CIBSE JOURNAL

The official magazine of the Chartered Institution of Building Services Engineers

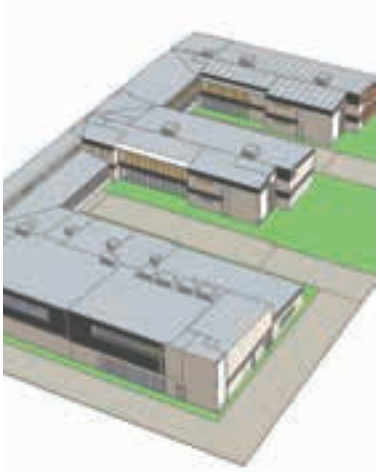
October 2016

PAST, PRESENT AND FUTURE

We celebrate CIBSE's 40th anniversary by asking six leading engineers to predict the city of the future

www.cibsejournal.com

Contents



Primary schools from 1976 and 2016 go head-to-head on energy consumption – page 34

Features

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BY HEATRAESADIA

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History lesson

This year marks the 40th anniversary of the formation of the Chartered Institution of Building Services, after the Institution of Heating and Ventilating Engineers (IHVE) merged with the Illuminating Engineering Society. (The E of 'CIBSE' was not added until 1985, hence fond nostalgia for the term 'CIBS' among more senior engineers.) The Institution was formed as building services were becoming more complex and technical; a new professional body was needed to take a more holistic view of the sector. Although it's hard to believe now, independent lighting engineers did not exist at this point.

Over the past 40 years, the industry has changed beyond all recognition. In 1976, engineers were still using slide rules and, if they were lucky, big clunky LED calculators – now, 3D thermal modelling is the norm. Back then, it was perfectly allowable to smoke pipes and Player's No6 over the drawing board; now, building services design follows the health and wellbeing mantra.

Our overview of the past 40 years looks at just how much else has evolved – from the move towards renewables to improvements in lighting design and energy efficiency. It also uncovers at least one lesson not yet learned; insight from former CIBSE presidents reveals that back then there was closer collaboration in the supply chain when designers followed the apprenticeship route. There is now a revival of this route into the industry, and our Q&A with Troup Bywaters + Anders, on page 77, reveals how much the employer and its apprentices are benefiting from their apprenticeship scheme.

> In 1976, engineers were using slide rules and, if they were lucky, big LED calculators – now 3D thermal modelling is the norm

There is one major difference between the news agenda of the *CIBSE Journal* in 2016 and its predecessor in 1976. The CIBSE Presidential address by Alex Loten that appeared in the magazine 40 years ago focused on the implications for the UK of voting to remain in the European Economic Community. He spoke of the benefits of standardisation and working with engineers from across Europe. Fast forward 40 years, and we are now having to come to terms with an EU exit and the commercial and regulatory implications.

For this 40th anniversary issue, we have asked eminent engineers – including Patrick Bellew and Max Fordham – to identify the challenges of urbanisation in 2050 (page 38). Their insight gives us some optimism that we can build liveable cities for the billions more people who will inhabit Earth by then.

Alex Smith, editor
asmith@cibsejournal.com

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NEWS

All the latest news from around the building industry

WORK STARTS ON ENERGY CENTRE FOR LEND LEASE'S GIANT ELEPHANT

Piling has started on the energy centre at the heart of Lend Lease's Elephant Park development in Elephant & Castle, London. The CHP plant at the Energy Hub will supply heating and hot water to almost 3,000 homes, as well as to shops, offices and community spaces.

Designed by Duggan Morris Architects, the Energy Hub will be run by E.ON and Lend Lease, and will include a nursery and café.

The 235-home Trafalgar Place, designed by dRMM Architects, is the first development on the site to be completed, and has been shortlisted for this year's Stirling Prize.

Elephant Park replaces the brutalist Heygate Estate, which was demolished in 2014.

May gives £18bn Hinkley Point C nuclear power station green light

An artist's impression of the approved Hinkley Point C plant

- **Critics say investment in renewables and energy efficiency would meet UK's needs more cheaply**

Prime Minister Theresa May has given the go-ahead to the £18bn Hinkley Point C nuclear power plant, after a six-week review.

May has been accused of backing down from security concerns about Chinese involvement in the plant, but she insisted the Somerset development was approved with 'significant new safeguards' to make sure China and other foreign investors could not own stakes in British nuclear plants without UK government approval.

