

CIBSE **JOURNAL**

#Build2Perform

January 2022

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**WHY NET ZERO AND SAFETY
WILL DOMINATE IN 2022**

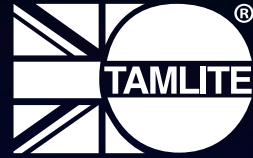
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Growing influence



The new year is a chance to reset and consider the challenges and opportunities of the next 12 months.

With the requirements for net zero ready buildings only three years away, building services engineers will be spending time thinking about the best route to net zero carbon for their clients.

The uplift in the Building Regulations announced by the government last month is intended to keep the industry on course for zero carbon, but some felt it was a wasted opportunity. While the 30% reduction in carbon emissions in housing was seen as a step in the right direction, it disappointed some. CIBSE's head of sustainability, Julie Godefroy, said the government

missed a significant opportunity to provide a meaningful step towards the Future Homes and Buildings Standard. It risked adding to the legacy of buildings and networks that will need future retrofit, she added. Cundall partner Simon Wyatt agreed, saying: The scale of the reduction was lower than the industry said it could deal with, which was a 50% reduction.

There was also disappointment that the government adopted a primary energy metric for calculating energy use, rather than one focused on operational energy. Primary energy factors are based on the fuel source, so, over time as the Grid decarbonises it will become increasingly irrelevant.

While designing for net zero, engineers in 2022 will also have to be increasingly aware of the changes to safety regulations, which will require them to enhance their competencies around the design of high rise residential buildings.

Another safety concern is the arrival of the Omicron variant of the coronavirus at the end of last year, putting indoor air quality back towards the top of the agenda. In December, the virus was particularly prevalent in primary schools. Children aged under 12 in the UK do not receive a Covid vaccination, so are particularly susceptible to catching the virus if there is no ventilation or air cleaning strategy.

On page 53, we feature a Q&A with Henry Burrige, who has been monitoring schools in the Co Trace project, which has produced four videos to help teachers interpret readings from CO₂ monitors so they can reduce the risk of catching Covid in the classroom.

The ongoing pandemic means a continued focus on indoor air quality in 2022, and more clients are showing an interest in air quality certification schemes. This is the experience of Cundall's Ed Wealend, who learned about the Reset Air standard while working in China. He thought certification would not be necessary here until he saw the poor quality of air in audits undertaken in the UK.

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Hywel Davies

How public sector clients can adopt procurement frameworks that support net zero and building safety



Liza Young

Designing workplaces for different minds and ensuring engineers thrive in the industry



Henry Burrige

Assessing the risk of Covid circulation in schools and helping teachers interpret CO₂ monitors



Tim Dwyer

The CPD looks at the factors affecting the success of in-home heat pumps with ambient loop heat networks

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IN BRIEF

Frameworks adopt safety code

The procurement bodies Crown Commercial Service (CCS) and Scape have adopted the Building a Safer Future (BSF) initiative as part of their framework contracts, in a bid to improve standards throughout supply chains.

They plan to make BSF Champion and Registered Signatory status requirements in their frameworks.

The BSF Charter was developed to change the culture and behaviours around building safety at all stages, from design through to management and maintenance.

CCS is an executive agency of the Cabinet Office and the UK's largest public procurement organisation, while Scape is one of the UK's largest public sector procurement authorities.

EC speeds up building refurbishments

The European Commission has set a target for EU member states to renovate poorly performing buildings by 2033, as part of its revisions of the Energy Performance of Buildings Directive (EPBD).

It also intends to ban public subsidies for new fossil fuel boilers from 2027 and has laid out a legal framework for countries that introduce their own national restrictions.

Gathering data including on imports of fossil fuel is an important part of the new rules, with more stringent measures due to be introduced in 2025.

Labour rates hit all time high

The rates paid to site workers reached their highest ever level in November.

Construction payroll firm Hudson Contract reported that average weekly earnings across the country were up by 1.8% to £944 the highest pay levels on record.

This was 4.7% higher than the same period in 2020, but weekly earnings in the capital rose by 6.1%, to £962.

Government accused of Grenfell Tower 'cover up'

Michael Mansfield QC says governments let industry exploit building regulations

The government may have deliberately concealed the dangers posed by the type of combustible materials responsible for the Grenfell Tower tragedy, according to lawyers representing the victims and survivors of the fire.

Michael Mansfield QC told the public inquiry that successive governments may have allowed private companies to exploit building regulations in 'one of the greatest scandals of our time'. He accused officials of colluding with the construction industry and failing to act over warnings from previous fires, including Lakanal House in south London, where six people died in 2009.

The inquiry heard that the government's approach to encouraging greater use of insulation materials was driven by a desire to

reduce carbon emissions and 'an unbridled passion for deregulation'.

Meanwhile, survivors of the disaster have urged the Metropolitan Police to start legal proceedings against those it believes are responsible for the fire before the end of the public inquiry.

Grenfell United said prosecutors should start work immediately on deciding whether charges could be brought against companies and individuals.

The police confirmed they were investigating up to 36 companies involved in the refurbishment of the tower block and had carried out several interviews under caution for gross negligence manslaughter, corporate manslaughter, fraud, and health and safety offences. However, it said it would only send files to the Crown Prosecution Service after the end of the inquiry.



High rise building designers urged to act now on safety ahead of new law

Designers of high-rise buildings should already be preparing for changes that will come into force next year, when the new Building Safety Bill becomes law, according to the chief inspector of buildings, Peter Baker.

The bill, which is currently under review in parliament, will include a more stringent approach to the design and construction of high-rise buildings, and clarify the safety responsibilities that fall on designers. It will also toughen up regulations to ensure everyone carrying out design or building work is competent and capable of complying with building regulations.

'Designers have a strong influence on safety and standards, particularly during the very early planning and design stages of a building project,' said Baker. 'Their decisions not only affect the safety of those carrying out the building work, but also those maintaining, using or living in a building after it is built.'

'I encourage designers to act now and prepare for the more stringent regulatory regime. The Health and Safety Executive (HSE) will continue to work with the building design industry and related businesses to support them to deliver safe and high-performing buildings, and ensure that residents of high-rise buildings are safe - and feel safe - in their homes, now and in the future.'



New homes must cut carbon emissions by 30%

Building Regulation targets regarded as a stepping stone to 'net zero ready' homes from 2025

The government has proposed new measures to improve ventilation and tackle overheating in new buildings, as part of its consultation on changes to Parts L and F of the Building Regulations for non-domestic buildings and homes.

New homes must cut their target carbon emissions by 30%, and non-domestic buildings by 27%, to meet the requirements of the revised Part L. These new design targets will come into effect in June 2022, with the regulations regarded as a stepping stone towards the Future Homes and Buildings Standard, which aims to make all buildings 'net zero ready' from 2025.

Cundall partner Simon Wyatt said the government should have targeted higher carbon emissions reductions: 'The scale of the reduction was lower than the industry said it could deal with, which was a 50% reduction.'

Julie Godefroy, CIBSE's head of sustainability, added: 'The uplift is a significant missed opportunity to provide a meaningful step towards

the Future Homes and Buildings Standard, and it risks adding to the legacy of buildings and networks that will need future retrofit.'

The government proposes three performance metrics against which new non-domestic buildings will be measured: primary energy, a CO₂ emissions target, and minimum standards for fabric and fixed building services. The introduction of a primary energy metric aims to make energy efficiency of each building a priority, regardless of the heat source, but it has been criticised by LETI co-founder Clara Bagenal George, who said: 'Primary energy is a complex metric, with factors that change over time. It will become increasingly irrelevant as the Grid decarbonises, and it favours gas over electricity, going against heat decarbonisation objectives.'

LETI suggests that operational energy becomes the key metric. 'It is already well known and understood within the sector, as well as by building owners and occupiers,' said George.

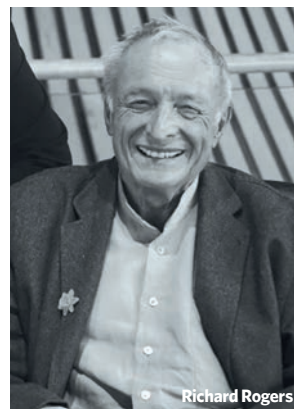
The government also intends to set the Fabric Energy Efficiency Standard so there is a 'meaningful uplift to the fabric of new homes and greater CO₂ savings'.

Eminent architect Richard Rogers dies

Tributes have been paid to Centre Pompidou architect Richard Rogers, who died at his home on 18 December, aged 88.

Fellow Pritzker Architecture Prize-winner Norman Foster, who first met Rogers when they were both students at Yale University, described him as a 'great pioneering architect of the modern age, socially committed, and an influential protagonist for the best of city life – such a legacy'. He added: 'I am so deeply saddened by the loss of my oldest and closest friend.'

In a seven decade-long career, Rogers was recognised with the Pritzker Architecture Prize, Royal Gold Medal, and American Institute of Architect's Gold Medal. 'Richard was gregarious, outgoing, generous, and possessed an infectious zest for life. His buildings are a social mirror of that personality – open, welcoming and, like his wardrobe, elegantly colourful,' said Foster, who paid tribute to Rogers' architectural legacy, which includes the Lloyd's building in London.



Richard Rogers

IN BRIEF

Hydrogen guide aims to debunk myths

Baxi Commercial Solutions has published guidance that aims to debunk the myths about how hydrogen can be used for heating, and produces a timeframe for transition to this lower carbon alternative to natural gas.

Your guide to hydrogen for heat distinguishes between hydrogen boilers, hydrogen ready boilers and 20% hydrogen boilers.

Following the recent hype about hydrogen, many want greater clarity on the achievable, future proof options available now, said technical director Andy Green.

He added that the standards and certification framework to enable a product to be classified as hydrogen ready is not yet in place, so claims that boilers are hydrogen ready now are inaccurate and potentially misleading.

CO₂ monitors mandated for offices

The government is proposing to introduce a requirement for trickle vents in all replacement windows and a new method for ensuring ventilation is not impaired as a result of energy efficiency improvements carried out on existing buildings. The changes are in Approved Document F: Ventilation, published last month.

Changes to ventilation will also be introduced to improve indoor air quality and reduce the spread of airborne viruses in new non residential buildings. This will include the mandating of CO₂ monitors and additional standards for recirculating ventilation systems in all new offices.

Consultants on £1bn net zero programme

Aecom and Mott MacDonald have won work on the government's £1bn Net Zero Innovation Portfolio. The scheme, aimed at accelerating low carbon technologies, systems and business models in power, buildings and industry, was announced last year as part of the government's 10 point plan for a green industrial revolution.

Aecom will supply programme management and technical advisory services to support the development of new technologies and processes, while Mott MacDonald will provide guidance on carbon control and storage.

IN BRIEF

McDonald's opens net zero restaurant

Fast food chain McDonald's claims its new restaurant in Shropshire is the first in its portfolio to meet net zero carbon standards in construction and operation.

The company says the Market Drayton facility will be a blueprint for future new build and retrofit projects, as part of the chain's strategy for becoming a net zero business by 2040.

Recycling materials for use in the restaurant's construction was key in reducing embodied carbon. The cladding includes recycled IT equipment and white goods, the kerb stones are made from recycled plastic bottles, and some signage is made from used coffee beans. Surplus wool from local farms has also been used in the insulation.

A solar array and two wind turbines reduce in use emissions, and energy not generated on site is supplied from renewable sources, the company says.

Architect defends plan to demolish M&S flagship store

Pilbrow & Partners compares scheme to replacing a 1970s diesel car with a Tesla

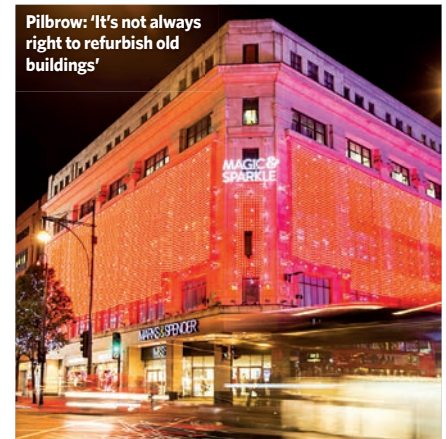
The architect designing a new high-profile store for Marks & Spencer on London's Oxford Street has claimed that the new building will lead to lower lifetime carbon emissions than could be achieved by retrofitting the existing store.

Fred Pilbrow, of Pilbrow & Partners, said it was 'not always right to refurbish' old buildings: 'I would compare this to a discussion about a not-very-well-performing diesel car from the 1970s,' he said, 'and what we're trying to do is replace it with a Tesla.'

He added that there would be less embodied carbon in the short term, but 'within between nine and 16 years, we will be ahead on carbon because our Tesla will perform better'. Pilbrow carried out a whole-life carbon comparison exercise with engineering firm Arup.

The M&S flagship store at Orchard House was built in the 1930s, and plans to replace it

with a 10-storey mixed-use new building have caused controversy. More than 2,000 people have signed a petition against the project based on its environmental impact, which they claim is 'simply incompatible' with the company's aim to achieve net zero emissions by 2045.



Pilbrow: 'It's not always right to refurbish old buildings'

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200,000 workers vanish in wake of pandemic

The UK construction industry has lost a huge number of experienced workers since the start of the pandemic, according to the Construction Products Association (CPA).

It has calculated that around 223,000 trade specialists have left since the summer of 2019, with more than half of them aged between 45 and 55. Losing this amount of experience threatens the industry's ability to deliver the government's plans for 'building back better', the CPA said.

'This ageing workforce demographic has been a concern for some time, but was expected to impact in 10-15 years' time as people came up for retirement,' said CPA economics director Noble Francis. 'Like many other things, the pandemic seems to have accelerated this and plunged construction into a deepening skills crisis.'

'People may still come back, but it looks like many have opted to take early retirement or work in other industries.'



IN BRIEF

Irish schools get €72m to improve ventilation

Schools in the Republic of Ireland will be able to draw on a €72m fund to improve ventilation, including the fitting of high efficiency particulate absorbing (Hepa) filters.

This follows intense criticism of the government for ignoring the advice of ventilation experts, with opposition Sinn Féin leader Mary Lou McDonald telling the Dáil (parliament) that children and staff were freezing in classrooms because of windows being opened to reduce the threat of Covid 19.

Taoiseach Micheál Martin said funding would be made available for schools that want Hepa filters in given situations, but that they would not be necessary in every classroom.

Ventilation grants for businesses in Scotland

The Scottish Government has created a £25m fund to help firms improve ventilation in workplaces. The money will initially be targeted at densely occupied spaces, such as restaurants, bars and gyms.

Grants will cover the installation of monitoring and adaptive devices, improvements to natural ventilation, and other small enhancements. The fund will remain open until 31 March 2022 or until the money runs out whichever occurs first.

Firms call for truly net zero public sector

Large construction firms, including Mace, Morgan Sindall and Willmott Dixon, have written an open letter to construction minister Lee Rowley calling for more focus on net zero in the public sector.

The firms say whole life carbon assessments should be made a statutory requirement and that procurement decisions should be based on the life cycle carbon of a project, rather than cost.

Their letter adds the payback period from operational savings if projects make use of sustainable building design techniques averaged six years, with only a marginal increase in capital cost.

Mark Robinson, chief executive of procurement group Scape, said the industry should work together to rethink traditional approaches and ensure net zero was embedded in the decision making process.

Professor Whitty says better ventilation will help with Covid-19 and other respiratory infections

Whitty urges businesses to invest in ventilation

Improving indoor air quality will protect workers, says UK's chief medical adviser

Investing in building ventilation will play a key role in helping the country recover from the Covid-19 pandemic and prepare for future health emergencies, according to the government's chief medical adviser, Professor Chris Whitty.

He encouraged business leaders at the Confederation of British Industry (CBI) conference to look closely at how they could improve the indoor air quality in their buildings to provide better long-term working conditions for their employees.

'We have realised the extraordinary importance of improving the ventilation of workplaces - not just for Covid, but also for many other respiratory infections,' Whitty said. 'If we invest in that now, we'll help the aftermath of Covid, but also cut down on things like flu outbreaks.'

He put investment in ventilation as the second most important step businesses could take behind helping their staff get fully vaccinated.

The Scottish Government has launched a £25m fund to help businesses improve their ventilation. Small and medium-sized businesses are being invited to apply for grants of up to £2,500 to install air quality monitors and carry out remedial work on windows and ventilation systems. The administration pointed out the importance of carrying out such work to prepare for winter, when people spend more time indoors and are more likely to keep windows and doors shut.

'All of these basic mitigation measures are really important at this stage, but some of them are also valuable long-term investments,' said First Minister Nicola Sturgeon. 'For example, better ventilation won't just reduce the spread of Covid - it will also help reduce the spread of other airborne viruses, now and in the future.'

Covid guidance targets classroom staff

A project assessing the risk of airborne Covid-19 transmission in schools has released four videos for teachers about the importance of monitoring air quality and ventilation.

The Co-Trace project, launched in February 2021, brings together researchers from the universities of Cambridge, Surrey and Imperial College London, who have been modelling and assessing data from air quality monitors in schools and evaluating the effectiveness of mitigation measures.

The team has developed four videos that aim to support classroom staff by explaining how to use CO₂ monitors provided by the Department for Education.

Co-investigator Dr Henry Burridge, senior lecturer at Imperial College London, said it was 'important to make teachers feel comfortable in understanding why they were being sent these monitors and how to use them and interpret the information'.

