »

» an air conditioning inspection to satisfy the requirements of the EU Energy Performance of Buildings Directive. TM44:2012 still provides a standard reference for the various regulatory authorities across the UK. It includes methods, checklists and schedules to inform the completion of a standardised set of reporting templates that may then be used to formally lodge a record of the inspection with the appropriate authority.

TM44 provides methods for two levels of air conditioning assessment, known as levels 3 (simple packaged) and 4 (complexed central), that are tied to the accredited competence of the air conditioning assessor. Level 3 assessors would broadly be expected to have the capability to inspect packaged air-to-air heat pumps; unitary packaged units, such as 'through the wall' units; split units (single indoor unit), and multi-splits (with several indoor units) connected by refrigerant pipework to a single outdoor unit; and VRF systems. Any systems that include a significant distribution of air or chilled water are likely to be categorised as 'complex' and require the services of a level 4 assessor.

Guidance for both level 3 and level 4 systems include inspections of refrigeration equipment and associated heat exchangers to ensure appropriate operation and effective heat rejection and distribution. Air moving systems – for example, fan-powered, ducted ventilation systems – are likely to take a more significant place in a level 4 assessment. This includes all components, starting from the external intake grilles through to the registers (such as grilles and diffusers) that deliver the conditioned air into the space, and embraces all the principal components along the way. The operational procedures and system controls, which may be integrated through building management systems, are assessed in some detail, since they are likely to have a significant influence on the operation of the air conditioning systems.

The building owner or operator would be expected to provide any available documentation for the systems in readiness for the inspection. The quality, extent and accessibility of relevant information provided prior to an inspection of the system has important consequences for the effectiveness and cost of an air conditioning system inspection. TM44 provides more detailed examples of what information can usefully be provided. Part of the assessor's work will be to gauge whether the information properly reflects the installed system. Documentation that clearly evidences that equipment and systems are already subject to regular good practice and appropriate checking and maintenance procedures,

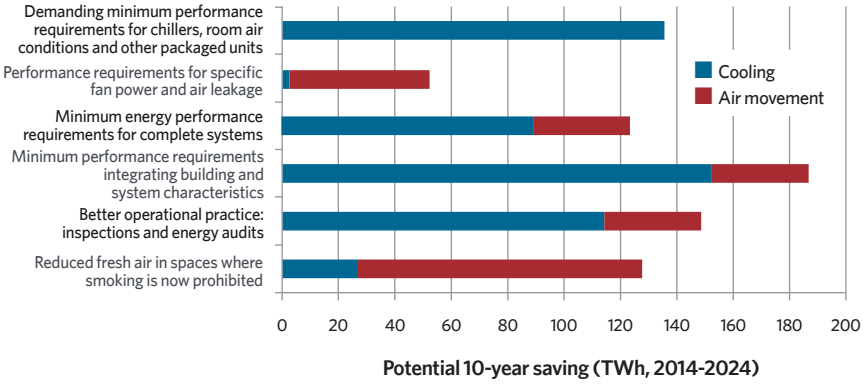

Figure 1: Realisable 10-year savings, 2014-24, from interventions to 'business as usual' in European energy consumption for air conditioning[3]

will potentially allow the assessor to reduce the extent of the inspection.

For the building owner and operator, an inspection should deliver more than simply meeting the statutory requirement, with significant benefit deriving from the knowledge and expertise of the assessor as they highlight how the operation of existing systems can be improved, or identify opportunities to replace older, less energy efficient, or oversized systems. The inspection report would typically include:

- The likely efficiency of the system and any suggestions for improvement
- Any faults identified during the inspection and suggested actions
- The adequacy of equipment maintenance and any suggestions for improvement
- The adequacy of the installed controls and control settings and any suggestions for improvement
- The current size of the installed system in relation to the cooling load and any suggestions for improvement
- Consideration of the capabilities of the system to optimise its performance under typical operating conditions.

Advice may also be given on systems that operate with refrigerants that are being phased out, or may have their use and supply restricted owing to environmental regulations. In these cases, the energy assessor may give advice on possible options for future system adaptation to use other refrigerants, or the need for refurbishment and replacement.

Only air conditioning inspection reports that have been produced and lodged on the register by accredited energy assessors are accepted as valid by the UK authorities. The intent is that the building operator will act on the advice and key recommendations and, by rectifying faults or by making the appropriate improvements, will contribute to the efficient running of air conditioning systems. This will reduce carbon emissions as well as building operating costs, and the resulting well-run, energy-efficient site could also save on maintenance and reduce the likelihood – and the resulting consequences – of unexpected systems failures.