Hinkley Point C will meet 7% of Britain's energy needs.

Ian Maclean, UK managing director for energy and industry at WSP Parsons Brinckerhoff, said: 'After years of delays, we can now look positively to the future, prepare our business and recruitment plans accordingly, and start filling the growing gap in our energy mix.'

Despite this step towards decarbonising the UK energy supply, Maclean said future energy sources should also include renewables, and gas-fired power stations as well as nuclear.

A report from the Energy and Climate Intelligence Unit (ECIU), said increasing investment in renewables and energy efficiency would meet the UK's future energy needs more cheaply than Hinkley Point C.

Its research concluded that the UK could cut its energy costs by £1bn a year and still maintain electricity capacity by growing 'demand response' measures, increasing investment in wind farms, and building new gas-fired power stations. The movement from centralised power generation to distributed networks, smart grids and increased renewable capacity undermined the economic argument for a new generation of nuclear power, it added.

The ECIU said Hinkley was 'not essential' and that the alternatives were 'tried and tested'.

In another report, energy consultant Utilitywise claimed it would be £12bn cheaper to invest in energy efficiency measures as an alternative to Hinkley, which it labelled an 'unnecessary expense'.

Bartle honoured to be named top apprentice

Morcambe-based Chris Bowker's Harry Bartle has won the 2016 ECA Edmundson Apprentice of the Year Award.

Bartle, aged 21, saw off fierce competition from three other finalists to be recognised as one of the top electrical and building services apprentices in the country. 'It's an absolute honour for me,' he said. 'The training and experience I have received from Chris Bowker has been first class and it's been a pleasure to represent the company.'

As well as the award, Bartle was presented with a cash prize and a toolkit, and will take part in a study tour, sponsored by Schneider, during which he will visit its facility in the French Alps.

He will also represent the Electrical Contractors' Association (ECA) as an ambassador in the coming months, helping to encourage young people to join the industry.

The three runners-up were: Luke Towers (Eaton Electrical); Joshua Lee (P & R Hurt Electrical and Mechanical Services); and Thomas Murray (Blackbourne Integrated M&E).

● To read about Troup Bywaters + Anders' apprenticeship scheme, see the Q&A on page 77

UK leads the way in EU energy cuts

The UK cut its energy use by more than 15% between 2000 and 2014, putting it ahead of all other EU member states apart from Greece, according to the European Commission's Joint Research Centre (JRC).

The EU as a whole cut energy consumption by 6.35% and has passed its interim energy efficiency target six years early.

The JRC report also revealed that EU members had cut energy use from 1,133 million tonnes of oil equivalent (mtoe) in 2000 to 1,061mtoe in 2014, putting it on track to exceed its 2020 target. The UK, which accounts for 12% of total EU consumption, cut its use by 15.3%, to 129.8mtoe.

Residential energy use in the UK was down by just under 10% during the period measured, and private industries achieved a 17.6% cut up to 2014. However, energy use continued to rise in transport and services, by 2.2% and 16.5% respectively.

Britain to follow US and China in ratifying Paris Agreement

Of the 180 nations that have signed the accord, only 26 have actually ratified it

Prime Minister Theresa May has promised to ratify the Paris Agreement on climate change by the end of the year.

The UK has been accused of putting environmental issues on the back burner as it deals with the political fallout from the 'Brexit' vote. However, May used her maiden speech at the United Nations in New York to say the UK remained determined to 'play our part in the international effort against climate change... the UK will start its domestic procedures to enable ratification of the Paris Agreement and complete these before the end of the year'.

US Secretary of State John Kerry signed the Paris Climate Accord at the United Nations General Assembly in April

To come into force, the Paris Agreement must be officially ratified by at least 55 countries, representing 55% of global carbon emissions.

So far, 180 nations have signed up to it, but only 24 – accounting for just over 1% of global emissions – had actually ratified it before China and the US did so ahead of last month's G20 Summit in Hangzhou.

France is the only major EU nation so far to have ratified the agreement, which was drawn up at last December's COP21 in Paris.

'History will judge today's effort as pivotal,' said President Barack Obama when the US and China – jointly responsible for 40% of the world's carbon emissions – ratified the accord. Signatories commit to keeping temperatures at less than 1.5°C above pre-industrial levels.

China will have to cut its carbon emissions by 60-65%, from 2005 levels, by 2030 and the US has committed to reducing its emissions by 26-28% below its 2005 levels by 2025.