- To find out more about the project, and watch the videos, go to www.CoSchools.org.uk
- Read our Q&A with Dr Burridge on page 53.



IN BRIEF**Offsite tower finished in record time**

A 14 storey residential tower in Southend, Essex, has been completed in just a few months, according to prefabrication supplier British Offsite.

The £53m Victoria Central apartment block made extensive use of the company's factory built Uni Panel system, which British Offsite says resulted in the envelope of the building being completed in 30% less time than if using traditional building methods. In all, 665 Uni Panels were assembled to cover around 2,640 metres.

Our products help reduce the risk and delays in construction, and help deliver occupiable homes faster, said British Offsite managing director Shaun Weston.

BBC exposes black market in refrigerants

An undercover BBC report has revealed the ease with which black market refrigerant gas is being brought into the UK, undermining restrictions imposed by the F Gas regulation.

Reporters followed an online advertising trail to Romania and found traders smuggling Chinese made gas across the border with Ukraine. The journalists were able to buy illicit R404A and R134a, which was then transported in cars and on public buses into the UK.

The BBC team also traced illegal refrigerant, being openly advertised for sale on Facebook, to a seller operating out of a house in London.

Sales of global warming refrigerant gas is subject to strict quotas under the European F Gas regulation that the UK continues to mirror since its departure from the EU.

Wates to design £450m gigafactory

Envision AESC has appointed Wates and Turner & Townsend to lead the design of a £450m car battery gigafactory in South Tyneside and Sunderland. Wates will supply the infrastructure, while Turner & Townsend will provide project and cost management services at the 50 hectare site at the International Advanced Manufacturing Park.

The gigafactory will form part of a £1bn partnership with Nissan UK and Sunderland City Council to create an electric vehicle hub.

New rules aim to improve delivery of public contracts

Replacing EU regulations 'will make it easier to exclude poorly performing firms'

The government says it wants to simplify rules on procurement to stop poorly performing contractors bidding for public sector jobs.

A green paper explains how it intends to replace 'bureaucratic' EU regulations with simpler and more flexible rules that give the

government more power to exclude firms that have failed to deliver projects on budget or on time, and that have demonstrated a less-than-rigorous approach to safety and environmental issues.

It also wants future procurement to give greater priority to bids that offer 'social value', including more work opportunities for local people, helping to build back from the pandemic, and supporting the transition to net zero.

Currently, suppliers can only be excluded from government contracts if there has been a significant breach of contract.

'Leaving the EU gives us the perfect chance to make our own rules for how the government's purchasing power can be used to promote strong values,' said Chancellor of the Duchy of Lancaster Steve Barclay. 'While doing so, we're increasing transparency and ensuring that procurement remains fair and open.'

He added that this would be part of the 'levelling up' agenda and would make it easier for small businesses to win work, including having access to a central registration platform that only requires them to submit company information once for all public sector bids.

Steve Barclay claims new rules would make it easier for small firms to win jobs



Industry must broaden its appeal and change the conversation about skills

The building engineering sector will not address its skills shortages if it keeps trying to replicate the past, says the CIBSE Patrons. The group of businesses, which supports the work of the Institution, believes the push for net zero carbon should prompt a radical rethink of the type and range of skills required by the industry, with more people recruited from financial, IT/digital, creative, energy systems, and artificial intelligence backgrounds.

'Net zero should change the conversation for our profession,' said Andy Sneyd, managing director of Exyte Hargreaves. 'It requires different skills and a new outlook, which will only come if we reach out to people from all backgrounds.'

Patrons' chair Scott Mason believes building services engineers will still play a vital role, but will need

to collaborate and recruit more widely – and beyond their traditional networks. 'We need a radical rethink if we are to broaden the appeal of this industry – and of Patrons, in particular. We are in a strong position to lead this change on behalf of the sector because we represent the whole supply chain,' he said.

Committee member Josh Emerson added that the industry had access to technology and design processes appropriate to net zero, but he questioned whether it had the right skills balance.

'We are working with cutting-edge products and smart systems that bring the dream of net zero closer. But we will need to look well beyond our traditional boundaries to find people with the creative skills and imagination to apply them so they can achieve their full potential,' he said.





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IN BRIEF

CIBSE Covid 19 guidance accessed by thousands

CIBSE's eight Covid 19 guidance documents were downloaded almost 40,000 times in 2021.

Of these, *Covid 19 Ventilation guidance v4* was downloaded 12,908 times in 2021, and v5, which was published in July, 8,631 times. The total number of downloads for the eight guides is 39,347 for 2021, while across 2020 and 2021 it is 73,000.

Covid 19 guidance is available for free at www.cibse.org/Coronavirus (COVID 19)

Bob Bean, lighting past president, dies

It is with great sadness that CIBSE learned of the death of Robert (Bob) Bean, past president of the CIBSE Lighting Division, forerunner of the Society of Light and Lighting (SLL), in October.

Bob, who joined the Illuminating Engineering Society in 1964, was the first in Britain to provide education on illumination considering lighting equipment, photometry and lamp performance. Among publications, he co-authored with Ron Simons

Light Fittings Performance and Design was one of the standard lighting text books in the 1970s.

Bob had been an honorary fellow of the SLL since 2014, and was a member of the *Lighting Research & Technology* panel.

CIBSE part of airborne infection research

CIBSE is a key strategic partner supporting research on airborne infection reduction. The research hopes to help support the minimising of the risk of airborne transmission, acknowledging any implications on energy use and thermal comfort, along with indoor air quality and occupancy levels.

Airborne Infection Reduction through Building Operation and Design for SARS CoV 2 (Airbods) is a UKRI funded research programme led by Professor Malcolm Cook, at Loughborough University, in partnership with University College London, the universities of Nottingham, Cambridge, and Sheffield, London South Bank University and Wirth Research. Information will be held at www.airbods.co.uk

Talented trio recognised at CIBSE ANZ awards

Young engineers impress judges with quality of their submissions and research

Three young industry talents have been recognised for their outstanding work at the CIBSE Australia and New Zealand (ANZ) Young Engineers Awards.

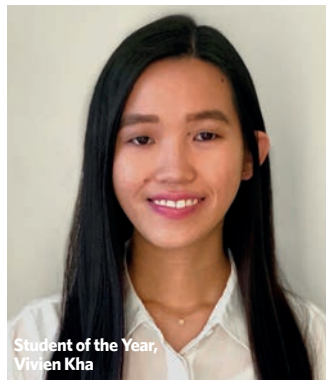
Vivien Kha, of the University of New South Wales, an undergraduate hydraulics engineer at Northrop, won the Mark Griffin Award, Student of the Year.

Neyra Nie, graduate electrical engineer at Beca, won the Graduate of the Year award, which has been renamed in honour of CIBSE ANZ and New South Wales committee member Haris Moraitis, who died in 2021.

The Jack Pirie Award, Young Engineer of the Year, was won by Arky Elston, mechanical engineer at Aurecon.

The awards are open to students, graduates and young engineers from Australia and New Zealand, who had to submit a three-minute video outlining how we can create spaces designed to last several generations while retaining flexibility to change, according to requirements, technology and cultural trends.

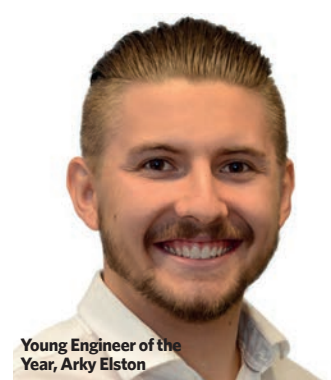
The awards, hosted by Prateek Alkesh, the new ANZ Young Engineers Network chair, were held online in November, and featured a message from CIBSE chief executive Ruth Carter.



Student of the Year, Vivien Kha



Graduate of the Year, Neyra Nie



Young Engineer of the Year, Arky Elston

Volunteers sought by PCC to help uphold professional conduct



CIBSE's Professional Conduct Committee (PCC) is seeking additional volunteers to ensure its Code of Conduct is fit for the future, writes PCC chair Doug King. The PCC is tasked with maintaining the code and administering CIBSE's disciplinary procedures.

As recent *Journal* articles have highlighted, new regulations on competence will require members of the Institution to demonstrate that they have appropriate 'skills, knowledge, experience and behaviour' - issues that are already at the heart of the Code of Conduct.

The PCC meets three times a year, but additional work may be required from time to time, including implementing disciplinary procedures. Membership is open to CIBSE members of any grade. However, some experience of dealing with disputes or contractual issues - as well as an interest in ethics - would be beneficial. We particularly welcome expressions of interest from those who can bring experience or knowledge of groups or sectors that are traditionally under-represented in the professional engineering institutions.

Send your CV and a short statement explaining your interest in professionalism in the construction industry to Laura Webb, director of membership, standards and networks, at lwebb@cibse.org by 31 January 2022. Shortlisted candidates will be invited to a short online interview.



CIBSE Young Modeller
2021 Nishesh Jain



Building Simulation Award
winner Patricia Pino

Jain and Pino named CIBSE's top modellers

Pair pick up building simulation awards at online awards event

The winners of the CIBSE Building Simulation Award and CIBSE Young Modeller Award 2021 were announced at an event held online in December.

Nishesh Jain, a Knowledge Transfer Partner associate at the UCL Institute for Environmental Design and Engineering, was recognised as the CIBSE Young Modeller 2021, having been runner-up in 2020.

The judges were very impressed with his continuous support for

the industry and academia, and his contributions to publications, including TM63, TM61 and TM64. They said Jain had successfully demonstrated how he has been advocating building simulation, both locally and abroad, and sharing knowledge across sectors through his involvement with UCL and DesignBuilder software.

Jain said: 'I believe that building simulation is an integral part of making buildings perform to meet low-energy, low carbon targets. Therefore, I actively participate in discussions ensuring that simulation delivers on

what it promises, and provides realistic and accountable solutions.'

Patricia Pino, supported by a team at Wirth Research – including Thomas Avery-Hickmott, Dr Giulio Vita and Rob Rowsell – won the Building Simulation Award for the project 'Covid-19 – the work environment – a multi-tool modelling approach to estimate infection risk within office spaces'.

The project modelled two floors in a London office for a client who wanted to ensure they could offer a safe environment to their employees in the context of the pandemic, using the modelling to assess the risk of infection for occupants throughout the space. Using the methodology, designers can understand the risk within their spaces and where to make improvements, which could be as simple as rearranging furniture.

In presenting the award, Darren Coppins – vice-chair of the CIBSE Building Simulation Group, and head judge – said the judges felt the modelling was pioneering and that it was important to recognise it. 'We particularly liked the way existing tools were leveraged to consider a complex new problem to a level of detail that provided a high level of robustness in modelling,' Coppins added.

To watch the awards ceremony and other presentations from CIBSE's Build2Perform event, visit: www.build2perform.co.uk/2021-presentations

Hong Kong projects praised for engineering excellence

Six projects and teams were recognised for their efforts in the design, construction, installation, commissioning and operation of low-energy buildings at the CIBSE Hong Kong awards in November.

Three additional accolades were also presented in recognition of the significant and important role played by building services engineering in creating safe and healthy environments, in particular in relation to Covid-19.

The Hong Kong awards were launched in 2019 to recognise engineering excellence in the built environment. They aim to encourage and recognise organisations and professionals who work collaboratively to deliver the most appropriate, cost-effective solutions, from design to installation and beyond. Entries were open to any organisation within Hong Kong that is responsible for the design, construction and operation of low-energy buildings.

CIBSE President Kevin Kelly said: 'It is clear that construction and engineering services industries in Hong Kong have the vision to lead outstanding building services design, practices and performance. All the winning entrants demonstrated engineering excellence in their projects.'

Hong Kong region chair Vincent Ma said: 'The winners and all participants have demonstrated their commitment to developing and promoting a positive impact on the design, installation, commissioning and operations of buildings.'

● For more information, visit cibsehka.org.hk

Full list of winners:

Project of the Year – Commercial/Industrial:

- Hong Kong Science Park expansion stage 1, Hong Kong Science and Technology Parks Corporation

Project of the Year – Public Use:

- West Kowloon Government Offices, Architectural Services Department and Electrical & Mechanical Services Department

Project of the Year – Residential:

- University Heights, Chinachem Group
- Wah Ha Estate (Chai Wan Factory Estate), Hong Kong Housing Authority

Project of the Year – Retrofit:

- The Mills, Nan Fung Textiles Second Mills

Facilities Management Team:

- Hongkong Land Central Portfolio Property Management Team, Hongkong Land (Property Management)

Covid-19 Achievement Award:

- Future-proofing the health of Central, Hongkong Land (Property Management)
- Neuron Health, Arup
- North Lantau Hospital Hong Kong Infection Control Centre, Architectural Services Department, China State Construction Engineering (Hong Kong) and China State Construction International Medical Industry Development Co

For more information about the awards and the Hong Kong region, visit: www.cibse.org/networks/regions/hong-kong

Call for *B&SERT* papers on housing performance

Editorial board is keen to showcase latest knowledge and developments in all areas related to building services

The future fit performance of the domestic sector will rely on innovative knowledge, tools and systems that support a 'future-proof' approach to upgrading the energy and environmental performance of homes, so that they deliver on current targets and remain resilient to future challenges, while maintaining occupant health and wellbeing.

The *Building Services Engineering Research and Technology Journal* (*BSER&T*) editorial board is keen to showcase the latest knowledge and developments in all areas related to building services in a 'Special Issue' publication.

If you have research or practice that could be suitable to feature, and you are able to produce a robust, peer-reviewed research paper, technical note or a review paper, we would like to hear from you. Material must include considerations of:

- The building systems needed to meet future challenges in the domestic stock
- Designing for uncertainty in building systems
- Factors that impact long-term performance
- Moving from heating-dominated to both heating- and cooling-based demand
- New technologies, energy networks and consumer patterns
- Optimised decision-making targeting long-term benefit
- Potential of under-researched areas, such as hard-to-decarbonise homes
- Topics that advance the understanding of the future fit performance of homes.

We will contact prospective authors within three weeks of the submission closing date to advise whether their paper has been invited to be developed for the issue. There will then be a maximum of 12 weeks to submit the final paper. All submissions will be subject to peer review.

Send an abstract of no more than 200 words, by 14 February to BSERT-Homes@cibse.org

For more information on *BSER&T*, visit journals.sagepub.com/home/BSE

BSER&T is available to members through the CIBSE Knowledge Portal at www.cibse.org/knowledge

New members, fellows and associates

LICENTIATE

- Omnd, Josh**
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- O'Neill, Patrick**
Gravesend, United Kingdom
- Orunsolu, Sulyman Oyeleke Osamudiamen**
Leatherhead, United Kingdom
- Perry, Nick**
Laindon West, United Kingdom
- Pople, Joe**
Bristol, United Kingdom

- Rogers, Melissa**
Plymouth, United Kingdom
- Seedat, Yusra**
London, United Kingdom
- Sum, Minty**
Wellingborough, United Kingdom
- Wallis, Max**
London, United Kingdom
- Warren, Theo**
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A framework for change?

The Construction Playbook triggered an independent review of public sector procurement that recommends adopting framework structures and features to deliver better, safer, faster and greener outcomes in the public sector. Hywel Davies reports

Effective contracting relies on commercial frameworks that support strategic planning, integrated teamworking and continuous improvement. They should enable delivery of safer, better, faster and greener project outcomes. Both the public and private sectors use a wide variety of frameworks, but there is a lack of clear guidance about how to structure them and what are best practice features. As a result, they are not always successful.

The Construction Playbook, published in December 2020, prompted an independent review of these frameworks, led by Professor David Mosey. *Constructing the gold standard*¹ delivers 24 recommendations for their adoption and use, and how they should be structured, to provide clear drivers that will deliver the policies in the Construction Playbook.

Professor Mosey's review looks at how public sector clients can adopt procurement frameworks that are consistent with the priorities and objectives of the Playbook, and that support improved whole life building safety, net zero carbon and social value, optimal use of digital information, and improved efficiency and innovation

This is really significant, because the public sector buys 40% of construction output. It has the greatest leverage of any client and has the potential to drive positive change in the industry. Good frameworks should reward those seeking to improve and, increasingly, discourage or exclude those who continue in poor practices and cultures.

Two recommendations explicitly address safety. Recommendation 3 states that all public sector construction frameworks should be required to prioritise safety and net zero carbon. Framework providers, clients and suppliers should all set out how their framework strategy, procurement, contract and management will achieve improved building safety and net zero carbon targets. Recommendation 13, meanwhile, calls for earlier supplier involvement to target improved quality and safety.

These recommendations extend the scope of those



Good frameworks should reward those seeking to improve and, increasingly, discourage or exclude those who continue in poor practices and cultures

in Dame Judith Hackitt's 2018 review, already accepted in full by government. She called for contracts for higher risk residential buildings to expressly prioritise safety and for tenders to be required to demonstrate how their solution would deliver safe outcomes. Safety information must also be included in the Golden Thread of information about the building.

Much has been said about the Building Safety Bill and the new regime it will bring, but it does not address procurement. The reality is that unless procurement practices and contracts change, so that safety is clearly seen as the priority, day to day practice will not change. Until tenders that do not convince clients that safety is a priority are not considered, the culture will not change. The culture follows the money.