Air conditioning systems and sensors interrogated and analysed by condition-based monitoring software, increasingly employing machine learning and 'big data', can provide intelligence on the need for preventative maintenance to

BEFORE ENROLLING A LAY INSPECTOR

Before considering site access by a lay inspector, an appropriate health and safety risk assessment should be undertaken and training provided that is appropriate to the site and the expected activity. It is vital that the lay inspector properly understands that access to some areas may require authorisation or specific training because of factors such as exposed moving parts, extreme temperatures, high pressures, noxious gases and other hazards, as well as the direct or indirect risk they pose to others through their actions. Appropriate personal protective equipment (PPE) would need to be supplied and worn. Lay inspectors must be properly trained so as not to be tempted to open (or potentially make contact with) certain pieces of equipment while they are still operational and, since most systems are automatically controlled, be aware that equipment may suddenly switch on.

The building operator would need to ensure that such activities do not compromise insurance and statutory requirements.

Figure 2: An example of a contemporary variable refrigerant flow (VRF) air conditioning system with a seasonal energy efficiency ratio (SEER) of up to 7.7, and seasonal coefficient of performance (SCOP) up to 4.8 (based on European ratings)

EXAMPLE VISIBLE SYMPTOMS OF PERFORMANCE ISSUES ON EXTERNAL COILS

Restrictions to outdoor airflow through the external coils will prevent the system operating at design conditions and optimum efficiency. This can lead to increased condensing temperatures, and each increase in 1K can add approximately 3% to the refrigeration energy consumption. Significant consequent increases in operating pressure can trip the high-pressure compressor cut-out that, for safety reasons, is not automatically reset but requires the manual intervention of an operator – which can potentially result in a loss of cooling for prolonged periods.

Restricted performance will commonly be caused by waste material or other items (such as packaging or tools) piled around an external unit cabinet; a shrub growing too close or too large; grass cuttings or other flora obstructing the coil; new constructions unintentionally corralling a previously well-ventilated space; and inappropriate shields being added to reduce noise breakout.

All coils will become dirty in use. As well as impeding airflow, this will act to reduce the heat transfer and adversely impact performance. The rate that dirt accumulates will be very site-dependent, but conditions can swiftly change, with unexpectedly high levels of dust resulting from sources such as local building works; agricultural processes; and climatic conditions depositing wind-conveyed sand and dirt particles.

Damage or erosion/corrosion to the coil surfaces will impact performance. This may be caused by, for example, accidental collisions with vehicles/people/falling items; chemical interaction with local pollutants; vandalism; or hailstones.

Evidence of icing or excessive standing water can be symptomatic of one of several issues including obstructed/insufficient airflow (possibly a faulty fan) and insufficient refrigerant (possibly resulting from leakage).

reduce the opportunities for failure. In larger installations, there will be onsite maintenance teams who will work to a planned preventative maintenance (PPM) regime. However, in many commercial applications, there will be no permanent maintenance presence, so system deterioration can still occur, remaining unobserved; this can result from the gap of up to five years between statutory air conditioning inspections or, in the absence of PPM, irregular and partial intermediate visits by maintenance contractors.

In such cases, there can be some benefit in considering enrolling a responsible person – such as the building manager, security personnel or caretaker– as an informed lay inspector who would then undertake a regular 'strolling survey', not only to ensure effective building operation, reduced energy use and lessened environmental impact, but also help to prevent disruptive system failures. The lay inspector would effectively provide an additional diagnostic resource to the person who has engineering responsibility for the building, although the lay inspector would not be responsible for any rectification work. Prior to enacting a programme of lay inspection, the responsible building operator should ensure that appropriate training and checking takes place (See panel, 'Before enrolling a lay inspector').

There are many problems that impact the successful operation of air conditioning systems where symptoms may be readily identified by a trained lay person. Most of these require observations of changes from the normal, or maybe optimum, conditions, so tours of inspection should be undertaken on a regular basis – the actual frequency will depend on the availability of the lay inspector and the size and complexity of the site. In a small installation – for example, a small office, boutique shopping complex or health centre (typical level 3 applications) the tour of inspection might take place on a weekly or even daily basis. In larger, more complex applications, where the access issues are more demanding, it may not be feasible to undertake such frequent inspections without impacting the normal role of the lay inspector.