Climate change committee is axed

The Energy and Climate Change (ECC) select committee is to be scrapped after the party conference season, with the Business, Innovation and Skills (BIS) department taking on the energy brief.

After the closure of the Department of Energy and Climate Change (DECC) – and the formation of the Department for Business, Energy and Industrial Strategy (BEIS) – the Solar Power Portal reports that official government documents show that the scrutiny committees will be changed to reflect the new landscape.

According to the House of Commons Future Business papers for the week beginning 10 October, the standing order relating to select committees will be amended to remove 'Innovation and Skills' from the BIS select committee and replace it with 'Energy and Industrial Strategy'. This will take effect on 17 October, when the ECC committee will be dissolved.

These changes also reflect the removal of climate change from a named government department, with the new BEIS committee presumably taking over scrutiny of this area in addition to the named briefs.

The ECC committee has been critical of the government's energy policy, after concluding that the UK will miss its 2020 renewable energy targets because of 'government failure to cooperate effectively across departments'.

It is not yet clear what will happen to the committee's ongoing inquiries, including investigations into the implications of the UK leaving the EU for climate change and energy policy.

Brexit to hit HVAC sales in 2016

Investment delays will wipe £95m off sales, says BSRIA

Brexit is hitting the growth of the HVAC and smart energy market in the UK, according to new research by BSRIA. It has forecast growth of 1.1% in the £4.5bn sector, compared with 3.1% before the EU referendum – representing a £95m loss in sales.

BSRIA said some markets were being harder hit than others, with air conditioning growth expected to fall from 12.8% to 5.5%, partly because of delays in construction investment decisions.

The Office for National Statistics (ONS), in an assessment of the UK's post-referendum economy, garnered further evidence that some projects are being put on hold. It revealed that there was a fall in output in the private commercial sector in July, which is a possible sign that companies are holding back on investments.

ALEKSANDAR TASEVSKI / SHUTTERSTOCK

However, although output growth for the construction sector overall was sluggish in July, the ONS said it was broadly in line with growth rates since the start of 2015.

ONS chief economist Joe Grice said: 'The referendum result appears, so far, not to have had a major effect on the UK economy.'

Brexit will have less impact on the growth of variable refrigerant flow (VRF) and central plant products, according to BSRIA. It said such products were linked more to larger projects close to completion, such as offices and hotels, new-build and refurbishment. Project delays resulting from Brexit would have a small effect in 2016, said BSRIA, but would impact on the market between 2017 and 2019. However, data points to a big growth in completed projects in 2017, which will mask any impact until 2018.

In the heating sector, BSRIA forecasted flat growth for 2016, pre-Brexit, but expects a 1.2% drop in the market as some consumers delay projects.

Nearly half of contractors think EU exit will be positive for business

Many building services contractors believe they will weather any economic fallout from the 'Brexit' vote successfully, according to a survey of members of the Electrical Contractors' Association (ECA), the Building Engineering Services Association (BESA) and SELECT, the Scottish electrical trade body.

Fewer than one in five (19%) respondents believe the UK leaving the European Union would have a negative impact on their business in five years' time, with 46% claiming it would have a 'positive impact' and 23% saying it would have no discernible impact.

The largest contractors (£20m turnover and above) are slightly less optimistic: 42% said they had a 'positive' outlook, while 29% believed Brexit would be 'negative' for business. While 18% of respondents said they were feeling 'very positive' about prospects for business, only 4% of the largest firms felt this way.

Smaller contractors (turnover below £200k) said 'more control of employment law' should be the top priority for the government as it negotiates the UK's exit from the EU. The very largest companies highlighted both access to the Single Market and negotiating non-EU trade deals as their main issues.

Most companies are not overly concerned about freedom of movement, with 92% saying they did not rely on EU migrant workers, and only 25% agree that Brexit will 'worsen the shortage of qualified workers'. BESA chief executive Paul McLaughlin said the survey 'clearly shows that many contractors are conditionally optimistic in the wake of the Brexit vote.'

However, BSRIA says freedom of movement of people and resources is a significant business factor for its members. It predicts a short-term downturn until Article 50 is implemented, and 'a general slowdown in investment until there are some clearly defined plans for trade tariffs'.