With many higher risk buildings in the public sector, it is essential that their operators address Professor Mosey's recommendations. One of the greatest risks of not delivering the reforms called for by Dame Judith is the lowest cost culture and race to the bottom that afflicts so much construction.

Government clients must stop cheering the runners in that race, egging them on to race further and faster the wrong way, in pursuit of lowest cost. Instead, it needs to be clear that public sector clients will now adopt the gold

standard and reward those who prioritise safety, zero carbon and true whole life value.

This will give taxpayers safer, more sustainable and healthier buildings that fully comply with all relevant regulatory requirements. It will also improve the prospects of those businesses and people who are seeking to do the right thing, follow the rules, and deliver safe, sustainable healthy buildings, but who feel hamstrung by those who appear not to. It's time to reward the right people through better public procurement, and *Constructing the gold standard* sets out a pathway to do that.

References:

- ¹ *Constructing the gold standard: An independent review of public sector construction frameworks*, produced by Professor David Mosey, Centre of Construction Law, King's College London bit.ly/CJJan22HD

A small step

Updated regulations uplift building standards and new thermal elements in existing buildings, but the inclusion of primary energy and dilution of energy forecasting disappoint, says LETI's Clara Bagenal George

In December, the interim update to the Part L and F regulations was published. Although it is an uplift in standards, industry has reacted strongly, saying that given our climate crisis this is a tiny step at a time when we need to be making huge leaps forward.

Primary energy has been introduced against the recommendations of 80% of the consultation respondents. Primary energy use is a measure of the energy regulated by the energy efficiency requirements of the Building Regulations, such as lighting, heating and hot water. It is a complex metric, with factors that change over time. It will become increasingly irrelevant as the Grid decarbonises, and it favours gas over electricity, going against heat decarbonisation objectives. Instead, we must start regulating the energy used by a building.

The proposed regulations put forward energy forecasting for buildings of more than 1,000m² using CIBSE TM54, but this has been watered down in the 2021 Part L Regulations. Now, the energy forecast can be based on design calculations, benchmarks, CIBSE TM54 or other modelling tools.

Moreover, most of the consultation respondents said the ≈30% carbon regulated reductions proposed were not enough, yet this is what the 2021 regulations will provide.

The Fabric Energy Efficiency Standard for residential new builds has been strengthened, but 72% said it should be a higher performance standard than this, and no change was made.

Standards of new thermal elements in existing buildings have increased in line with the proposals (from 0.28 to 0.18 in walls), but 81% who responded to the question said the performance should be better than this.

There has been an uplift in the efficiencies of building services in new non domestic buildings in line with the original recommendations.

We welcome the introduction of CIBSE TM54 modelling, but this has only been introduced for predicted energy use calculations, and it needs to be required for new homes, not just new non domestic buildings.

A new Approved Document O: *Overheating* has also been introduced, but more review is needed to understand if the points raised in the consultation have been incorporated.



Focus on fans

A key component of smoke and heat control systems, the fan should be subject to regular assessments and a thorough maintenance regime. Following the release of a new Smoke Control Association guide, UK Axial's **Simon Plummer** discusses fan maintenance best practice and the requirement to ensure life safety equipment is fit for purpose

Emergency-use fans for heat and smoke control systems are specifically designed and manufactured for safety-critical applications.

So it is imperative that they are maintained correctly to ensure they continue to offer building occupants the very highest degree of protection throughout the lifespan of the system.

Modern, up-to-date equipment is required to be manufactured in accordance with the latest standards. However, existing plant that has been in place for many years may not comply with the 2015 version of EN 12101-3, so may need urgent attention.

Repair and replacement of such critical components should only ever be carried out by the manufacturer's authorised representative. For fans certified by a notified body, the substitution of a critical component by an alternative version of this component must be approved by the body.

Recognising the need for further industry guidance on how best to maintain equipment in accordance with manufacturers' maintenance procedures, the Smoke Control Association (SCA) – in association with the Fan Manufacturers' Association – has produced a new industry guide to act as a reference document for maintenance and facilities companies, ensuring best practice in smoke extract fan maintenance.

It is expected that the guide will raise awareness of the need to ensure that any powered smoke extract fans that are selected, manufactured and installed in accordance with EN 12101-3:2015 must then be maintained correctly to ensure life-safety equipment remains fit for purpose. This will offer building owners or operators a reduced level of risk and liability, while also providing the highest level of smoke protection for building occupants.

The product of a BSI working group – members of which were from manufacturers, installers, test establishments and motor manufacturers – the guidance document will also help those making decisions about the potential replacement of existing primary smoke extract or pressurisation fans, with new equipment designed, tested, certified and manufactured to the very latest standard.

- The guide is available as a free download at www.smokecontrol.org.uk/resources
- **Simon Plummer** is divisional manager UK Axials, a member of the SCA



THE CLOCK IS TICKING

Over the next 12 months, the building services sector will be focusing on net zero targets, while ensuring building occupants are safe from Covid and other risks. **Alex Smith** looks at the main trends for 2022 and previews the guidance that will ensure CIBSE Members have the competencies to meet the challenge

The clock is now ticking and the targets are in place, declares CIBSE technical director Hywel Davies. We have to design net zero buildings now.

Creating net zero carbon buildings will be at the forefront of building engineers' minds in 2022. The stark evidence of climate change means there is no time to lose, and the construction industry has the will and the ingenuity to deliver buildings that leave no carbon trace. In the UK, the threat of climate change has coalesced once disparate views, and now the only question is how quickly we accelerate towards the Future Homes and Buildings Standard¹, which aims to make all buildings net zero ready from 2025.

Energy reduction should not be the only priority over the next 12 months, however. Attention should also be paid to health, safety and wellbeing, not only in the way we keep occupants safe from the virus, but also in how we ensure buildings that put lives at risk are never designed. The next year will be an opportunity for engineers to ensure their competencies are in line with what will be required under the Building Safety Bill² – these competencies will be required for all buildings (see page 20.)

The ultra-contagious Omicron variant of Covid 19 has been a jolt for those who thought the virus had been neutralised by vaccination and increased immunity. There will be no room for complacency in 2022, and attention will turn to difficult-to-ventilate buildings.

Net zero carbon and health, wellbeing and safety are two of CIBSE's Knowledge and Research Priorities³, with the others being: circular economy; climate adaptation; digital engineering; retrofit and refurbishment; and smart buildings.

Simon Wyatt, a partner at Cundall and chair of the CIBSE Knowledge Generation Panel, says CIBSE's five Covid 19 guidance documents were downloaded almost 40,000 times in 2021. These didn't just focus on ventilation, but also on lifts and escalators, and public health engineering issues. The rate of publication has been remarkable, he says.

CIBSE's publication diary for 2022 shows a plethora of relevant guides around the net zero revolution. *AMI17 Heat pumps for non-domestic buildings* follows hot on the heels of the housing equivalent, *AMI16*, while *TM65.1* and *TM65.2* add much-needed embodied energy data on building services systems.

Wyatt believes there will be an increase in clients' interest in the operational energy use of their buildings in 2022. CIBSE's *TM54 Operational energy performance* guidance enables designers to calculate predicted in-operation energy use and compare it against buildings' actual energy use, allowing building managers to identify performance gaps. A revised *TM54* will be published in 2022.

The lack of mandatory operational assessments in *Conservation of fuel and power: Approved Document L⁴*, published last month, was lamented by Wyatt. In the draft document, it was mooted that large buildings would be required to assess operational energy by using *TM54* or other modelling methodologies, such as the Passivhaus Planning Package.

The big missed opportunity is that a significant proportion of the market will develop buildings without any clue of the operational energy use, says Wyatt, who adds that the success of the Nabers energy rating system in Australia, where energy use in buildings has been reduced by 70%, shows what can be achieved by predicting energy use.

Ed Wealend, head of research and innovation at Cundall, says a new generation of developers in the UK is using the Design for Performance (DfP)⁵ initiative, which is based on Nabers, and that London property firms are keen to get the first DfP-rated building. A bit of healthy competition is good way to drive the market, he adds.

Nathan Millar, sustainability principal at Elementa Consulting, has also seen an acceleration in interest in zero carbon and decarbonisation, and expects it to start becoming the norm in 2022. We're seeing clients of all sizes, from the public and private sectors, trying to find the best route to net zero, says Millar, who believes one of the big drivers is access to green funding. Developers need to clearly articulate the energy use of their buildings to investors, he adds.

Time to define

How net zero is defined should become clearer in 2022. Last year, LETI supported by CIBSE, RIBA and the Whole Life Carbon Network



produced a set of definitions that included operational and whole life carbon⁶. Last month, CIBSE and LETI carried out an industry survey, *What does zero carbon mean?*, and will be publishing FAQs on a net zero definition in early 2022, which CIBSE, potentially, will adopt.

It's about getting clarity on the details of terminology so there is no greenwashing, says Clara Bagenal George MCIBSE, associate at Elementa Consulting and co-founder of LETI.

With its inclusion in net carbon definitions, interest in embodied energy will continue to grow this year. In 2020, CIBSE published *TM65 Embodied carbon in building services*, which provided a methodology for calculating embodied carbon for building services products. Manufacturers were also encouraged to share data on the embodied energy in their products and, as a result, CIBSE produced *TM65.1 Embodied carbon of residential heating*. *TM65.2* will be the equivalent for offices and will be published early in 2022.

TM65 was important and we've seen that being rolled out globally,



A visual of the retrofitted HQ of the Cambridge Institute for Sustainability Leadership



AC units could be reused or repurposed in a circular economy

says Millar. *TM65.2* is the next piece of the jigsaw. Suppliers will follow a similar methodology and approach to calculating embodied carbon, so we can have confidence about their equipment and material.

Cundall's Wyatt believes more local authorities will follow the lead in the London Plan, which requires developers to calculate and reduce whole life cycle emissions for planning permissions referred to the Mayor (and encourages it on all major developments).

TM65 has been a gamechanger, he adds. There's now no excuse for us to not ask for EPDs [environmental product declarations] from manufacturers.

Wyatt and Millar both predict that the circular economy will gain traction in 2022, with audits determining what can be reused or repurposed in existing buildings.

The publication of *TM66 - Creating a circular economy in the lighting industry* in November is an invaluable addition to the body of guidance in this area.

The inclusion of embodied energy in whole life carbon assessments will drive the retrofit of more buildings, such as the Cambridge Institute for Sustainability Leadership's Entopia Building (left), which was previously a telephone exchange. LETI published the *Climate Emergency Retrofit Guide*⁷ and, in 2022, will be working with CIBSE on a version for non-domestic buildings.

Staying Covid secure

Covid will still loom large in 2022. There has been a bit of complacency over the past six months because the vaccine was seen to be controlling Covid, says Wealend, who is chair of the CIBSE clean air working group and co-author of *Covid-19: Air cleaning technologies*.

He says the focus is now on schools, which have been a larger driver of community transmission. A study by Leeds University on the effectiveness of standalone Hepa filters and ultraviolet (UV) air cleaning units in 30 schools will be published in the spring, which will help the Department for Education determine whether schools need a strategy beyond opening windows to flush out any virus.

Covid has led to an uptick in people wanting to monitor indoor air quality, adds Wealend, who is an Approved Person for Reset, a Chinese certification body for indoor air quality. AirRated is the UK equivalent. We had no interest in Reset until Covid came along, he says. My initial impression was that it wasn't necessary in the UK, but having reviewed the data of five to six buildings, I have changed my mind. >>

» A safe new year

In her *Independent review of Building Regulations and fire safety*, Dame Judith Hackitt identified four major areas that she believes contributed to the Grenfell Tower disaster: ignorance, indifference, lack of clarity on roles and responsibilities, and inadequate regulatory oversight and enforcement. In response to the report, the government introduced the Fire Safety Act in April 2021 and the Building Safety Bill, which is expected to receive Royal Assent in mid 2022. Among the requirements of the Fire Safety Act, owners and managers of multi occupied residential buildings have to examine external walls and doors as part of a fire risk assessments.

The Building Safety Bill is more relevant for engineers. It requires owners of high rise residential buildings to manage the safety risk and ensure that those planning, designing, constructing and maintaining a building take responsibility for fire safety. The bill also establishes the role of building safety regulator (BSR), which will operate within the Health and Safety Executive and oversee design, and construction of all buildings, and also occupation of for high risk buildings. Importantly for engineering professionals, the BSR will set new competence requirements for work on all buildings, which engineers will have to be aware of in 2022.

New competence regulations

The Draft Building (Appointment of Persons, Industry Competence and Dutyholders) Regulations, contained in the bill, require everyone working on buildings, and employers, to assess competence and demonstrate it to clients and regulators. There are three dutyholder roles principal designer, principal contractor, and building safety manager. Clients have statutory responsibilities under the dutyholder regs for the appointment of all the designers, contractors including the principals. The dutyholders will need to work together to plan, manage and monitor the design and building work, and have systems in place to ensure they comply with relevant building regulations. These new roles mean responsibility is being placed on clients and designers and contractors, said Hywel Davies at CIBSE's online Build2Perform conference. It's for clients to take all reasonable steps to satisfy themselves about the competence of those they propose to appoint, he added.

There will also be a duty on designers and contractors to be satisfied they are accepting an appointment that they are competent to undertake, with penalties for those who take on work they are not competent to do. This is a significant shift of responsibility, and it's very much falling to industry and clients, said Davies.

The bill also states that occupied higher risk buildings must have at least one clearly identifiable accountable person, known as the principal accountable person. They will be responsible for appointing a building safety manager, who will coordinate the management and oversight of building safety risks.

To support the bill, the Competency Steering Group (CSG) was formed to work with the what is now the Department for Levelling Up, Housing and Communities and industry to define competency standards. The government is working with the CSG to develop a



Engineers wanting to work on high-rise buildings will have to change their CPD

competency framework and specification for building safety managers, which it plans to publish in 2022 as part of a suite of competency standards. Dame Judith made it clear that the industry needed to change, and that our standards of compliance had fallen and we needed to address those, said George Adams, chair of Working Group 1 Engineers (one of 12 sections of the CSG).

The group's core activity was to examine competency in the industry and how it could be improved. As part of this, it looked at Annex 1G UK SPEC, which focuses on how competency is measured for professional engineers working on any building.

In its report, the group proposed the need for a lead engineer, who would support the principal designer, principal contractor and building safety manager. A dutyholder can also be a lead engineer. An additional compliance requirement will be necessary for professional engineers who want to practise in the area of higher risk buildings.

CIBSE is working with the Engineering Council to enhance the current UK SPEC for contextualised registration, says Vince Arnold, CIBSE board member and trustee: CIBSE members are involved in writing the enhanced competence requirements for building services, fire and structural [including facade] within working groups. If you become a contextualised registered engineer, you will face revalidation, expected to be every five years, by interview or submission of portfolio that gives evidence of your skills, knowledge, behaviours and experience in the field of higher risk buildings.

Working Group 1 will now develop an initial training workshop for end users on how they can roll out their own methodology of safety case process and report, says Adams, who adds that it is important for members to plan their CPD for 2022. If you want to practise within the world of higher risk buildings, your CPD will have to change to support the requirements, to show you are up to speed with safety in that area of our industry. [CJ](#)

References:

CIBSE guides are at www.cibse.org/Knowledge/Guides. Covid-19 guidance is free to non-Members

- 1 The Future Buildings Standard, accessed Dec 21 bit.ly/CJJan22Pre1
- 2 Building Safety Bill, accessed Dec 21, bit.ly/CJJan22Pre2
- 3 CIBSE Knowledge and Research Priorities bit.ly/CJJan22Pre3
- 4 Conservation of fuel and power: Approved Document, Dec 21 L bit.ly/CJJan22Pre4
- 5 Design for Performance initiative, Better Building Partnership. bit.ly/CJJan22Pre5
- 6 LETI net zero carbon definitions, bit.ly/CJJan22PRE6
- 7 Climate Emergency Retrofit Guide, LETI, bit.ly/CJJan22Pre7



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PEACE OF MIND

Ahead of new guidance on catering for neurodiversity in the built environment, which is due to be released in the spring, we speak to experts and an engineer with dyslexia to find out how the industry can help neurodiverse people thrive

The proportion of dyslexic people in engineering is expected to be much higher than the 10-15% of the general UK population with the condition

Ive always known there was something odd, but I had no words for it at the time. I seemed to be able to do the things that other people couldn't and not do things that everyone else could.

There is no doubt other neurodiverse engineers would identify with the experiences of Professor Andy Ford, who publicly announced he was dyslexic in 2020.

A CIBSE past president, and director of research and enterprise at the School of the Built Environment and Architecture at London South Bank University, Ford says he concealed his condition for most of his life, surrounding himself with people who could fill in the gaps for the things he found challenging because of his dyslexia.

He says the talents of many neurodiverse engineers are not being realised because they are not being supported in industry, but there are ways in which organisations can help neurodiverse people thrive.

Form filling, for example, can be extremely difficult for people with autism or dyslexia, so membership organisations should do more to make their entry processes easier.

Another way to help is by designing spaces that are sensitive to people's different neurological states. A new design standard PAS 6463 due out in the spring, aims to do exactly that.

The author is Jean Hewitt, senior inclusive design consultant in the inclusive design team at Buro Happold. An environment that is easy to understand with sensible acoustics, lighting and wayfinding can be calming for individuals and doesn't contribute to anxiety, she says.