There are many observations that may be undertaken, some of which may be derived from the assessor lists in TM44, which require no specific engineering understanding but will require an engineer or technician to set up the scope for observations and interpret the findings. The panel 'Example visible symptoms of performance issues on external coils' provides an example of how simple observations of the external refrigerant coil can aid in identifying performance issues.

Lay inspectors will benefit from a simple set of information sources and relatively low-cost devices that, with appropriate training, can help inform their observations – their role being to assist in identifying deviations in normal operation that may, in turn, cause loss of performance. These may include:

- Basic performance specifications for the building environments
- Environmental meters (for example, measuring temperature, humidity, noise or lighting)
- Simple dataloggers
- Information derived from building management systems
- Bills from utilities and contractors
- Records of consumables use, such as filters and lubricants
- Building operating logbooks
- Maintenance requests and logbooks
- Patterns of staff sickness
- Building use studies and post-occupancy evaluations.

The use of non-expert inspectors is no substitute for a proper maintenance and inspection routine. More detailed information about the inspection process may be found in the CIBSE TM44, as well as in the literature provided by equipment manufacturers.

Turn to page 80 for references. »

Module 184

September 2021

1. In the work undertaken by Hitchin et al, what was considered as being able to deliver the highest realisable 10-year saving?

- ☐ A Better operational practice: inspections and energy audits
- ☐ B Demanding minimum performance requirements for chillers, room air-conditioners and other packaged units
- ☐ C Minimum energy performance requirements for complete systems
- ☐ D Minimum performance requirements integrating building and system characteristics
- ☐ E Reduced fresh air in spaces where smoking is now prohibited

2. In the UK, what is the effective minimum combined rated cooling output in a building that indicates it is likely to require a regular air conditioning inspection by an accredited assessor?

- ☐ A 2kW
- ☐ B 7kW
- ☐ C 12kW
- ☐ D 17kW
- ☐ E 22kW

3. Which of these was not explicitly mentioned as being typically included in an assessor's inspection report?

- ☐ A Adequacy of equipment maintenance
- ☐ B Adequacy of the installed controls and control settings
- ☐ C Current size of the installed system in relation to the heating load
- ☐ D Faults identified during the inspection
- ☐ E Likely efficiency of the system and any suggestions for improvement

4. In the illustrated VRF system, what is the rated SEER (based on European ratings)?

- ☐ A Up to 1.2
- ☐ B Up to 3.5
- ☐ C Up to 4.8
- ☐ D Up to 7.7
- ☐ E Up to 9.0

5. Which one of these is most likely to be true for a building that is subject to air conditioning inspection?

- ☐ A All VRF systems will require a level 4 assessor
- ☐ B Complex systems are required to have more frequent inspections than simple systems
- ☐ C Following and documenting manufacturers' operating and maintenance instructions will alleviate the need for an inspection
- ☐ D Inspection must be undertaken by an accredited assessor
- ☐ E Regular and properly documented lay inspection is sufficient evidence of an air conditioning inspection

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References:

1 *AR6 Climate Change 2021: The Physical Science Basis*, **www.ipcc.ch/report/ar6/wg1/** – accessed 10 August 2021.
2 *World's largest survey of public opinion on climate change: a majority of people call for wide-ranging action, UNDP* **bit.ly/CJSep21CPD1** – accessed 31 July 2021.
3 Hitchin, R, *et al*, *Realisable 10-year reductions in European energy consumption for air conditioning*, Energy and Buildings 86 (2015) 478–491.
4 *A guide to air conditioning inspections in buildings* **bit.ly/CJSep21CPD2** – accessed 31 July 2021.

Achieving Passivhaus standards in schools using decentralised ventilation

With buildings accounting for 39% of all carbon emissions, according to the World Green Building Council, there is increasing pressure to meet ambitious net zero targets. Creating ultra-low energy buildings will be necessary if we are to reduce our energy consumption and subsequently our carbon emissions. While modern building standards aim to reduce carbon emissions further, Passivhaus standards raise the bar far higher, while aiming to create more comfortable buildings.