A catalyst for collaboration

Dorte Rich Jørgensen, sustainability manager, Atkins Global

If industry is to benefit from a Brexit deal, our sectors must collaborate. We have a great opportunity, as 38 professions – through the Royal Academy of Engineering – are advising the government on what the sector needs from Brexit. Our leaders must focus on common values, such as technical excellence, fairness and a more sustainable future. If we work together to ensure the best deal from Brexit, we can set a new standard of leadership for our industry and secure a more cohesive construction sector.

In brief

ELECTRICAL CONTRACTORS STILL BULLISH

Almost eight in 10 electrical and building services specialists saw their turnover increase or stay steady in the second quarter of 2016, according to the Electrical Contractors' Association (ECA).

Its research showed that firms remained confident in the face of the uncertainty caused by the UK's vote to leave the EU, with 82% expecting turnover to increase – or stay the same – in the third quarter of this year.

'Our business survey for Q2 indicates that electrical and building services firms have been doing more business, despite potential challenges in the wider economy,' said ECA chief executive Steve Bratt.

KEEPING COOL ON MARS

A team of scientists has designed a cooling system for spacecraft taking part in future missions to Mars. Researchers from the Indian Institute of Science (IISc) and Kisarazu College's National Institute of Technology, in Japan, have developed a technique that passes coolant gas through a porous wall to absorb the heat.

Spacecraft are expected to enter Mars' atmosphere at speeds of between 9,000mph and 20,000mph, creating severe aerodynamic heating. The coolant gas will form a film on the outer surface of the craft and then be left in its wake.

SUNNY TOWER UP

A 'solar-powered skyscraper' is to be built in Melbourne, Australia. Covered in PV cells and using energy-storage batteries, the 60-storey Sol Invictus Tower will be designed to store off-grid power for the residents of its 520 apartments. There will also be wind turbines on the roof, the windows will be double-glazed, and LED lighting will be fitted throughout. Construction on the project is expected to begin in two years' time.

Johnson and Tyco join forces

Johnson Controls and Tyco have merged to create one of the largest building controls businesses in the world.

The new company – named Johnson Controls International – includes building management systems and controls, fire, security and HVAC equipment, plus energy storage systems.

The combined business has a turnover of US$30bn and employs 117,000 people in 150 countries. It also claims to have one million customers.

Balfour brings back 'Kilpatrick'

Balfour Beatty has merged its engineering services and construction businesses to create Balfour Beatty Kilpatrick. The Kilpatrick name was dropped seven years ago, when the business merged with Haden Young to create Balfour Beatty Engineering Services.

The newly formed M&E business, led by managing director Simon Lafferty, will have a turnover of almost £300m and employ more than 2,000 people.

It is already scheduled to work on the proposed Hinkley Point C nuclear power station, the new Queen Elizabeth Class aircraft carriers project, Crossrail, Gatwick Airport, and the nuclear decommissioning project at Sellafield.

Breathing easy

Breathing Buildings has been included in *The Sunday Times*' Hiscox Tech Track 100, which ranks Britain's private technology companies with the fastest-growing sales over the past three years. It is compiled by Fast Track and published in the newspaper each September.

The company manufactures hybrid ventilation systems and, according to the league table, it increased annual sales by 52.25% to £7.8m.

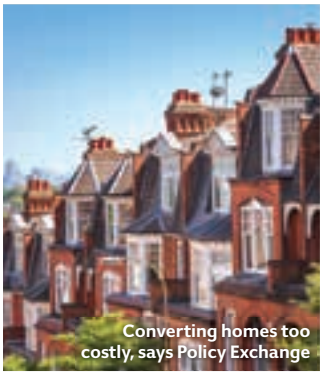
Also in the list was BBOXX – a manufacturer of solar-powered battery packs – which aims to provide reliable electricity to 20m people living off grid in the developing world by 2020.

Heat pumps costly and impractical, says think tank

Policy Exchange challenges government heating strategy

A leading think tank has called into question the government's Future of Heating strategy, which focuses on shifting homes to electric heat pumps. In its report *Too hot to handle? How to decarbonise the way we heat our homes*, Policy Exchange said the strategy looks expensive and difficult to achieve.

The centre-right think tank said heat pumps have high upfront and running costs because of the increasing gap between electricity and gas prices. It also warned that shifting 80% of homes to heat pumps would require an extra 105 gigawatts of peak generation capacity, plus about £40bn to upgrade the power network.