Strength in neurodiversity

The term neurodiversity was coined in the late 1990s by autistic sociologist Judy Singer. According to Singer, it refers to the concept that certain developmental disorders such as attention deficit hyperactivity disorder (ADHD), autism, dyslexia and dyspraxia are normal variations in the brain, and people with these features also have particular strengths.

Stephen Gill, a consultant, and founder



of the Institute of Refrigeration's Dyslexia in Engineering Day campaign, is himself dyslexic. He says: Everyone is different and, within that neurodiversity, there are people who learn differently and they are neurodivergent or neurodiverse.

Gill says some associated strengths of dyslexia such as creativity, problem solving and thinking outside the box are relevant to engineering. As such, he says the proportion of dyslexic people in engineering is expected to be much higher than the estimated 10-15% of the general UK population with the condition. So, it is increasingly important to ensure that the building engineering sector embraces the challenges and opportunities posed by neurodiversity.

Organisations, employers and managers must learn to understand the benefits that neurodiverse individuals can bring to the industry, as well as the challenges they face.

Most organisations are not geared up to nurture the full potential of their neurodiverse workforce

If we are to succeed as a workplace, as an Institution, and as a profession, we need to get the best out of everyone, Gill says.

Unfortunately, at the moment, organisations are not geared up for it, he adds, and the majority of neurodiverse individuals keep it hidden because they are worried about exposing themselves and their weaknesses.

The challenges

During his childhood, Ford recalls that people with dyslexia were called slow because of a lack of awareness of the condition. Even today, he adds, the challenges don't go away; you overcome them, but they don't disappear your brain is what your brain is.

He says certain aspects of university, such as exams, were a struggle because there was no allowance for dyslexia and I ended up failing more regularly than I wanted to. I can't claim to have a great degree, and I only just scraped through the second time in my A Levels. I'm lucky because many people give up at this point.

Despite struggling with reading and writing and form filling, which was almost impossible Ford found support in people around him who were good at the things he wasn't.

Like Ford who, at the age of 30, established his own consulting practice, Fulcrum Consulting (later bought by Mott MacDonald) many neurodiverse engineers go down the self-employed or entrepreneurial routes, says Gill, because the way to leadership through college, management, and management school is not open to them.

In an informal survey of engineers, via LinkedIn, Gill found that 713 identified as dyslexic and, of those, 98% said they wouldn't tell their employers they have it. More than half didn't belong to an engineering association because they felt they wouldn't fit in.

Coming out as neurodivergent can set people back in their careers, says Gill: They may not be sacked, but they may not get a career promotion. Dyslexia is a career killer.

He cites a former mentee, who was a rising star, but who struggled during the first stages of management because of her dyslexia.

I suggested to make an appointment with HR and they would put everything in place it

The majority of neurodiverse engineers keep it hidden because they are worried about exposing themselves and their weaknesses

turned out to be the worst advice I had ever given. They said perhaps you should go into your previous role, so she resigned. That was a wake up call for me and why I [started the Dyslexia in Engineering Day] campaign.

Gill, who has been liaising with various professional organisations, says it's important for membership bodies to work together to ensure their registration processes are accessible for neurodivergent people.

Do they really have to fill out forms these days? There are other ways, he says. They need a review of their membership processes, and they need a creative brainstorming committee.

CIBSE's approach

In his experience as an academic in Dublin, CIBSE President Kevin Kelly says he witnessed many dyslexic students graduate with first class honours degrees because the modern educational environment enabled people with dyslexia to come through more easily. There were examination methods that allowed people to record answers on a voice recorder rather than in written form if they preferred, and papers could be read out to people.

He acknowledges that, as a professional body, CIBSE could be subconsciously excluding certain groups as a result of its entry methods. To attract more people into engineering, Kelly admits CIBSE should be more diverse in our message.

We're in such a fast-changing climate, with global challenges around zero energy buildings, that we need as diverse a set of minds addressing the problems as possible, he says. That difference is what helps to solve the most complicated problems in our world.

CIBSE is starting to weed out the unconscious bias of asking people to fill in forms, he adds for example, the board and council nominations procedure has been improved, and neurodivergent



CIBSE past-president Andy Ford struggled at university because 'there was no allowance for dyslexia'

» individuals can now send in videos rather than fill out forms. If we can do better with our procedures, please tell us how, because we want to do it better, Kelly says.

Guidance

About 70% of people with autism will have hypersensitivity to certain parts of the environment, says Jean Hewitt. There are so many other conditions as well, and the thing they often have in common is a sensitivity to noise, light, patterns and colours, and touch. So, acoustics and lighting are incredibly important.

Hewitt is technical author of PAS 6463 *Design for the mind – neurodiversity and the built environment*, which went out for public consultation in November. The final version will be released by the British Standards Institution (BSI) in spring (see panel, Design for the mind).

The guidance is aimed at designers, developers, architects, surveyors, inclusive design and access consultants, occupational therapists and building managers.

Failing to design for neurodiversity could put employees off coming back to the office, says Hewitt, adding. We need a diverse workforce and, if we don't fix it, people will home work. This would be sad, because we need that diverse community in our buildings.

The majority of these people are very capable and it's wrong that our workplaces, social places and even living accommodation haven't thought beyond the neurotypical.

Inclusivity

Feeling like you don't belong is a daily struggle for many neurodiverse individuals, whose talents and skills are being overlooked because of a lack of understanding and institutional support. Often, as Gill points out, the modifications or adjustments needed are very minor, but can make a huge difference.

With the challenges posed by climate change and reaching net zero, we need minds that think differently and creatively. We need to attract loads of other people, and we're not going to be able to do it the way it's been done before, says Ford. There is huge benefit in building an organisation that has people with different skill sets who can talk to each other freely to develop ideas.

Building services engineers alter buildings heating, ventilation, lighting and acoustics, so designing with neurodiversity in mind is surely an extension of the work we already do. CJ

Feeling like you don't belong is a daily struggle for many neurodiverse individuals, whose talents are being overlooked because of a lack of understanding and support



DESIGN FOR THE MIND

PAS 6463 *Design for the mind – neurodiversity and the built environment*, which will be reviewed after two years, focuses on control and clarity of space. Clarity encompasses the lighting, acoustics, sightlines – everything logical, says technical author Jean Hewitt, and control is the adjustment of lighting or having the choice to sit somewhere calmer and quieter.

'A lot of people will experience a sensory overload – some people shut down and become non-verbal; it's a bombardment of noise, light and smell. It's such a sensitive experience that the brain can't cope with it,' she says.

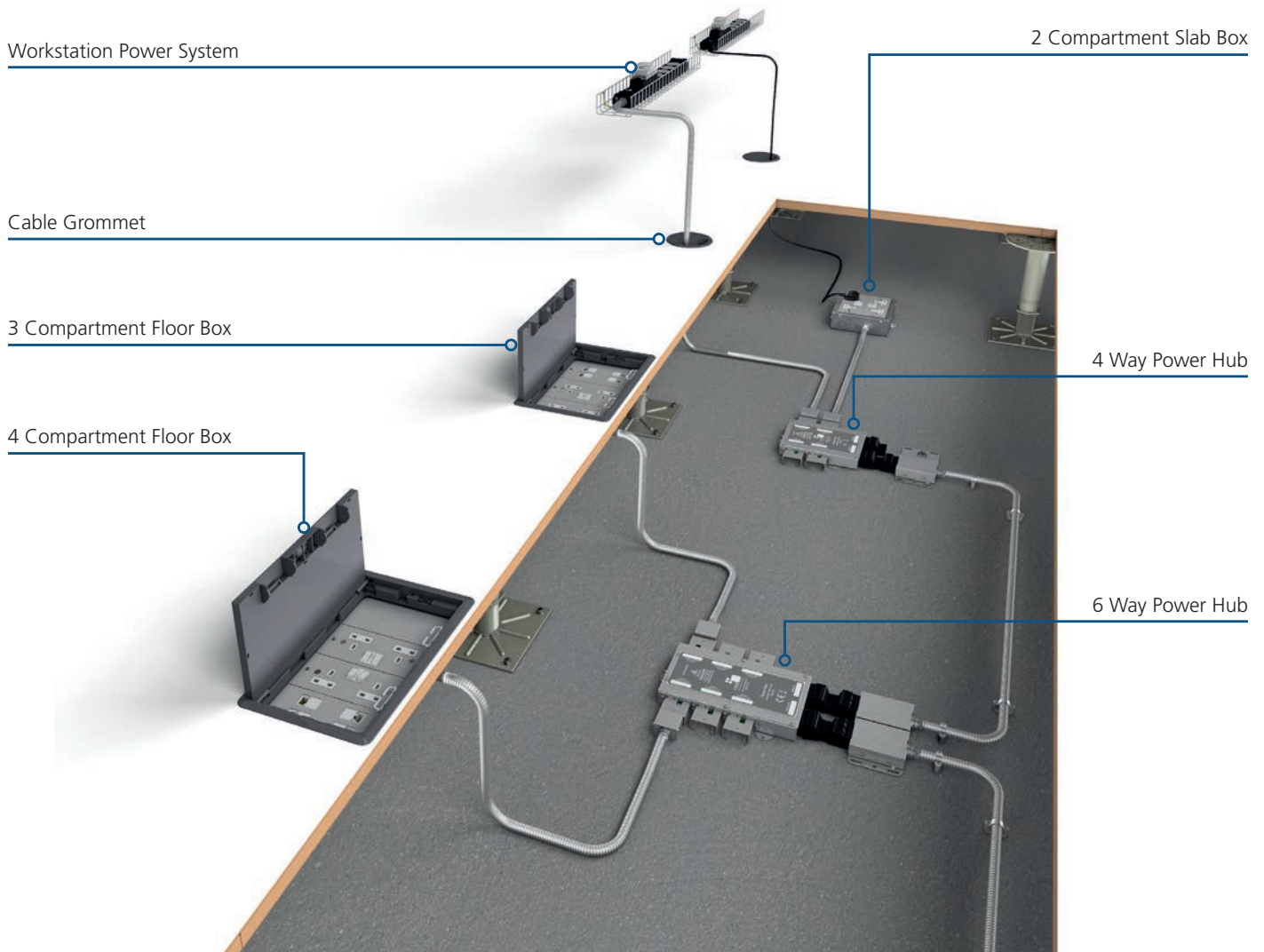
As well as practical advice about fittings and their design, the document informs about the quality of light, suggesting to steer clear of fluorescent lights in favour of LEDs. However, LED lights can have a flicker if not appropriately designed, so guidance around this – and the colour temperature of lighting – is also included.

'A lot of people find the blue and white light disturbing, so it's about giving people a choice, such as a desk lamp and changing the colour tone of the lighting. Warmer lighting tends to be more calming than blue light, which tends to wake us up,' Hewitt says.

In terms of wayfinding, the guide refers to designing logical, clear spaces with good sightlines, 'things that you would normally think of as being good design', says Hewitt, who says the publicly available specification is likely to get absorbed into a British Standard and become a code of practice.

'Hopefully, people will start reading it, applying it and testing it, and coming back and helping BSI and others to evaluate it,' she adds.

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WORK LIGHT BALANCE

The most influential guide to lighting the workplace has had its first update for a decade. **Helen Loomes** outlines the key changes

Lighting design is going through a small revolution. The volume of the space is taking on as much importance as lighting the visual task, and the latest version of the most influential lighting guide in this area, EN 12464 1 *Light and lighting – Lighting of workplaces*, is reflecting these changing times. Adopted into national standards in the UK in the autumn, as BS EN 12464 1:2021, this latest version appears a decade after the last revision. So, what are the key updates?

The most obvious changes are to be found in the revised tables in Chapter 7 – the list of specific lighting requirements. Here, there is a changed layout and additional considerations. As well as the previously required illuminance, which specifies the lowest maintained value in the activity area, there is now an additional, higher modified value, and requirements for mean cylindrical illuminance, walls and ceilings are specifically listed in the tables.

The modified value enables the illuminance to be adapted to real tasks and activities. The aim is to create optimum visual performance and avoid errors at work by considering varying factors, including the age of the user. Increases in light levels refer to the scale of illuminance in EN 12665, which are levels at which the average person can detect visible change.

In a brightly lit area, large changes in values are needed; in a dimly lit area, people can already perceive much smaller changes. These are not maximum and minimum values, however; rather, they are ranges to be considered.

Increased illuminance is required if:

- The visual task is critical to the workflow
- The correction of errors is costly
- Accuracy, higher productivity, or increased concentration are important
- The task is small or of low contrast
- The task is performed for an unusually long time
- The area has little daylight
- An employee's eyesight is below the usual level of vision.

If there are one to two additional requirements, an increase of one level should be made – for example, from 500 lux to 750 lux. More than two additional requirements leads to an increase of two levels. Where the visual task requirements are lower, however, it is possible to reduce illuminance by one level, but this is a rarity.

This change gives the lighting designer the ability to tailor the lighting to the actual needs of the user, and to make it more adaptable. The use of lighting control is, therefore, recommended: dimming means the

luminous flux of a luminaire can be adjusted individually, defined lighting scenes used, daylight considered efficiently, and variation of colour temperature added.

Quality criteria are now integrated into the tables for wall, ceiling and cylindrical illuminance, and are intended to provide greater safety and enhance the ambience of the room. For good visual communication and recognition of objects, vertical and cylindrical illuminance levels of between 50 lux and 150 lux are required, depending on the activity.

To avoid the impression of gloominess, and to increase adaptation and wellbeing, it is desirable to use bright room surfaces. So, in addition to the new illuminance levels on walls and ceilings, there are recommendations for reflectance levels. Up to 90% is now recommended for ceilings, and 60% for floors. Glazing with a reflection factor of 10% is also recommended, and even the reflectance of important objects such as furniture and machines should be considered. Although a project may still be in the planning stage, all reflectances should be recorded as accurately as possible.

Illuminance is still targeted to where it is needed, using the defined areas of task, surrounding area and background area. One change is that the visual task or activity

The recommendation to set the illuminance up to two levels higher than the required maintained value will be controversial

can be horizontal, vertical or inclined. Once the area is defined, the requirements levels, uniformity, glare limitation, and so on can be taken from the application tables of the standard. For some applications, the new standard contains changed specifications for example, the increase in illuminance from 300 lux to 500 lux for general activities in classrooms.

For areas where different tasks are performed, the most stringent requirements must be used. The modifiers are then used to calculate the appropriate illuminance value for the actual working condition. Once this maintained value is calculated, the illuminance levels for the immediate surrounding and background areas are then selected.

There is a change in the border area. To simplify uniformity calculations, points within a band next to the wall can be excluded from the calculation, unless the area of the visual task lies within this boundary area. The introduction of this band allows for a more efficient and cost effective lighting system. Its width is set at 15% of the smallest dimension of the area under consideration or 0.5m, whichever is the smaller.

If higher maintained illuminance values have been selected, the wall, ceiling and cylindrical illuminance values should also be increased by the same number of steps on the scale of illuminance. The recommendation to set the illuminance up to two levels higher than the required maintained value will be controversial, but then this is covered by the standard, which says that dimmable lighting should be used to ensure levels are met during varying hours of operation. >>

Ref. no.	Type of task/ activity area	Maintained illuminance, Em		U _o	R _a	R _{UGL}	Em, z Lx	Em, wall Lx	Em, ceiling Lx	Specific requirements
		Lx								
		required ^a	modified ^b							
13.1	Unloading/loading area	200	300	0.40	80	25	50	50	30	
13.2	Packing/grounding area	300	500	0.50	80	25	100	100	30	
13.3	Configuration and rehandling	750	1,000	0.60	80	22	150	150	30	
13.4	Open goods store	200	300	0.40	80	25	50	50	30	
13.5	Rack store - floor	150	200	0.50	80	25		-	30	Illuminance at floor level, R _{UGL} only the viewing direction of the luminaire.
13.6	Rack store - rack face	75	100	0.40	80	-	-	-	-	On aisle rack face. Band of 1.0m may be excluded from the perimeter.
13.7	Central logistics corridor (heavy traffic)	300	500	0.60	80	25	100	100	30	
13.8	Automated zones (unmanned)	75	100	0.40	80	25				

a required: minimum value

b modified: considers common context modifiers in 5.3.3

Tables such as the one above on warehouse lighting have been expanded to include a higher modified illuminance and specific levels for cylindrical (EM z), wall and ceiling illuminance

» We need to emphasise what electricity is consumed, rather than the installed load, for this to become accepted though.