Ventilation plays a crucial part in meeting Passivhaus requirements: achieving high airtightness and reducing space heating demand. Openings in buildings such as windows allow heat to escape, wasting the energy generated within the building. Consequently, Passivhaus buildings have high airtightness to achieve low heat losses. But, in increasing the airtightness of a building to conserve energy, indoor air quality can suffer. Therefore, a mechanical ventilation solution with heat recovery (MVHR) is required to manage indoor air quality while minimising energy wastage.

SAV Systems, in conjunction with our Danish partner Airmaster A/S, has recently been awarded Passivhaus Component certification for the flagship AirMaster AM 1000. It is the first decentralised, duct-free, MVHR unit on the market to be awarded the certification. In certifying the AM 1000, SAV Systems offers an innovative ventilation strategy that exemplifies the low carbon standards of Passivhaus.

Most approved MVHR solutions available under the Passivhaus framework are centralised systems that normally have a high specific fan power (SFP), resulting in increased electrical consumption. AirMasters are decentralised, delivering room-by-room ventilation, and harness the Coanda effect for air distribution. The result is SFPs of about half that of traditional MVHR solutions for Passivhaus buildings. Furthermore, the AM 1000 can recover up to 90% of the room's heat using an aluminium heat exchanger.

SAV Systems has had previous experience in the world of Passivhaus standards, having supplied Danfoss Heat Interface Units, known as FlatStations, to the award-winning Agar Grove in Camden. Upon completion, it will be the largest Passivhaus heat network in the UK. However, it was our time working with the City of Edinburgh Council (CEC) that inspired SAV Systems to undertake Passivhaus certification for the AirMaster AM 1000. CEC has set ambitious targets to achieve Net Zero by 2035, leading the council to apply Passivhaus design principles to all its new schools.

Passivhaus ideals are well regarded because of their targets for ultra-low energy standards, awarding certification only to components that meet their demanding criteria. The certification of the AM 1000 highlights the essential role that decentralised MVHR can play as a ventilation strategy for Passivhaus buildings. As buildings strive to achieve Passivhaus standards, decentralised MVHR solutions like AirMaster will play a vital role in this journey.

For more information contact **education@sav-systems.com** or visit **sav-systems.com**

SMART MECHANICAL VENTILATION | SAV

Products of the month

Rinnai offers full product availability for all models 24/7 and next day delivery

Company guarantees product availability and delivery, including for 48-58kW units

Rinnai UK has announced guaranteed product availability for all models, including its 48-58kW range of continuous flow products and systems.

Rinnai says it is also guaranteeing speed of delivery, with all orders placed despatched within 24 hours on a next-day delivery service. Rinnai products can also be shipped the same day – or night – by priced-in special courier, direct to any site in UK major towns and cities.

Rinnai UK managing director Tony Gittings says: 'We are here to help and serve the marketplace. It is a totally integrated part of our operation now – our answer is "yes" to any supply and shipment question to anywhere on mainland UK.'

Rinnai says its continuous flow hot water heating units and systems guarantee limitless hot-water supplies to any site as long as there is a constant supply of gas and water. Rinnai also guarantees to supply temperature-

controlled and useable hot water in unlimited quantities for all hygiene regimes in all types of sites.

Rinnai offers 24/7 technical service, product and spares availability, as well as online technology support, such as the 'Help me choose' facility on the **www.rinnaiuk.com** website.

Gittings says: 'It is also important for the installer, building services consultant and end user to understand that continuous flow can readily and quickly replace any other form of hot-water delivery that fails or cannot cope with demand. A site does not need to do what they believe is a 'like-for-like' replacement – essential services' sites simply need uninterrupted and reliable flows of hot water to maintain hygiene standards.'

According to Rinnai, its specification and design team can also prepare installation schematics that demonstrate best practice regarding legislative design considerations, and to combat legionella, G3 and a host of other onsite compliance issues. The result, Rinnai claims, is a high efficiency, low emission system delivering unlimited amounts of hot water.

Call 01928 531 870 or email sales@rinnaiuk.com or engineer@rinnaiuk.com Alternatively, use the smart online contact points 'Help me choose' or 'Ask us a question' on the homepage at www.rinnaiuk.com

Rinnai expands in the South West region

Company boosts South West sales force with new appointment

Rinnai is expanding its sales force in the South West with the appointment of Dorset-based Andy Bell who started life in the industry as an apprentice before moving on to sales and specification roles.