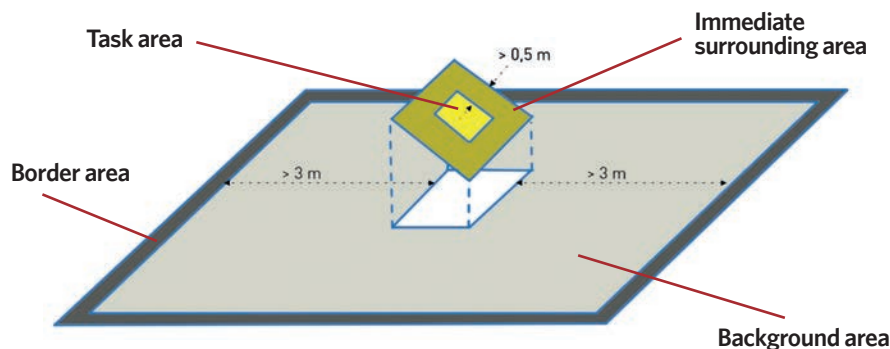
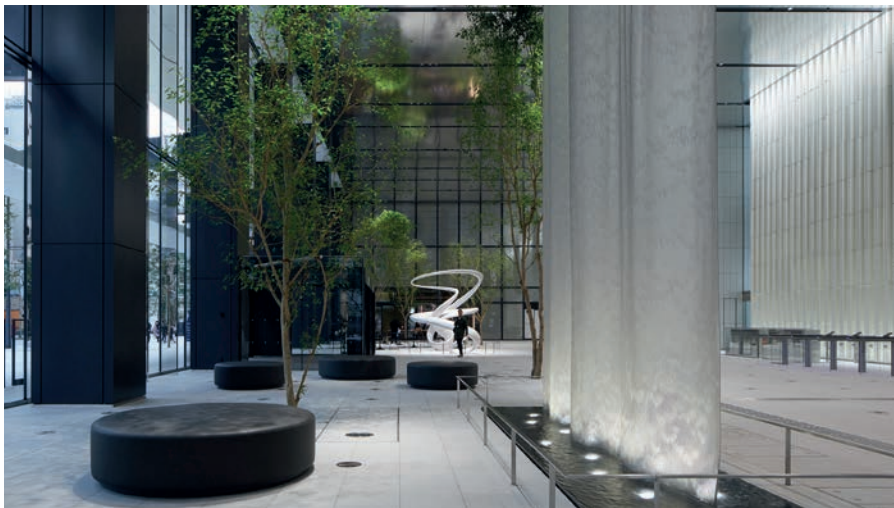
Glare

Glare is the unpleasant sensation caused by bright surfaces in the visual field – such as illuminated surfaces, parts of light sources, windows and skylights – and can be psychological or physiological. To select a luminaire suitable for the lighting installation in a particular room, the rating of the psychological glare emanating directly from the fitting must be calculated according to the CIE unified glare rating (UGR) table method. In addition, a new informative annex to the standard describes the recommended procedure for the application of UGR in unusual situations. There are further details on the procedure – for example, for unusual luminaire sizes, irregular surface shapes and arrangements of fittings – as well as deviating degrees of room reflection.

Flicker and stroboscopic effects (also referred to as temporal lighting artefacts, or TLA) can lead not only to reduced visual comfort and work performance, but also to physiological effects, such as fatigue and headaches. So, lighting systems should be designed to avoid the negative effects of flicker and stroboscopic effects throughout the dimming range. Flicker is described by using the IEC short time flicker indicator (PstLM). Flicker can be perceived by the eye at a frequency below 80Hz. Stroboscopic effects can be objectively quantified with the stroboscopic visibility measure (SVM) method. A PstLM of 1 and an SVM of 0.9 should not be exceeded. From 2023, the SVM limit will be cut to 0.4.

BS EN 12464 1:2021 refers to the European Ecodesign Directive, in which the limit values for lamps operated directly on mains voltage are specified. This currently affects retrofit lamps in particular – details can be found in the directive – but beware: in the next stage, these

Toranomon Hills Business Tower, Tokyo, Japan, by Sirius Lighting Office, winner of the Radiance Award at the 2021 International Association of Lighting Designers Awards: the volume of the space continues to take on more importance, with an emphasis on lighting vertical surfaces and objects



Defined areas for task, immediate surrounding and background – one change is that the visual task or activity can be horizontal, vertical or inclined

KEY CHANGES

- Differentiated illuminance
- Visual and non-visual effects of light
- Walls, ceilings and cylindrical illuminances
- Design considerations
- Task, surround and background area
- Glare requirements
- Flicker and stroboscopic effects
- Example requirements of different applications
- Requirements for railway installations

specifications could also apply to LED luminaires. Discussions on this are under way.

Other practical approaches and methods are presented in the appendices, which describe the room brightness and detection of objects and people. In Appendix B, there is additional information on visual and non-visual effects of light. It notes that light is not only essential for vision, but also produces biological, non-visual and emotional effects that are important for human performance, wellbeing and health. However, current lighting practices, and the demand for energy conservation, tend to reduce illuminance. This can create conditions that are not conducive to human wellbeing and visual performance.

The importance of darkness and daylight rhythms – especially before, after and during bedtime – are also described, and it is noted that changes in the distribution of the light spectrum at different times of the day can be helpful to stabilise circadian rhythms. The non-visual effects depend on the amount and time of exposure, spectral power distribution, exposure duration and personal parameters, such as circadian rhythms. These goals can be achieved with daylight and electric lighting.

The appendices give examples of lighting designs for an open-plan office, an industrial workshop, and a manufacturing area. Starting from the basic requirements of the tables, the individual requirements are analysed step by step, which can lead to modified maintenance values of the different areas.

This is a brief overview of the main revisions to what may be the most important standard for lighting designers. There are some welcome changes, which start to make an adjustment away from lighting engineering to lighting design in its fullest sense. **C**

- **HELEN LOOMES** FSELL, of the Trilux Akademie, is vice-president of the Society for Light and Lighting.
- BS EN12464-1 *Light and lighting – lighting of workplaces*, published in August 2021, is available at shop.bsigroup.com
- Material source: Trilux Akademie. For more on the standard, visit www.trilux.com/e-learning/register and enter the code 'Academy' to get to registration page.

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Turning a Grade II listed Victorian police station and magistrates court into a luxury London hotel required innovative services design, as **Andy Pearson** explains

FRESH START

Giacomo Casanova, Oscar Wilde and the Kray twins are among the many famous names to have appeared at London's Bow Street Magistrates Court. There has been a court in Bow Street since 1740, and it was here that the first British police force, the Bow Street Runners, was founded in 1749. The current court building dates from 1879, and the adjoining police station, built in a similar Greco Roman style, was completed at about the same time. The police station shut up shop in 1992; the magistrates court heard its final case in July 2006.

After passing through the hands of various developers, the two buildings were sold to the UK arm of Qatari investment firm BTC in 2016. It set about turning the Grade II listed Victorian police station and magistrates court into a luxury, 91 room hotel for the New York based NoMad chain.

It was a very challenging and complex project incorporating the level of services required for such a luxury hotel, given the nature of the existing heritage building, and required innovative thinking and collaborative working to ensure successful delivery, recalls Andrew Pegram, project partner and head of hotels at Hoare Lea.

Hoare Lea collaborated with development manager Sydell Group (NoMad brand owners), New York based interior designer Roman and Williams, and EPR Architects on the transformation of the 19th century buildings. Sydell Group's aspirations were for a six storey building with an extensive food and beverage offering, comprising atrium restaurant, ballroom, nightclub, private dining rooms and several bars, in addition to 91 luxury guest rooms. In a nod to the buildings historic origins, the new scheme also includes the Bow Street Police Museum, housed in part of the former police station, and a wing of cells in their original condition that the public can visit.



NoMad was declared Hotel of the Year at the Ahead Europe 2021 awards

The retained structures form two sides of the square shaped building. A retained facade forms its rear, behind which and close to it is an existing residential block. With considerable constraints posed by the existing space, the site, and its neighbouring buildings, we had to find ways to maximise the number of guest rooms and the capacity of the food and beverage offering, says Pegram.

At the centre of the site is a large, glazed courtyard that is key to the scheme being able to accommodate many of the hotel functions critical to its success. Beneath the courtyard and the new build guest rooms infill extension is a newly created, three level basement, the upper level of which houses the gym, giant atrium restaurant,



One of the 91 luxury guest rooms in the NoMad Hotel, which opened in May 2021



SERVICES PROVIDED

- Mechanical, electrical and plumbing services
- Lighting
- Fire engineering
- Acoustics
- Vertical transportation
- Energy and sustainability
- Sustainability assessment and certification

and three large kitchens, with associated stores and prep spaces. Beneath this, on basement level 2, are the back of house spaces, including uniform dispense, locker rooms and staff canteen. This level also includes the top half of a double height plant space, the lower half of which forms basement level 3.

Around the perimeter of the courtyard is a newly constructed accommodation block, housing a large proportion of guest rooms. The remaining rooms and larger suites are in the existing heritage buildings, with some of the cells and custody suites enlarged and converted into hotel rooms by removing separating walls.



A laser point-cloud scan of the existing building

Peggram says a major challenge early in the project was the enabling works package, which included construction of the basement, the accommodation block's concrete frame, and builders' work ducts.

The existing buildings had been laser point cloud scanned, which allowed the designers to walk through them virtually. However, because the scan was undertaken before the soft strip had taken place, some details remained concealed. We had to design the builders' work early, making due allowances to enable works to progress without the design being fully developed.

The design was modelled in Revit. To accommodate the hotel, changes included repurposing one of the existing stair cores as an intake air shaft, to enable large quantities of outside air to be drawn from the roof down to the basement to supply the kitchens and extensive back and front of house spaces.

Similarly, one of the lightwells was transformed into a giant service riser, one of many risers. According to Peggram, the challenge of reusing the Victorian buildings meant the services distribution strategy does not follow that of a traditional hotel, to ensure that maximum value is offered with minimal spatial impact. Service risers were extremely tight, with each one unique, requiring us to coordinate closely, with trimming steelwork often appearing through risers.

The large number of risers is partly a result of the building facades being sealed to ensure acoustic levels are achieved, and all guest and function rooms have mechanical supply and extract ventilation. For the guest rooms, outside air is supplied via two roof mounted air handling units. Delivering this was a real challenge, particularly where we had to work with the existing build fabric, says Peggram.

What made the heritage aspects of this scheme particularly awkward, from a services perspective, was that the magistrates' court and police station had been built independently of each other, so their floor plates were not aligned.

The level changes in this building are very surprising; in terms of distribution, we've had to service some rooms from above, some from below, and some laterally; everything was bespoke, explains Peggram.

Once inside the guest rooms, the supply air ducts terminate at a heavily attenuated fan coil unit (FCU), discretely located above the bathroom or lobby. This supplies air to the bedroom through high induction air >>

The challenge of reusing the Victorian buildings meant the services distribution strategy does not follow that of a traditional hotel

» diffusers with a decorative grille. Air is extracted from the bathroom, ensuring good indoor air quality.

Heating and cooling was provided to the hotel via a combination of variable refrigerant flow (VRF) systems and hybrid water based VRF systems. Additional, supplementary cooling is provided by modular air cooled chillers. The guest bathrooms also feature softened hot and cold water to the wash hand basin, shower and baths. Heating hot water can account for up to 50% of the hotel's total regulated energy load, Peggram says.

Heat for domestic hot water and supplementary heating is provided by a gas fired, small scale combined heat and power (CHP) engine and high efficiency gas fired boilers. The adopted energy strategy for the hotel was agreed as part of the planning consent before purchase of the building by our client, adds Peggram.

This solution offered great carbon reduction at the time it was conceived because carbon emissions from CHP were very favourable and the hotel has a high hot water demand. Using CHP to charge a large volume of hot water storage over a longer period of time ensures maximum operational hours of the CHP.

Now, given the carbon reduction of the grid and carbon intensity factors, hotel heating is typically led by air source heat pumps. However, the client chose to stay with the existing strategy, given the limited available space for the required heat pumps.

To be able to offer additional guest rooms and value to the client, the boilers, hot water storage cylinders, the CHP engine, and the hot water and chilled water circulating pumps are located in the centre of the hotel, in the level 2 plantroom, which is sandwiched

We have fitted all the odour control you can imagine: electrostatic precipitators, pre filters, secondary filters, carbon filters and Hepa filters



The giant atrium restaurant is only part of the hotel's extensive food and beverage offering

between guest rooms above and below. The room's internal location meant the space was designed as a box in box arrangement, to ensure the associated noise and vibration were inaudible to sleeping guests.

Ventilation design was also key to keeping the extensive basement kitchens comfortable. Cooling is provided by chilled water coils in the supply ductwork branches. These coils condition the air to ensure the chefs and pastry areas don't overheat, says Peggram.

To conserve energy, the kitchen has an intelligent demand controlled ventilation system. This involves the system measuring the surface temperature of the cooking equipment to determine the status of the appliances and adjusting the volumetric flowrate



Some cells from the original buildings have been retained for the public to visit



Many famous faces appeared before the magistrates' court during its long history



The atrium bar, one of several in the hotel

through the extract canopies accordingly. From an energy conservation perspective, it is more beneficial than a heat recovery coil, says Pegram.

There are five kitchens in the hotel meaning five kitchen exhausts, which all terminate at roof level. The hotel's proximity to nearby residences meant odour control was critical on the exhausts. We have fitted all the odour control you can imagine: electrostatic precipitators, pre filters, secondary filters, carbon filters and Hepa filters, adds Pegram.

The roof features two levels of plant, including AHUs, ventilation units, chillers and the outdoor units from the VRF systems. For acoustic reasons, the chillers and outdoor units had to be

housed in a bespoke enclosure to ensure the airflow was maintained.

From a space perspective, the rooftop was a real challenge because, in addition to odour and acoustic issues, we had to deal with rights of light issues, which meant height had to be kept to an absolute minimum, Pegram says.

The hotel opened in May, and the former magistrates court is now a destination of choice. Its main court room houses the NoMad Hotel ballroom a transformation of which Casanova, the infamous socialite and pleasure seeker, would no doubt have approved. **CJ**

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No home unsuitable for a heat pump, claims study

Pilot project reports successful installations in Victorian properties

Heat pumps can be fitted in all types of homes, according to a study commissioned by the government.

As part of the Electrification of Heat demonstration project, funded by the Department for Business, Energy and Industrial Strategy (BEIS), 750 heat pumps were installed in homes across the south of Scotland, Newcastle, and southeast England.

The project showed that heat pumps could be installed in homes of different styles and across the age spectrum, from Victorian mid-terraces to 1960s blocks of flats.

'The project has not identified any particular type or age of property that cannot have a successful heat pump installation,' the study's report said. 'The suggestion that there are particular home archetypes in Britain that are unsuitable for heat pumps is not supported by project experience and data.'

Energy and clean growth minister Lord Callahan said the trial had shown that low carbon heating could be effective in all types and age of home, and added: 'As technology continues to improve and costs plummet over the next decade, they will become the obvious, affordable choice for consumers.'



Older and more modern homes were included in the project

For the trial, different heat pump types were installed between July 2020 and October 2021, including low- and high-temperature air source models, ground source heat pumps, and hybrid systems, where the heat pump worked in tandem with a gas boiler.

The trial did acknowledge the additional challenges associated with installations in older homes, but said these were 'manageable', with 163 properties built before 1945 included in the trial.

There will be more reports based on the demonstration project in the coming months.

Backing for heat battery pilot

Caldera has secured a £470,000 grant from the Department for Business, Energy and Industrial Strategy (BEIS) to roll out its heat batteries to 12 pilot homes in the south of England.

The firm has developed a domestic-scale heat battery, Warmstone, that stores heat energy using low-cost, renewable, off-peak electricity. It performs like a gas boiler – releasing heat when required to power a home's heating and hot water – but is zero carbon and requires no home-efficiency retrofit to work.

According to the firm, the technology is suitable for more than a million hard-to-heat UK homes that are off the gas grid and reliant on oil or liquefied petroleum gas.

Off-grid homes are among the highest polluting in the country; they constitute 4% of the UK's housing stock, yet generate 11% of its carbon emissions from residential heating. They are hard to decarbonise because they tend to be larger, older homes, which are expensive to insulate sufficiently to accommodate alternative technologies, such as a heat pump.

Rollout of the project, which was due to be completed by Christmas, is being supported by the BEIS Energy Entrepreneurs Fund.



Getting ready for heat network regulation

Consumer protection scheme Heat Trust is helping Ofgem prepare for imminent regulation of heat networks by taking a senior officer from the regulator on a 12-month secondment grant funded by the Department for Business, Energy and Industrial Strategy.

Ofgem veteran Richard Bellingham, who was head of compliance, responsible for understanding retail supplier activity and how it impacts consumer outcomes, has now joined Heat Trust as head of compliance and audit.

The government plans to introduce statutory regulation of heat networks in the next few years, including consumer protections, pricing rules, minimum technical standards, and requirements for heat networks to decarbonise.

Mitsubishi Electric launches heat pump for ambient networks

Mitsubishi Electric has released a water-to-water heat pump for the multi-residential market. Ecodan Hydrodan units operate with low-GWP refrigerant, and can be installed in individual apartments to deliver domestic hot water, using an integrated storage tank, and low-temperature hot water for heating.

They connect to an ultra-low temperature, fifth-generation ambient heat network, which has typical temperatures of 10-30°C. This means multiple water source heat pumps can use the network as a heat source or heat sink, depending on the demand for heating or cooling. The advantage of this is that the network can be an energy store, using rejected energy from cooling plant to heat hot water in homes.

Each packaged unit offers a capacity range of 1.1-7.5kW, with flow temperatures of up to 60°C. The 170-litre integrated tank has variable pressure independent control valve loop control, which allows the flow into the unit to change independently of the pressure in the system.





HEATING MADE TO MEASURE

A digital twin of an East Sussex village is being created by Buro Happold to assess how demand for heating and electric vehicle charging will affect the electrification strategy for rural communities. **Andy Pearson** reports

Buro Happold is using the village of Barcombe, in East Sussex, to develop a roadmap to show how rural communities off the gas grid can switch to low carbon electric heating in a planned and affordable way.

The consultant is working with local community energy group Ovesco, electricity distributor UK Power Networks (UKPN), and Community Energy South, under the CommuniHeat partnership. The key output from this project will be a publication on how to approach decarbonising heating in off grid rural communities across the UK.

Phil Proctor, associate director, Buro Happold Energy, says the biggest potential barrier to the decarbonisation of heat in Barcombe, as with most rural villages, is a lack of capacity in the electricity network. He sums the situation up succinctly: Barcombe is a rural village of 700 homes; it is not on the gas grid, it burns oil for heating, locals travel higher than average miles, and it's located on a weak part of the electricity network.

Proctor says having UKPN on board is key to making the transition to low carbon heating affordable. We know we'll need to invest in the electricity network, but we need to do so in a planned way to minimise the number of interventions [and, hence, cost to consumers], rather than UKPN reacting on an ad hoc basis, he explains.

In Barcombe, the focus of decarbonising heat is on individual choice, but supported by access to community services, such as

community assets that may include heat networks and renewable generation. A range of low carbon heating technologies is available, including low temperature heat pumps, high temperature heat pumps and direct electric boilers. Which goes into a home, and how it performs, will determine how much electricity is required and when.

In an unplanned approach, the network has no influence or sight of consumer choices and yet it has to be able to react and respond to them, Proctor says.

To help establish the potential impacts of the different heating technologies and of additional energy efficiency measures, a digital twin of the village has been created (Figure 1). You have to bring all the data into one environment to link it together; that way, you can collectively make the right decisions, explains Proctor.

Populating the model with the heat demand for each building has been a challenge. Publicly available data is bad in terms of predicting what is needed; it has to be refined with data from the community,



Barcombe village is not on the gas grid

The survey data is showing that buildings are about 30% more efficient than EPC data is telling us. That has big implications, because you'll be oversizing your networks and over estimating bills by a huge margin

Phil Proctor

homes to get a more refined view of heat consumption patterns. The information gathered has been revealing.

The survey data is showing that buildings are about 30% more efficient than EPC data is telling us, says Proctor. That has big implications, because you'll be oversizing your networks and overestimating bills by a huge margin by relying on EPC data.

Where a community heat network is proposed, the digital twin includes a script to optimise the network based on load diversity and heat profile estimates. If we wanted to put a heat network into a village, the model would tell us where to put it and which buildings to connect to it, Proctor explains.

Alongside heat data, the model includes power network data. A network diagram normally shows the meter and not the property behind the meter; we're adding intelligence the other side of the meter, to inform the network strategy, Proctor adds. An inbuilt engine sizes the power network based on loads, and geospatially aligns the network data with building data. The modelling represents the first step in



otherwise your predictions will be way out, says Proctor.

To establish the current heat demand, the village was divided into building archetypes. Publicly available data, such as Energy Performance Certificates (EPCs), was initially mapped onto each type. With help from Ovesco, surveys were then undertaken on a selection of archetypes, with the full support of community members. In a number of cases, data loggers were also installed into

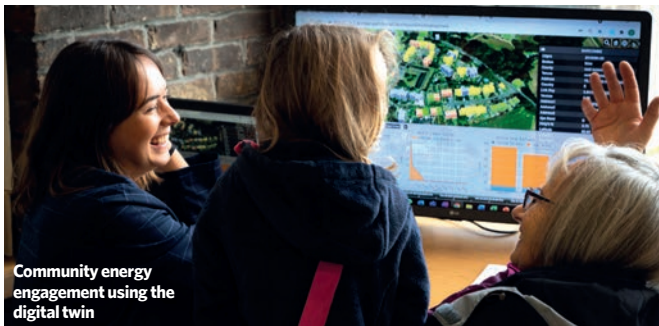


Figure 1: Screenshot of Barcombe's digital twin, with predicted heat demand. The coloured blocks represent different building typologies

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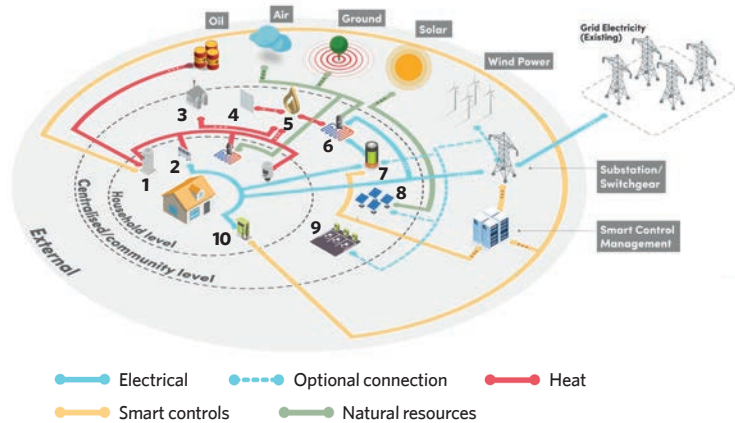


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Scenario planning



- 1 Boiler 2 Electric heating 3 Biomass 4 Thermal storage 5 Heating network 6 Heat pump 7 Batteries 8 Solar (PV) 9 EV charging (car club) 10 EV charging one way

Figure 2: Various scenarios are being modelled because Buro Happold does not know what technologies consumers will choose

» what is a multi step process of modelling, developing an implementation road map, and designing the solution, which can all be done in the same digital environment.

Having populated the model, Buro Happold is now starting to model various scenarios. It's scenario based, because we do not currently know what technologies consumers will choose, says Proctor (see Figure 2).

What we can say is that, if they made a certain choice, the model can anticipate what the outcome would be for consumers, in terms of their energy bill and capital cost, versus the implications for the network.

In another scenario, the model will be used to assess the implications of adding a 7kW electric vehicle (EV) charger to the heating load for every home with a drive. Proctor explains: The focus of CommuniHeat is about getting the heat price down and understanding the network impact of heat, but from a network perspective you also need to be able to understand the impact of combined heat and EV charging.

The model will also be used to assess the impact on Grid demand of adding energy efficiency measures to homes. We'll model the impact of putting insulation into properties by adjusting the heat profile, which we'll then convert into a power profile to assess the impact on the network, says Proctor

The team is now running the optimisation exercise, which will attempt to minimise the cost to the consumer of the oil to electric transition. This includes appraising the benefits of access to community energy services, which include community owned renewable energy and new financing mechanisms. Our results show community owned assets and local energy markets can make a real difference to the cost to the consumer, says Proctor.

Other scenarios planned include modelling the impact of battery and thermal storage. All these technologies are in the model. Once we've optimised consumer costs, we'll look at demand flexibility, Proctor adds.

The resulting insights are being collated, and Proctor says these are proving really interesting and could lead to real changes in the way we approach decarbonisation for these communities. CJ



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PANEL GAINS

Incorporating solar energy arrays in district energy networks powered by heat pumps has the potential to reduce carbon emissions, but by how much and at what cost? FairHeat's **Mark Reynolds** crunches the numbers and considers the options

Heat networks will be a key feature of the UK's future energy strategy, with around 20% of heat forecast to be delivered via such networks, many of which are likely to use heat pump technology as the lead heat source.

To further reduce the operational carbon emissions of these systems and mitigate the additional burden that the electrification of heat will place on the electrical Grid infrastructure, rooftop photovoltaic (PV) and solar thermal arrays have been proposed as potential supplemental technologies.

This article investigates the technical feasibility and economic benefits of replacing or supplementing heat pump load with solar thermal or PV.

As this study is based on urban heat networks in London, where roof space availability is limited, it was unclear which technology would provide the best carbon reductions and if they offer feasible business cases for use on new and existing developments.

In London, the capital costs of a communal heating system are heavily influenced by the carbon offsetting cost required by the Greater London Authority (GLA), currently priced at £95 per tonne of CO₂ over a 30 year lifetime. Reducing operational carbon emissions can, therefore, reduce capital cost significantly.

This research asks three central questions:

1. Is it more beneficial to use available roof space to generate heat directly from a solar

PV and solar thermal arrays have been proposed as potential supplemental technologies to heat pumps



In comparison with the solar thermal, the PV offsets annual electrical demand rather than onsite heat generation

thermal array or use a PV array to generate electricity and reduce the heat pump Grid electricity consumption?

2. Can greater carbon and cost reductions be achieved by increasing the heat pump size alone?
3. What is the lowest capital expenditure (capex) achievable when considering the GLA carbon offsetting payments?

Modelling approach

An hourly demand model was created, based on a standard, fourth generation, 2 pipe, low temperature heat network that supplies heating and hot water to end users via heat interface units (HIUs).

The base case is a heat network with a 55 °C flow temperature where air source heat pumps (ASHPs), in combination with a thermal store, are sized to contribute 80% of the annual heat demand (annual heat fraction). This is typical for meeting the GLA minimum decarbonisation requirements. The remaining 20% annual heat demand is provided by peaking gas boilers.

The load profile used within the hourly load model was based on heat demands for domestic hot water (DHW) and space heating taken from live operational data of 337 occupied dwellings across 2019 and 2020.

Data analysis showed a major change in usage pattern between the years. An example of the difference between the weekday DHW demand profile between 2019 and 2020 is shown in Figure 2.

The most notable difference between the datasets is the reduction in the morning weekday peak DHW demand, which is 56% lower in 2020. The large reduction is probably because of the Covid 19 pandemic resulting in more flexible working.

Despite the difference in profiles, the conclusions of the assessment were not affected by the profile used. The 2019 profiles were used as the basis of the analysis.

The annual operation of ASHP, boiler, PV and solar thermal generation were modelled using manufacturer data and the CIBSE Test Reference Year weather dataset for London. The model prioritised the use of solar thermal over the ASHP, with the gas boiler used as peaking plant when the solar thermal, ASHP and thermal storage couldn't meet peak load.

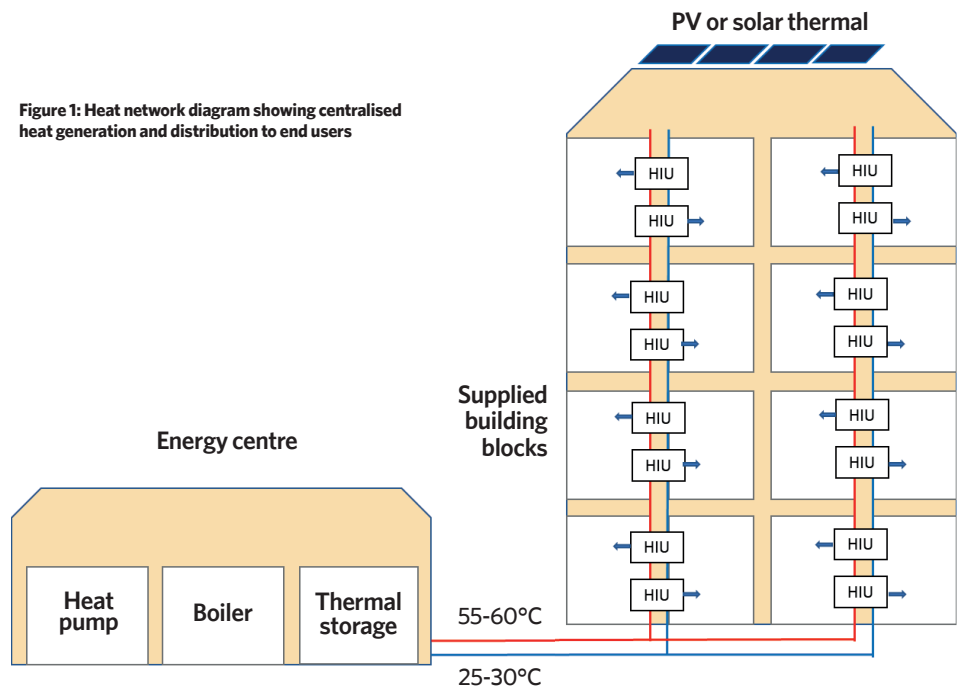
PV electricity generation was directed to supply the ASHP, with surplus exported to the Grid at an export tariff of 5p/kWh.

Monthly carbon emission factors for gas and electricity were used to calculate the annual carbon emissions for each scheme. Linear cost factors were used to estimate capital and operational costs for the varying sizes of each technology.

Five schemes in London were analysed, ranging in size from 100 to 1,000 dwellings. The required plant sizing and available roof space was representative of the existing schemes.

As the conclusions were similar across all scheme sizes, results from the 350 dwelling scheme are used to illustrate the findings of the full research paper.

Figure 1: Heat network diagram showing centralised heat generation and distribution to end users



On schemes of 100 1,000 dwellings, the use of PV is preferable in terms of capital cost, delivered cost of heat and total system cost

Addition of solar thermal or PV to the base case

The impact on costs and carbon emissions of using the rooftop area for a solar thermal or PV array was investigated.

A solar thermal array mostly offsets heat that would otherwise be provided by the ASHP during months when the Grid carbon intensity is typically low. Figure 3 (page 42) shows that the array causes a maximum 1.7% reduction in gas boiler annual heat fraction. This has a slight reduction in electricity and gas consumption and a minimal reduction in annual operating expenditure (opex). Throughout all scheme sizes, the use of solar thermal always caused an increase in total system cost.

In comparison with the solar thermal, the PV offsets annual electrical demand rather than onsite heat generation. Given the high cost of Grid electricity, reducing electricity usage and therefore opex costs had a greater impact on reducing total system cost. Accordingly, the total

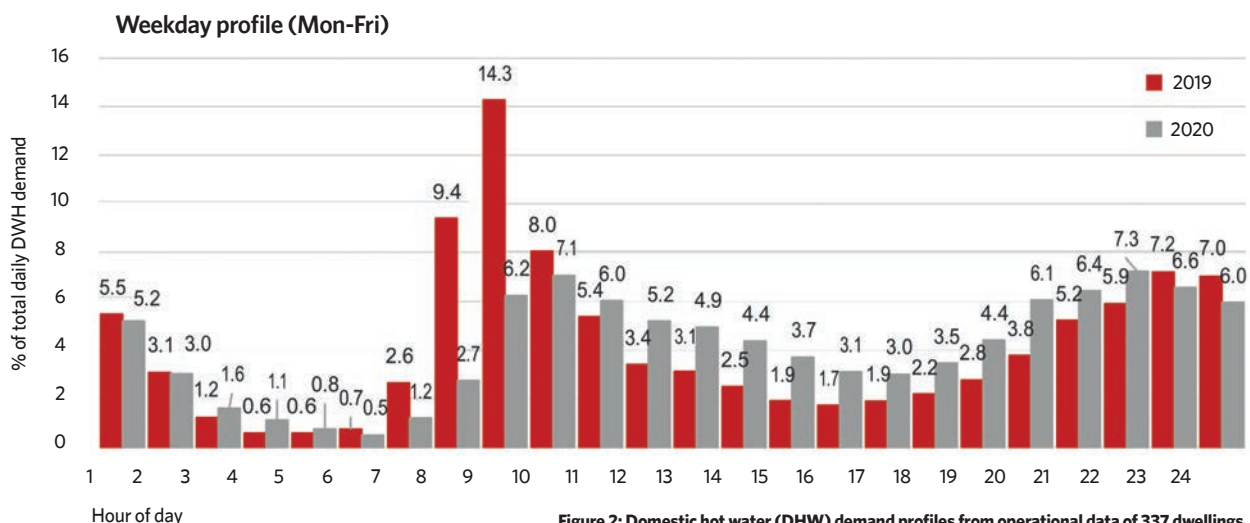


Figure 2: Domestic hot water (DHW) demand profiles from operational data of 337 dwellings

Both PV and solar thermal arrays provided an equivalent reduction in carbon emissions at approximately 6% from the base case

» system cost was always lower for a system with a PV array than with a solar thermal array. Both PV and solar thermal arrays provided an equivalent reduction in carbon emissions at approximately 6% from the base case.

Increasing ASHP size from the base case

The impact of ASHP sizing and gas boiler capacity were investigated in relation to the base case, which assumes no solar thermal or PV is used.

An increase in the annual ASHP heat fraction, from 80% to 90%, resulted in a 19% reduction in carbon emissions greater than the reductions provided by all PV or solar thermal options assessed.

Increasing the annual ASHP heat fraction increased the ASHP cost. However, this was offset by the reduction in carbon emissions and, hence, GLA carbon offset payments.

Increasing the ASHP heat fraction further, to 95%, provides a capex reduction vs the base case. Above 95%, the ASHP cost increases significantly and the carbon reductions diminish. A 95% ASHP heat fraction was shown to be optimal from a capex perspective.

There is, however, a 0.3p/kWh increase in delivered cost of heat because of increased electrical use at 95% heat fraction.

Key findings

On schemes of 100 1,000 dwellings, the use of PV is preferable to solar thermal in terms of capital cost, delivered cost of heat and total system cost. The reduction in operational carbon emissions was similar between both technologies.

Total system cost was found to reduce with increased PV size, so long as onsite electricity use is kept above around 40%. This study calculated PV array utilisations to be > 80% on all scheme sizes investigated because of limited available roof space.