Bell says: 'My previous role developed and I was awarded a NEBOSH [National Examination Board in Occupational Safety and Health] qualification for health and safety so I could also manage the construction design and management (CDM) regulations requirement. I continued operating all through the pandemic, helping develop a method of investigating a customer's needs and surveying the potential install remotely via video technology; this enabled us to meet the customers needs, even though we could not get access at the time. I have been trained in system design and the video surveying method.'

Rinnai products offer end users a limitless supply of instantaneous temperature-controlled hot water, provided water and gas

supplies are constant. Temperature accuracy ensures hot water can be provided to support anti-legionella regimes, thermal disinfectant and comfort.

Rinnai manufactures hot-water heating units and systems for all and every type of commercial, institutional and residential site. The company manufactures more than two million units a year and operates on each of the five continents with an established reputation for high performance, cost efficiency and robust, extended working lives.

Rinnai units are UKCA certified, A-rated water efficient, with a wide range of accessories, including water treatment systems plus multiple fuel options. The whole range is available 24/7, 365 days a year. Any unit can be delivered to any UK site within 24 hours.

Rinnai says it is committed to decarbonisation, and the N series of units is hydrogen blend-ready now and can also use BioLPG, which delivers net-zero carbon emissions.

Rinnai also offers comprehensive training courses, CPDs and technical support in all aspects of the hot-water heating industry.

More information can be found on Rinnai's website and its 'Help me choose' dedicated webpage. Visit www.rinnaiuk.com

Plug-and-play CO_2 sensors in Mitsubishi ventilation system

Mitsubishi Electric has launched a new product to improve indoor air quality in a multitude of settings, including schools, restaurants, offices, shops, hotels and factories.

The LGH-RVS-E is the latest in the Lossnay range of commercial ventilation systems, and is designed with a plastic heat exchanger rather than paper. This makes it ideal for humid locations, such as bathrooms and wet rooms. It is also able to address the cooling and ventilation needs of spaces such as offices and schools.

The units are easy to install and simple to interlock with Mitsubishi Electric's Mr Slim and City Multi air conditioning systems.

The LGH-RVS-E comes with a new generation of controls, more flexible commissioning, and two plug-and-play CO_2 sensors that reduce installation costs by taking their power from the fan unit rather than needing a separate power supply.

The units can be integrated with Mitsubishi Electric's AE-200E central control for touchscreen control of products, as well as energy monitoring and automated reporting.

Visit les.mitsubishielectric.co.uk/products/ventilation/commercial-lossnay/commercial-lossnay-series

Humidifier help from Condair

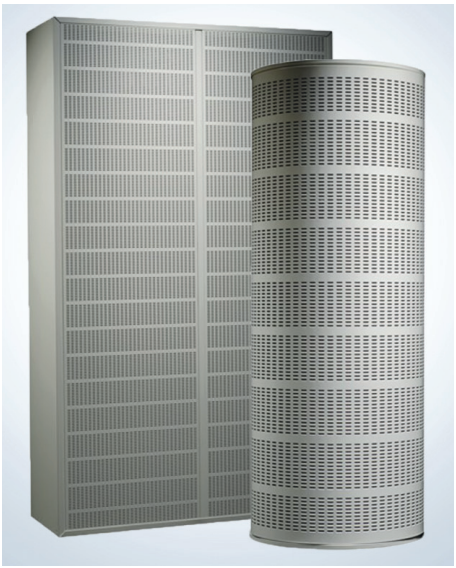
Humidity control specialist Condair has released a 10-point guide to specifying humidifiers. Aimed at HVAC consultants, the illustrated guide covers topics such as air handling unit versus in-room strategy, psychrometrics, product sizing, technology selection, installation, and hygiene management.

'It includes some very useful rules of thumb and will prompt a consultant to review important aspects of a project they may not have otherwise considered,' says Dave Marshall-George, sales director at Condair.

The document can be downloaded for free from Condair's website.

Visit www.condair.co.uk/guide

Waterloo strengthens product offering with displacement



Waterloo has strengthened its product offering by replacing its displacement range with the full portfolio of Swegon displacement products. By integrating a range of airborne products from the Swegon group, the supplier of air terminal devices aims to deliver the widest range of room unit products in the UK market.