Increasing heat pump size from a base case 80% annual heat fraction always resulted in lower carbon emissions than installing the maximum available array sizes of PV or solar

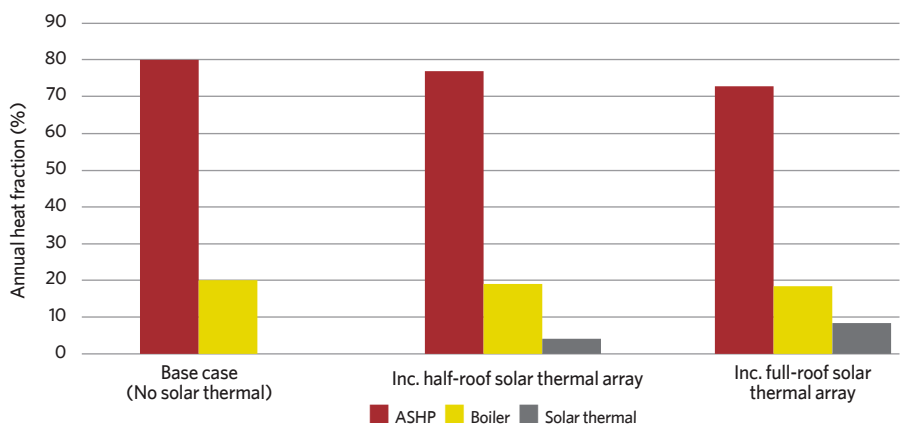


Figure 3: Effect of increasing solar thermal capacity on annual heat fractions

	Base case	With PV	With solar thermal
Total installed capex (£)	£709,000	£771,000	£836,000
Net annual opex (£)	£84,000	£76,000	£82,000
Total carbon emissions (kg CO ₂)	173,000	163,000	163,000
Total system cost (£ NPV)	£2,383,000	£2,300,000	£2,497,000
Delivered cost of heat (£/kWh)	£0.043	£0.038	£0.040

Table 1: Results for the base case with maximum PV and solar thermal arrays against the base case with no array

	Base case (80% ASHP heat fraction)	90% ASHP heat fraction	95% ASHP heat fraction	97.5% ASHP heat fraction	100% ASHP heat fraction
Total installed capex (£)	£709,000	£662,000	£646,000	£649,000	£712,000
Net annual opex (£)	£84,000	£88,000	£91,000	£92,000	£93,000
Total carbon emissions (kg CO ₂)	173,000	142,000	123,000	115,000	108,000
Total system cost (£ NPV)	£2,383,000	£2,392,000	£2,417,000	£2,440,000	£2,530,000
Delivered cost of heat (£/kWh)	£0.043	£0.044	£0.046	£0.046	£0.047

Table 2: Effect of increasing heat pump size and annual heat fraction while the boiler size is kept constant

thermal. However, this marginally increases the total system cost and delivered cost of heat.

The optimum ASHP heat fraction to minimise capex was found to be around 95% because of the carbon emissions reductions and subsequent GLA carbon offsetting costs reductions.

Conclusion

Where heat pumps are the central generation technology in a hybrid system, optimising the ASHP heat fraction should be considered before investigating the use of solar thermal or PV. Targeting an ASHP heat fraction of 95% provides the best opportunity to reduce carbon emissions without increasing capital costs.

After optimisation of the ASHP/ thermal store provision, PV is preferred over solar thermal to counterbalance both the electricity and lifetime costs of the larger ASHP. **CJ**

■ This article provides a high-level summary of the research findings. Visit www.fairheat.com to view the full presentation and download the research paper
 ■ **MARK REYNOLDS** is a consulting engineer at FairHeat



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Key factors to consider for in home heat pumps with ambient loop heat networks

This module explores the criteria for successful assessment of domestic heat pumps

This article will consider factors that will impact the success of an assessment of the building circulation loop for in home water to water heat pumps designed to exchange heat with ambient (otherwise known as ultra low temperature) communal heat networks. Such a communal heat network is defined by CIBSE CP1 *Heat networks: Code of Practice for the UK* as one that serves a single building that contains more than one customer (the building does not need to contain the plant).¹ The January 2021 *CIBSE Journal* CPD, Module 174, explored the application of residential (in home²) water source heat pumps in conjunction with communal ambient heat networks, which maintain the temperature of an ambient loop typically between 15 °C and 25 °C. This compares with a traditional building heat network circulating water in the order of 80 °C to 70 °C flow, with an expected 20K or 30K temperature drop through the load in each apartment. In home heat pumps usually have a modest capacity of 4kW to 9kW and are therefore paired with a domestic hot water (DHW) storage system. As noted in the recently published CIBSE AM16 *Heat pump installations for multi-unit residential buildings*, the temperature of the ambient loop is maintained through landlord operated plant, such as centralised heat pumps, gas boilers or connection to a wider district heating network, or potentially a passive ground loop array. As noted in CIBSE AM16, the cost to the landlord of operating the ambient loop and building level plant may be passed to the residents through a service charge. As the heat pumps are powered from the residents electrical supply, most in home heat pump systems can facilitate simplified billing and reduced standing charges.

Ensuring that the ambient loop is sized appropriately to supply sufficient water at an appropriate flow temperature is dependent on the designer understanding the coincident load profile of the multiple demands across the building which is not an exact science. Despite the increasing rigour in regulatory requirements for buildings and systems, there remain plenty of opportunities for uncertainty in the design process, which can result in systems that operate inefficiently, ineffectively,

or both. Table 1 provides some examples of common areas that are likely to contribute to these uncertainties. The increased use of modelling and simulation, when employed appropriately, can undoubtedly improve the prediction of building and system performance, but that is predicated on a proper representation of the built environment being created in the virtual

»

Sources of uncertainty when establishing load requirements for a building

Design criteria
Building fabric performance
Overheating risks and potential cooling requirements
Calculation methods
Operating profiles and diversity of use - both heating and hot water
Equipment performance
Pipe and ductwork insulation standards
Commissioning tolerances
Changes in use and extensions to building
Deterioration over time
Policy or tradition of adding safety margins

Table 1: Examples of sources of uncertainty when establishing load requirements for a building (Source: extended from CIBSE B12016, Table 1.22)

» world. As somewhat controversially illustrated³ by Iman et al, the reliability of the modelled solution will also be dependent on the knowledge and skill of the modeller.

The peak heating, cooling and hot water demand for a development may be obtained by calculation and modelling, or by monitoring demands of existing buildings. Actual data derived from similar operational buildings are extremely useful as a check on proposed designs.

As discussed in CP1,¹ when employing communal networks for multi residential systems, the peak heating demand for the building is always found to be significantly less than the sum of the peak design demands calculated for the individual dwellings. For example, many dwelling space heating demand calculations assume that there is heat loss to adjacent unoccupied properties. If these heat demands are then multiplied by the number of dwellings to give a block heat demand, there will be significant oversizing. A space heating diversity factor may be applied to the individual dwelling space heating demands, calculated to include heat losses to adjacent properties. CP1¹ recommends the rule of thumb empirical formula from the Danish guidebook *Varme Ståbi*,⁴ illustrated in Figure 1.

For a small number of apartments, it would not be appropriate to apply the diversity factor but, as can be seen, groups of more than 10 apartments are likely to have a coincident heating demand of less than two thirds the sum of individual peak demands.

CIBSE AM16 highlights that accurate calculation of DHW loads is particularly important for the design of heat pump systems in multi residential buildings, as DHW forms a large proportion of the overall heating load, in terms of both peak load and annual energy consumption. The flow temperature in the network is set to meet the specific needs of the residential systems, and this is often determined by the temperature required to meet domestic DHW needs. (The actual maximum temperature required for the DHW in the dwelling will depend on whether instantaneous or storage hot water is used – see the recent CIBSE note, *Domestic hot water temperatures from instantaneous heat interface units*, for a clear explanation of current thinking.) Realistic assessment of diversity (of use) is particularly important. There are continuing efforts to produce metrics that can be applied by the designer, including the CIBSE supported Loading Unit Normalisation Assessment (LUNA) project,⁵ as it is thought that current practice tends to overestimate demand¹. CIBSE CP1¹ recommends that the method of Danish

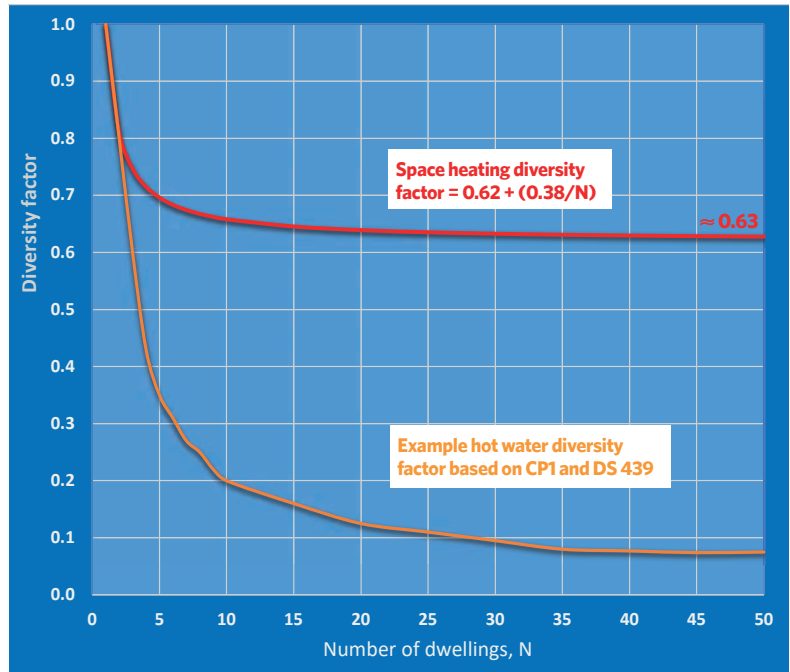


Figure 1: Example of space heating diversity factors – noted as ‘rule of thumb’ in CP1 for UK applications, and diversity factors for instantaneous domestic hot-water systems for dwellings, based on equation included in Danish standard DS 439 and employing default values (Source: CIBSE CP1)

standard DS 439⁶ may be applied, which employs a (relatively simple) equation that is clearly explained in CP1 with an excellent example and produces a demand in terms of a nominal cumulative design DHW flow. This was applied to provide the example diversity graph in Figure 1.

The resulting peak load on the heat network effectively relates to the demand from instantaneous hot water heating – for example, as would be realised by employing heat interface units (HIUs) with a higher temperature network. When applying ambient loops in conjunction with in home heat pumps, it is highly likely that there will be some form of DHW storage, such as individual hot water cylinders in each apartment. This can significantly reduce the peak load on the heat network, as heating of the water store may be scheduled to minimise the coincidence of multiple residences drawing heat at the same time. (Maximising this benefit requires considered design, building wide control, and the compliance of the residents.)

The building network distribution losses will be dependent on the location and temperature of the pipework, and the insulation. So, for example, when considering

Flow °C	Return °C	(Flow - Return) K	Network heat loss kW	Average loss per metre, W·m ⁻¹
80	80	0	8.72	9.88
80	70	10	8.05	9.12
80	60	20	7.38	8.37
80	50	30	6.71	7.61
70	70	0	7.38	8.36
70	60	10	6.71	7.61
70	50	20	6.04	6.85
70	40	30	5.38	6.10
60	60	0	6.04	6.85
60	50	10	5.37	6.09
60	40	20	4.71	5.34
60	30	30	4.05	4.59
30	30	0	2.06	2.33
30	20	10	1.41	1.59
20	20	0	0.75	0.85
20	10	10	0.38	0.43

Table 2: Illustration of heat losses from insulated 880m communal heat network (Source: Glen Dimplex Heating & Ventilation⁹)



Figure 2: Example of insulated pipework that serves a building heat network

heating systems, a communal network that passes through a heated space, such as a corridor or an equipment room, will have a lower temperature difference between the pipe and its surroundings, and so a lower potential heat loss than a pipe passing through an unheated area, such as an undercroft or a ventilated riser.

The thickness and efficacy of the insulation will be determined by a combination of considerations including legislative, economic and space as well as being dependent on the quality of installation. Practically, some losses will always occur, and these have been an inevitable part of the design and the operational efficiency of traditional systems. The overall efficiency of an already installed system will reduce as the thermal performance of building fabric and hot water systems is increased, as the losses from the distribution network become a greater proportion of the total energy supplied to the building.

A proportion of the heat lost from the distribution loop will increase the risk of overheating, particularly in the summer and shoulder seasons, and notably in communication spaces such as corridors. A knock on effect is that an increasing number of residential buildings are being designed with cooling systems to overcome the problems of overheating at least some of which may be the result of the heat being lost from the distribution loop. (With in home heat pumps connected to ambient loops, cooling may be provided effectively, as discussed later.) Because of the uncertainties in design, and the eventual installed detail of a building's heat network, it is not unusual for designers to apply a rule of thumb percentage guesstimate of heat losses from a distribution network. However, BS EN ISO 12241⁷ *Thermal insulation for building equipment and industrial installations – calculation rules* provides a model that can be more reliably applied to account for the key parameters that characterise the flow of heat between the water flowing in the pipe and the surrounding environment.

An example calculation was undertaken, employing BS EN ISO 12241, to compare the heat loss from a distribution network at different temperatures for a notional multi residential building with 55 apartments, with the communal network length of 880m, fed from central boilers (serving HIUs) delivering a peak of 365kW to meet the demand for heating and DHW service in the apartments. Table 2 shows the calculated heat losses⁸ for the network at various flow and return temperature pairs, and is illustrative of the impact of changing temperatures (without varying the flowrates or pipe dimensions).

Referring to Table 2 for a typical traditional design, with flow at 70 °C and return at 40 °C, the losses would vary between 7.38kW and 5.38kW across the network, depending on the load and the resulting return temperatures. At the design load of 365kW, the 7.38kW loss equates to 2% of the load probably far less than a rule of thumb might indicate, but also dependent on a consistently good standard of insulation. It is notable that the pipework heat losses at the lower flow temperatures, which are akin to ambient networks, are relatively tiny.

As recently reported⁹ by Wang et al, the various types of heat pump applications are likely to result in different values of diversity factors for energy demand, and further studies are needed, particularly with the increasing use of heat pumps and heat storage. For example, despite the high coefficients of performance (COPs) that would typically be achievable with in home heat pumps, the primary energy source will be electricity used to power the heat pump compressor. Depending on the heat pump type and the arrangements for legionella control in storage cylinders, there may also be an electrical component that is attributable to the top up heating of domestic hot water.

A specific attribute of in home water to water heat pumps, such as illustrated in Figure 3, is that they can provide cooling, as well as heating, to the space. The ambient communal loop will provide a relatively low temperature source so giving a reasonable heat pump cooling energy efficiency ratio (EER). This arrangement also allows energy recovery if some areas in the building require cooling while, concurrently, others demand heating (for example, for DHW). If there are any common areas, commercial spaces or shared facilities such as gyms or communal parts of the building that employ the ambient loop, these can contribute to the mix of heating and cooling. The heat demand from a residential development could, through the ambient network, provide free cooling for refrigeration. Unless the cooling load is a small proportion of the heat load, it is likely that mechanical cooling input to the loop will be required. This will add to the complexity of assessing diversity of load in the network, but can deliver very significant operational gains, so reducing energy use and carbon emissions.

© Tim Dwyer, 2022.

Turn to page 48 for further reading and references. >>



Figure 3: Example of an in-home water-to-water heat pump that can provide cooling as well as heating (Source: Glen Dimplex Heating & Ventilation)

Module 190

January 2022

» **1. What range of temperatures would be typical of the flow in an ambient network?**

- A 80 C to 70 C
- B 70 C to 60 C
- C 45 C to 60 C
- D 25 C to 45 C
- E 15 C to 25 C

2. Which of these was not listed as a potential uncertainty when establishing load requirements?

- A Building fabric performance
- B Operating profiles
- C Policy or tradition of adding safety margins
- D Potential cooling requirements
- E Specific heat capacity of water in loop

3. If a multi residential building included 30 apartments, what is a rule of thumb diversity factor for the space heating?

- A 0.43
- B 0.53
- C 0.63
- D 0.73
- E 0.83

4. Which document may be most appropriate to evaluate the heat loss from the pipes in a communal heat network running within a building?

- A AM16
- B BS EN ISO 12241
- C CP1
- D DS439
- E LUNA

5. If the example 880m communal heat network was operating at 25 C flow and 15 C return, what is the likely approximate average heat loss from the pipe per metre?

- A Between 0 and 0.5W·m⁻¹
- B Between 0.5 and 1W·m⁻¹
- C Between 1 and 2W·m⁻¹
- D Between 2 and 4W·m⁻¹
- E At least 4W·m⁻¹

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Further reading:

The application of in home heat pumps connected to ambient networks is developing quickly and, aside from manufacturers' technical resources, the CIBSE documents AM162 and CP11 provide a very useful grounding, with excellent examples and useful bibliography.

This article was inspired by *Design guidance for diversity factors for ambient temperature networks using the Zeroth Energy System*, published by Glen Dimplex Heating & Ventilation.

References:

- 1 CIBSE CP11 *Heat networks: Code of Practice for the UK* 2nd edition, CIBSE 2020.
- 2 CIBSE AM16 *Heat pump installations for multi-unit residential buildings*, CIBSE 2021.
- 3 Iman, S et al The building performance gap: Are modellers literate? *BSER&T* 2017, Vol. 38(3) 351-375.
- 4 Danish guidebook *Varme Ståbi*.
- 5 CIBSE Technical Bulletin *Domestic water demand assessment for pipe sizing* 2nd edition, CIBSE 2020.
- 6 DS 439 *Code of practice for domestic water-supply systems*, Dansk Standard 2009.
- 7 BS EN ISO 12241:2008 *Thermal insulation for building equipment and industrial installations - calculation rules*, BSI 2008.
- 8 *Design guidance for diversity factors for ambient temperature networks using the Zeroth Energy System*, GDHV, 2021 - www.gdhv.co.uk/zeroth-diversity-guide.
- 9 Wang, Z et al, Sizing of district heating systems based on smart meter data: Quantifying the aggregated domestic energy demand and demand diversity in the UK, *Energy* 193, doi:10.1016/j.energy.2019.



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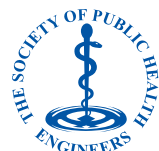
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› Products of the month

Rinnai makes emissions pledge in new manifesto

Company sets out steps to becoming carbon neutral through innovation

Water heater manufacturer Rinnai has published its Innovation Manifesto, which sets out a pathway to carbon neutrality while maintaining high standards of quality.

The manifesto has four segments: Background to carbon neutrality; Initiatives and directives to realise low carbon; Decarbonised society: reducing CO₂ emissions from business activities; and Investing in carbon neutrality.

Its aim is to assess carbon emissions at each stage of the production and procurement process (95% are produced during the working life-cycle of a Rinnai product, and 5% during other manufacturing processes) and provide the necessary data to work towards carbon neutrality.

The manifesto details plans to halve emissions from Rinnai products and manufacturing techniques by 2030, primarily



through the development of hydrogen power technologies. By 2050, further developments in this field will allow products to become carbon neutral from early production through to disposal.

Rinnai is actively contributing to international hydrogen development, carrying out combustion tests on 20-30% hydrogen gas blends in the UK, USA and Italy. Rinnai Japan is also developing technologies for 100% hydrogen

usage in collaboration with other countries.

The company plans to invest £332m over five years, with £200m going into product development - in areas such as hydrogen combustion equipment, heat pumps and other next-generation technologies - and £100m into manufacturing, to enable a switch to renewable energy sources and fossil-fuel free facilities. In addition, £32m will go towards promoting sales of low carbon alternatives, such as the ECO ONE hybrid water heating system, and the global promotion of energy efficient water heaters.

Rinnai is also taking accountability for emissions within its offices and factories through efficient use of electricity and directed energy. By 2030, in-house emissions will be reduced by 50% and the plan is for all the company's sites to be carbon neutral by 2050.

UK managing director Tony Gittings (pictured) says: 'Rinnai is taking action to ensure it is carbon neutral as soon as possible. We are a business based on engineering excellence and are employing technological creativity to achieve our goals.'

■ Visit www.rinnaiuk.com

Carrier OptiClean is a breath of fresh air

BRE tests show air scrubber rapidly reduces levels of virus sized particles

Carrier's OptiClean air scrubber and negative air pressure machine has been proven to rapidly reduce concentrations of ultra-fine, virus-sized particles in the air.

Research by the UK Building Research Establishment (BRE) demonstrated that OptiClean cuts levels of airborne particulates up to 1µm diameter, including virus-containing aerosolised droplets, by two-thirds within 30 minutes - and it does so as effectively in the corner of a room as in the centre.

'OptiClean effectively targets ultrafine, virus-sized airborne particles, and can be installed in buildings as part of a risk-reduction and mitigation strategy,' says



Matthew Maleki, product manager at Carrier UK.

The BRE tests were conducted in a sealed room, into which ultrafine airborne particulates were introduced and their sizes controlled to mimic virus particles. Within 30 minutes of activation, OptiClean reduced the particle concentration in the room by a factor of

three and maintained this for extended periods.

OptiClean has two modes: a standalone air scrubber mode, to reduce exposure to airborne pathogens, as demonstrated in the BRE research; and a negative-pressure machine mode, to limit the escape of contaminated air by filtering and expelling it.

It has an M5 pre-filter, which

prevents the main H13/14 Hepa filter from clogging, to enhance the unit's effectiveness and durability, with an efficiency rating of up to 99.995%.

OptiClean is easy and quick to deploy, and can be moved rapidly to areas requiring treatment. The European version can be specified with internal UV-C lamps to target pathogens and activated charcoal filters to absorb volatile organic compounds.

OptiClean was named among *Time* magazine's 100 Best Inventions of 2020, and, in the UK was selected as Air Conditioning Innovation of the Year in the Cooling Industry Awards.

Carrier UK has deployed the air cleaner at its offices in Leatherhead and Stockport to protect staff and support its own healthy buildings policy.

■ Call 01323 723 944 or visit bit.ly/CJJan220ptiClean

New Luceco lighting solutions specification guide now available

LED lighting manufacturer Luceco has launched a new publication demonstrating the range and diversity of its LED luminaires. The company has showcased new fittings for the public service, commercial and industrial sectors.

Notable luminaires include: Sigma, an installer-friendly, direct/indirect recessed luminaire for low-glare applications, to assist with LG7-compliant designs; and Callisto, a linear surface-mounted, IK10-rated luminaire that thrives in semi-industrial and recreational settings.

Other features include Luceco's new, two-tier wireless lighting systems. Luceco Platform offers the ability to transform existing installations with wireless systems for dimming, presence and daylight control. The Luceco Elevate wireless lighting controls provide a function-rich system, with energy and emergency lighting reports, asset tracking, and use of the Luceco Platform.

The Specification Guide has been designed to give professionals detailed information in simple categories, with further information available on Luceco's website.

■ Call 07890 320152, email Zoe.nh@luceco.com or visit www.luceco.com



Radisson Heathrow gets air conditioning upgrade

Radisson Hotel & Conference Centre London Heathrow has been equipped with Ciat and Toshiba HVAC technology (provided by Toshiba Carrier UK) as part of a major refurbishment. It now has a high-performance CIAT Floway 5000 air handling unit with a counter-flow plate exchanger, ensuring outstanding guest comfort and low costs. Ciat Floway units achieve Eurovent's top airtightness rating and improve leakage for lower-rated systems by 60%.

■ Call 01323 723 944 or visit ciat.uk.com/product/floway access rhe



Diffusion supplies fan coils to One Bishopsgate Plaza

British heating and cooling equipment specialist Diffusion has provided the 41-storey One Bishopsgate Plaza development with 980 new fan coil units (FCUs).

Diffusion's new Highline 270 FCU is the most efficient fan coil on the market, with a specific fan power of 0.16W/l/s. It is ErP Directive 2015 compliant, can be mounted in ceiling and underfloor applications, and has a lifetime ECO removable wire mesh filter.

■ Visit www.diffusion-group.com



Aquatech Pressmain is keeping us warm again this winter

Water booster and pressurisation unit producer Aquatech has just released its PED-compliant Aquaspill range of pressurisation units, designed to maintain the water pressure in heating and chilled water systems for large commercial situations, including district heating systems. The systems include options to deal with temperatures of 3°C to 200°C, a fill pressure of up to 25.0 bar, and almost unlimited content.

■ Email sales@aqpm.co.uk or visit www.aquatechpressmain.co.uk

Make carbon savings with Advenco's Fusion FPH S hybrid hot water system

Commercial hot-water specialist Advenco has introduced the Fusion FPH-S range of low carbon hybrid hot-water systems. Fusion uses the company's FPI32 heat pump, a high-pressure ATSH calorifier with electric immersion, controls and metering, to provide a sustainable and cost-effective system for projects.

'For organisations with small to medium hot-water demands and a desire for a more sustainable business model, the Fusion FPH-S range provides a single, easy to accommodate, highly effective response,' says Bill Sinclair, technical director. 'By choosing one of these packaged hybrid water systems, you gain optimum efficiencies, lowering carbon emissions and assuring Building Regulations are met.'

Available in 16 variants, the ASHP preheat and immersion work seamlessly to deliver high operational efficiency. The Fusion heat pump offsets much of the electric immersion top-up in the calorifier, to save up to 53% of carbon emissions.

■ Call 01252 551 540 or visit advenco.co



Carrier continues to invest in UK air conditioning and heat pumps >

The UK is a key European market for Carrier's advanced air conditioning and heat pump solutions, according to Didier Genois, vice-president and general manager of Carrier Commercial HVAC, Europe. He said: 'We will continue to invest to ensure customers have the very best products to meet UK requirements, as well as the support needed to grasp the opportunities opening up in decarbonisation and healthy buildings.'

Developments include a new range of high-performance cooling systems for data centres and compact heat pumps for small projects, both due for release in 2022.

■ Call 01323 723 944 or visit <https://tinyurl.com/3n7fzyka>



Patented NVHR system gives air ambulance a lift >

Breathing Buildings has supplied controlled hybrid ventilation to the new East Anglian Air Ambulance HQ, using its NVHR 1100 ventilation with heat recycling units and S1500L e-stack units. The patented system allows single-sided, enhanced natural ventilation, while making the most of internal heat gains to deliver superb thermal comfort and indoor air quality. It offers energy savings of almost 50%.

■ Call 01223 450 060 or visit www.breathingbuildings.com



< Jung Pumpen releases new features for Compli device

The successful Jung Pumpen Compli wastewater and sewage lifting station is now easier to install, operate and maintain. New features include:

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■ Call 0118 9821 555 or visit www.pumpstechnology.co.uk/www.jung_pumps.co.uk

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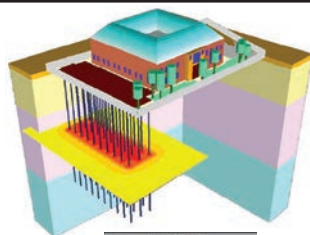
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Ventilating classrooms is key to mitigating the spread of Covid-19

Dr Henry Burrige

Class monitor

A project assessing the risk of airborne Covid-19 transmission in schools has released four videos about the importance of monitoring air quality. The project's co-investigator, Dr Henry Burrige, explains

The Co Trace project, launched in February 2021, brings together researchers from the universities of Cambridge, Surrey and Imperial College London to assess the risk of airborne Covid 19 transmission in schools, and evaluate the effectiveness of mitigation measures.

Alongside principal investigator Paul Linden, of the University of Cambridge, co-investigators Henry Burrige, Christopher Pain (both of Imperial College London) and Prashant Kumar (University of Surrey) have been modelling and assessing data from air quality monitors in schools to support ventilation guidance. As part of the project, the team has produced four videos to assist classroom staff in using CO₂ monitors provided by the Department for Education (DfE). Here, Dr Burrige, senior lecturer in fluid mechanics at Imperial College, explains the aims of the project.

Why was Co-Trace set up and what are its aims?

Through the Royal Society's Rapid Assistance in Modelling the Pandemic initiative, we identified that schools were going to be a potential source of Covid transmission. We were aware that ventilation was an important mitigation measure in UK schools, which typically have no mechanical ventilation provision.

The Co Trace research project has been focusing on detailed studies of schools, where we have been placing air quality monitors and modelling the implications.

I am also joint principal investigator on the DfE's pilot project investigating the changes in ventilation of schools when CO₂ monitoring is carried out. I felt it was excellent that the government was rolling out monitors to help classroom staff. However, I became aware of the need to help teachers understand why they were being sent these monitors, and how to use them and interpret the information, so we felt we should make the videos and materials.

Phase one of Co Trace will end in August, and we have secured funding for an extension project, School Air Quality Monitoring for Health and Education. This will involve sending out monitors to a few thousand schools to record data for analysis.

Can we reduce the risk of children becoming infected with Covid-19?

Primary school children are challenging, because they interact with each other closely, and are in close contact for long periods. One of the things we can do to try

to mitigate the spread of Covid through the air is to ventilate classrooms appropriately, or encourage outdoor play where possible. In terms of ventilating a classroom, if the children are sitting still, they will not be learning effectively if they are freezing cold. Last winter, the advice was open all of the windows all of the time, but these monitors enable us to say, use your monitors to strike the right balance between opening windows and keeping a comfortable environment.

Should other measures be considered, such as air cleaning devices?

If classrooms for which the ventilation architecture (windows and doors), heating provision and room usage mean the space cannot be ventilated adequately, school leaders need to consider all options. Some long term solutions can be expensive and take a while to put in place. For example, should contractors need to implement a solution over, say, the summer holidays, air cleaners are something to consider as a short term solution. See an online DfE marketplace of suitable devices at bit.ly/CJJan22aircleaning

Can this guidance be applied to other indoor environments?

Yes. In my university department, for example, we have established CO₂ monitoring in all teaching spaces; we use the data to support our estates team in checking and maintaining the mechanical ventilation provision. We also provide CO₂ monitors in naturally ventilated teaching spaces, so lecturers can manage the ventilation.

If I was responsible for office space, I would undertake CO₂ monitoring to check the balance between occupancy and ventilation. It's relatively cheap to do, and either gives peace of mind, or can quickly identify issues that are sometimes relatively easily addressed.

Is there an opportunity for more education on indoor air quality?

Long term, the way to make sustainable changes to our indoor environments and ensure everyone's wellbeing is improved, without costing too much in energy, is through good education. You need occupants to understand why they should care about the air quality they're exposed to and how they can play a role in managing that exposure.

- Find out more, and watch the videos, at www.CoSchools.org.uk

EVENTS



NATIONAL EVENTS AND CONFERENCES

Building Performance Awards 2022

24 February

The shortlist has been announced for the CIBSE Building Performance Awards 2022, so make sure you are there to celebrate with the best of our industry. The awards recognise the people, products and projects that demonstrate engineering excellence in the built environment, focusing on actual, measured performance outcomes. Find out who tops the awards on the night. www.cibse.org/bpa

CIBSE REGIONS AND GROUP EVENTS

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

SLL and East Midlands Finding darkness with the light

11 January

Webinar exploring the role of responsible outdoor lighting design in confronting the global loss of the night, with Dr John Barentine, principal consultant at Dark Sky Consulting.

North East: Drilling for minewater heat schemes: how to end up in hot water

11 January

Seminar offering lessons learned

from projects undertaken, successes and challenges. With speaker Bryan Laycock, of Dunelm Geotechnical & Environmental.

SLL in conversation with

12 January

Richard Morris MSL, associate and lighting designer at Arup, and Mike Simpson FCIBSE FSL will discuss sports lighting, with reference to SLL Lighting Guide 4: Sports lighting.

HCSE: How to plan, design and deliver high performing heat networks

19 January

Speakers will present on how to implement requirements on low temperature heat networks.

North West: Indoor Air quality, infection control and building wellness

20 January

Seminar by Dr David Glover, founder and technical director of Plasma Clean, covering: how IAQ relates to infection control and building wellness, the merits of air quality sensors, and building wellness standards.

HCNE: EV feeder pillars and infrastructure

25 January

Presentation on current EV infrastructure and the role of the feeder pillar, with speaker Alan Read, of Charles Endirect.



CIBSE JOURNAL PODCASTS

The latest *CIBSE Journal* podcast, 'The challenge and opportunities of delivering heat networks', sponsored by Grundfos Pumps, discusses the challenges and opportunities of realising the government's ambition of significantly growing heat networks in the UK. All *CIBSE Journal* podcasts are available on the CIBSE Soundcloud - at soundcloud.com/build2perform - Apple Podcasts and Spotify.

Merseyside and North Wales: Acoustics, ventilation and overheating guide

17 February

With speaker Anthony Chilton, head of acoustics at Max Fordham.

LIVE ONLINE TRAINING COURSES

CIBSE training courses have been reformatted to work online, with a live trainer.

Above ground building drainage

11 January

Overview of IET wiring regulations (18th edition)

12 January

Mechanical services explained

18-20 January

Low and zero carbon energy technologies

19 January

Fire safety building regulations: Part B

20 January

Design of heating and chilled water pipe systems

25 January

Building services explained

25-27 January

Low carbon consultant design

26-28 January

Embodied carbon in MEP design How to use CIBSE TM65

26 January

Below ground building drainage

27 January

Electrical services explained

8-10 February

High voltage (11kV) distribution and protection

8 February

Heat networks code of practice (CPI)

7-8 February

Fundamentals of drainage

10 February

Fire alarm detection and codes BS5839 1: 2017

15 February

Energy surveys

16 February

Designing water efficient hot and cold supplies

22 February

Design of ductwork systems

22 February

Residential fire sprinkler design BS9251: 2021

23 February

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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

STUDENT WEBINARS

18 January

Student webinar offering information about CIBSE membership. The focus is on the benefits of membership, including resources, societies, events and awards.

For details and to register, visit bit.ly/CJJan22Webinars

CIBSE JOURNAL WEBINARS

Water source heat pumps and ultra low heat networks for the multi residential sector

This recent webinar, sponsored by Mitsubishi Electric, explores the future of ultra-low heat technology with multi-residential apartments.

To register, and to access other *Journal* webinars on demand, visit www.cibsejournal.com/cpd/webinars

Membership webinars

CIBSE Membership hosts free, two-part webinar series to support members with applications for the Associate and Member grades and registration with the Engineering Council at Incorporated Engineer and Chartered Engineer levels.

Upcoming webinars:

- 18 and 25 January
- 8 and 15 February



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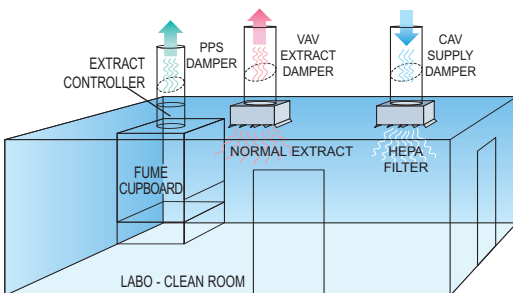


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