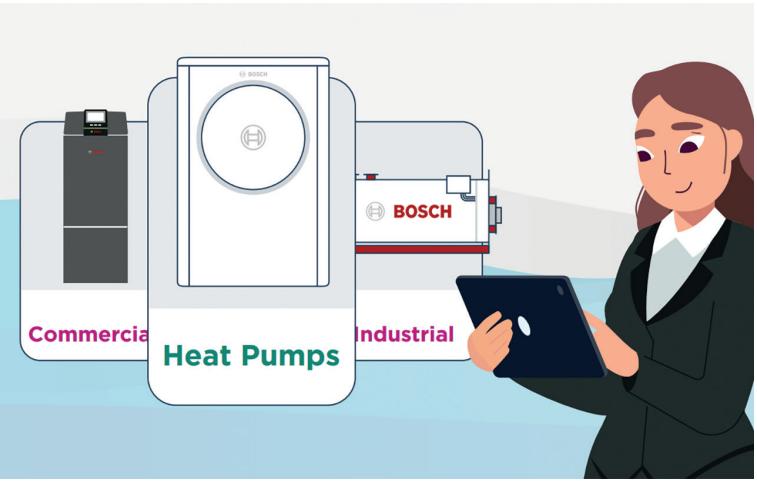
The new displacement terminals are made to effectively discharge air at low velocity to ensure good comfort in rooms. In large spaces, such as airports, theatres, factory floors, open offices, and supermarkets, where a traditional mixed system can fall short, using a displacement system can have significant advantages on indoor air quality and efficiency.

Rooms with high ceilings can benefit from substantial energy savings by installing the displacement terminals with Varizon, as only the occupied zone needs to be cooled from the low level of displacement installation.

Waterloo has introduced 11 models, the majority of which are complete with Swegon's Varizon system, which offers one of the best levels of user comfort at close range on the market.

Visit www.waterloo.co.uk or email rachel.roots@waterloo.co.uk

Bosch Commercial & Industrial educates market on heat networks



Heating, hot-water and steam solutions provider Bosch Commercial & Industrial has launched a new educational online resource to help support the implementation of heat networks across the country.

The 'Heat Networks Hub' is intended to inform project developers, consultants and contractors about the cost- and climate-saving benefits of district heating technology.

The hub includes a newly released animation 'Hello to Heat Networks' that provides detail about what heat networks offer, how they work and their wider benefits, including versatility, affordability and future-proofing credentials.

The hub also includes a 'Knowledge' section where visitors can discover the latest changes and trends in this sector and how it may affect ongoing or future projects.

Visitors can delve into information about Bosch Commercial & Industrial's portfolio, including its BESA-registered heat interface units, energy centre and plantroom technologies. They can also view similar heat network projects for inspiration. Training courses and CPDs are available through the hub.

To find out more, visit the dedicated page on the company's website.

Visit www.bosch-industrial.co.uk/heat-networks

Panasonic's new Smart Multi-site Control Solution provides advanced HVAC control and management

Panasonic Heating & Cooling Solutions has introduced its new Smart Multi-site Control Solution, a twofold, enterprise-wide energy management platform for corporate HVAC installations that, Panasonic says, is easy to install and has a simple, user-friendly interface. The smart solution offers a dual approach: AC Smart Cloud is designed to be used by business owners and facilities or energy managers for remote control, reporting and scheduling, while the AC Service Cloud is designed as an ideal solution for HVAC professionals requiring remote access to a system for maintenance and monitoring purposes.

Visit www.aircon.panasonic.eu/gb_en

Elco Heating Solutions delivers upgrade to flagship hospital

Elco Heating Solutions has supplied four TRIGON XXL EVO gas condensing boilers to The Wirral's flagship Arrowe Park Hospital, as part of an important system upgrade. The replacement boilers are supplying heating and hot water to several areas of the hospital, including CAL 1, CAL 2 and the maternity wards.

Two TRIGON XXL EVO900 and two EVO1100 units were specified. According to Elco, they feature a unique heat exchanger geometry and a water-cooled cold-flame burner, which limit nitrogen oxide (NO_x) emissions to 20mg·kWh^{-1}, while offering gross seasonal efficiencies of up to 96%.

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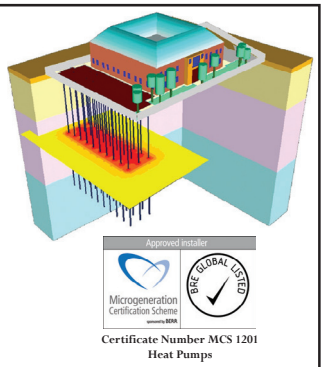

Certificate Number MCS 1201
Heat Pumps

Fire Protection

The Rumford Club will hold a black-tie dinner at the House of Lords in 2022

Sebastian Grey

Back at the club

As engineering networking group The Rumford Club welcomes back guests, members and speakers, incoming chair Sebastian Grey explains what to expect in its 75th anniversary year

The built environment and engineering services sectors' dining and debating group, The Rumford Club, is making a return, following a shutdown during the pandemic.

Socialising, rebuilding networks, exchanging ideas and debating the topics of the day are back, as the club celebrates its 75th anniversary with a series of events at the National Liberal Club in London between October 2021 and March 2022, and a black-tie dinner at the House of Lords in 2022.

The club provides an opportunity for professionals – including consultants, contractors, manufacturers, educators, researchers and many more across the sectors – to meet and debate the issues of the past, present and future. Each dinner has a keynote speaker and topic of debate.

What is the history of The Rumford Club?

It was founded in 1947 by engineers Bernard Oldham and Don Sayers to encourage debate and discussion around technical issues such as air movement in buildings. The topics for discussion have expanded over the years, but its key remit is still to host regular dinner meetings with keynote speakers discoursing on topics around the industry, which frames the subsequent debate.

The club was named after Count Rumford, born Benjamin Thompson in America in 1753, who went on to become a fellow of the Royal Society and achieved popular acclaim for his designs for domestic fireplaces.

What kind of events does the club put on?

Currently, the club hosts dinners at the National Liberal Club in London, and its patron is Lord Rupert Redesdale. Before the pandemic, the club's programme included talks from the likes of Dr Scott Steedman, director of standards at the BSI, on standards in the industry; Rudi Klein, past CEO of SEC Group, on the post-Carillion landscape and the change needed to create a vibrant building services sector; and an intriguing talk on medieval thermal comfort by Robyn Pender, of Historic England.

The club's black-tie speakers are also impressive; one of the events featured former astronaut Michael Foale, who delivered a presentation titled 'Out of this world critical built environments: how to save a space station', and told us how he went outside the space station to stop it leaking air.

Why should people join the club?

People have lost a lot as a result of the pandemic but, as we return to normal, The Rumford Club can be the place to help rebuild, kick-start and generally improve their careers, through meeting people and being able to get back into debating the topics we all know and love. It's a second home within the industry.

How do people become a member?

Membership of The Rumford Club used to be on a member-recommendation basis, then further review and approval by the committee only. In 2017, however, the committee agreed to a more open membership policy. This gives people within the industry who may not know a member an opportunity to join by filling in an online membership application, which is then sent to the committee for approval.

Although the club was initially founded for – and by – engineers, the variety of topics for discussion on issues such as heating, ventilation and achieving net zero are all relevant to anyone within the built environment. Current membership splits into two broad groups: the established, more senior people from the built environment, and younger engineers who want the opportunity to network with key influencers from their sector and build on their knowledge.

What speakers can we expect to see next at The Rumford Club?

Speakers for the year ahead will include: Ruth Carter, CEO, CIBSE; Isobel Sheldon, chief strategy officer, Britishvolt; Ian Pillay, development director, Clean Power Hydrogen Group; Sharon Duffy, head of engineering delivery optimisation, Transport for London; and Simon Wyatt, partner, sustainability, Cundall.

- Visit **www.therumfordclub.co.uk** to find out about becoming a member and attending dinners. Membership starts at £30 a year, with subsequent costs for each dinner of £65 or £55 (without alcohol).

EVENTS

YOUNG ENGINEERS AWARDS

14 October

Celebrating the best young talent within our industry, the annual Young Engineers Awards bring together the CIBSE Employer, Apprentice and Graduate of the Year awards. The accolades recognise and reward the innovative thinking, hard work and skills of graduate engineers, while showcasing employers that are committed to developing and encouraging young talent. Winners will be announced at the online event. Register at **www.cibse.org/yea**

CIBSE REGIONS AND GROUP EVENTS

For up-to-date information on regions and groups meetings, webinars and podcasts, visit **www.cibse.org/events**

Student routes to membership webinar
6 September
Session giving information on the benefits of CIBSE Student membership, and the different membership levels available within Engineering Council Registration.

Home Counties North West: Seminar on managing mental health in the workplace
9 September
Workshop to give you the tools to manage your day-to-day roles, and positive steps and changes that will equip you with coping mechanisms to recognise where small changes can be made.

NEW LIVE ONLINE TRAINING COURSES

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

Fire alarm detection and codes BS 5839-1: 2017
6 September

Heat networks code of practice (CP1)
6-7 September

Below-ground building drainage
7 September

Low carbon consultant design
7-9 September

CIBSE JOURNAL PODCASTS

CIBSE Journal hosts regular podcasts on industry-relevant topics. In the latest podcast – 'How heat pumps are changing the future', sponsored by Mitsubishi Electric – consultants and industry experts discuss how heat pumps are transforming heating and cooling.

All *CIBSE Journal* podcasts are available on the CIBSE SoundCloud, Apple Podcasts and Spotify.

Overview of current fire legislation and guidance
9 September

Earthing and bonding systems
13 September

Emergency lighting to comply with fire safety
14 September

Above-ground building drainage
16 September

High voltage (11kV) distribution and protection
17 September

Energy Savings Opportunity Scheme
20 September

Mechanical services explained
21-23 September

Heat networks (CP1) half-day update
23 September

Building services overview
5 October

Mentoring skills workshop
6 October

Power system harmonics
11-13 October

Building services explained
11-13 October

Overview of IET wiring regulations (18th edition)
12 October

Electrical services overview
13 October

Introduction to heat networks code of practice
14 October

Low carbon consultant building operations
18-21 October

Electrical services explained
19-21 October

Mechanical services overview
21 October

Fundamentals of drainage
25 October

Heat networks code of practice (CP1)
25-26 October

Mechanical services explained
25-27 October

Fire safety building regs Part B
26 October

ONLINE LEARNING

CIBSE has a portfolio of online learning courses, which contain interactive content with quizzes and additional resources to support your learning. **www.cibse.org/training**

CIBSE JOURNAL WEBINARS

CIBSE Journal is hosting two webinars in September:
2 September: Building up to a digital evolution, sponsored by Grundfos.
22 September: Ready or not: UPS systems monitoring and management, sponsored by Kohler Uninterruptible Power.
Register for the webinars at **www.cibsejournal.com/cpd/webinars** All previous *CIBSE Journal* webinars are available on demand.

CIBSE BUILDING PERFORMANCE AWARDS 2022

15 SEPTEMBER 2021

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Discover the 21 categories on the CIBSE Building Performance Awards 2022 website, including the new CIBSE Embodied Carbon Award which aims to empower the building services community to meet net zero carbon goals.

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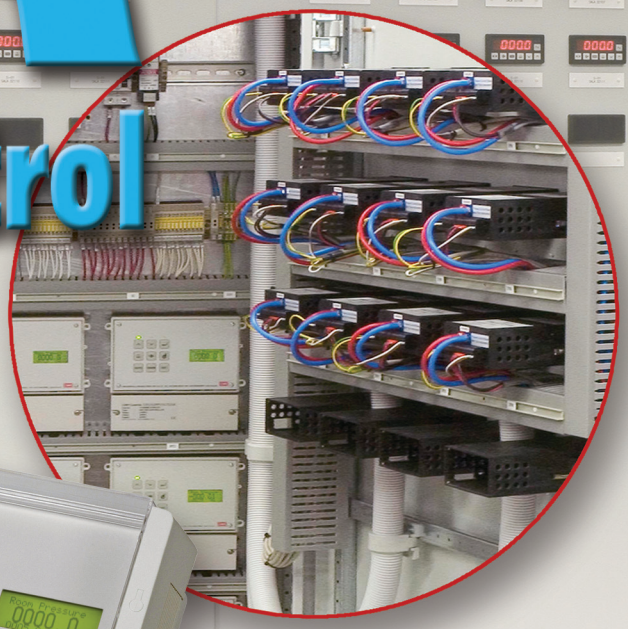

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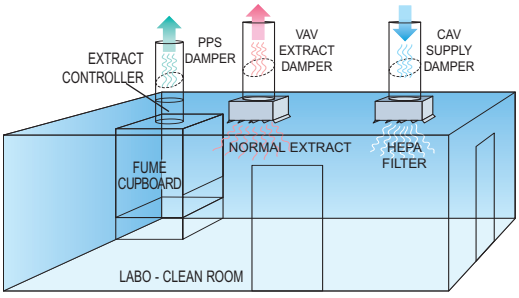

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