Converting homes too costly, says Policy Exchange

ZOLTAN GABOR / SHUTTERSTOCK

The report estimates that the strategy could cost around £300bn – or £12,000 per household. It suggested an alternative approach, which includes tightening standards for new-build homes, greater use of 'greener' gases and rolling out heat networks.

At last month's CIBSE Homes for the Future Group debate – hosted by Hoare Lea – Phil Jones, chair of the CIBSE CHP/District Heating Group, said: 'There is no single magic bullet – I see a mixed-energy economy with different solutions, part of which is CHP.'

However, Barny Evans, of WSP Parsons Brinckerhoff, called for an all-electric future for heating homes. As the National Grid is decarbonised, he said, generating electricity by burning gas in a CHP will become a higher-carbon alternative.

Huw Blackwell, of the London Borough of Islington, said CHP had a future with renewable fuels, and added: 'District heating is likely to be key to moving heat around, managing the thermal swings and the electrical supply and demand variations.'

Underfloor heating guidance

The NHBC Foundation has issued new guidance – *Underfloor heating: a guide for housebuilders* – in a bid to make sure the growing amount of underfloor heating is installed correctly. It includes advice on how to plan pipework distribution properly to maintain an even temperature across each room. The guidance also recommends that installation takes place after external windows and doors have been fitted – and once the home is watertight – to mitigate the risk of frost damage.

Neil Smith, head of research and innovation at NHBC, said the guidance was produced with the support of BSRIA and is 'aimed at helping smaller companies, in particular, to get things right and ensure that systems deliver all of their advantages in practice while avoiding potential problems'.

GETTING THE HOUSE IN ORDER

The Palace of Westminster risks 'crisis' and a 'catastrophic event' without a £4bn restoration, the Joint Committee on the Palace of Westminster has warned. It has recommended that MPs and peers vacate both Houses of Parliament for six years so urgent repairs can be carried out.

The committee, which CIBSE gave evidence to, found that complete and sudden failure of M&E services is a real possibility. This could be a devastating fire, extensive flooding, or a gas leak. Steam and electrical systems adjacent to each other present an unacceptably high risk to safety and of failure. See the report at **http://bit.ly/2cq6FO4**

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Andrew Marks has been appointed director of Cundall's Hong Kong office. He joins the company from CSA Building Services Consulting Engineers, where he was responsible for overseeing the technical team and deliverables in Southeast Asia.

With 16 years' experience of working in Asia Pacific and the UK as a chartered electrical engineer, Marks will work to expand the mechanical, electrical and public health, specialist lighting and sustainability services in the Hong Kong office.

Stan Smith has celebrated 50 years with the engineering services business of Interserve, the international support services and construction group.

Martin Trentham, head of national design at Interserve Engineering Services, said: 'Stan is a highly respected mechanical design engineer and a valued member of the team, known for his dedication and can-do attitude.'

Steve Richmond has been promoted to head of marketing and technical in Rehau's Building Solutions division, which includes district heating, renewable energy, underfloor heating, and cable management products

Richmond has many years' experience within the company and, in his new role, will help it become even more customer-focused, with the marketing and technical teams working closely together.

Night of Heritage Light triumphs at Darc Awards

- **SLL-organised event beats global opposition to carry off creative accolade**

The Night of Heritage Light (NoHL), organised by the Society of Light and Lighting (SLL), has been named the Best Creative Lighting Event at the Darc Awards 2016, on 15 September. It received 1,300 votes from international professional design agencies.

To celebrate the International Year of Light, the SLL lit nine Unesco World Heritage sites – including Fountains Abbey in Yorkshire, Blenheim Palace, the Tower of London and Ironbridge Gorge – on 1 October 2015. Each site was allocated a design team, led by a recognised lighting professional and SLL member. The event was also supported by more than 100 lighting professionals.

SLL past-president Liz Peck accepted the award on behalf of the society, accompanied by some members of the NoHL organisational team: Simon Fisher, SLL secretary Brendan Keely, and SLL coordinator Juliet Rennie. Rhiannon West and Dan Lister were unable to attend.

The Giant's Causeway

CREDIT: GARETH O'CATHAIN PHOTOGRAPHY

Jeff Shaw, president of the SLL, said: 'It is very exciting to receive an award that is given by our peers in the lighting industry, and a tremendous honour to be recognised by leading designers from around the world.

'The Night of Heritage Light represents all that is exciting and challenging in our industry, and it's tremendously inspiring to existing lighters – and those just joining the profession – to see what can be done. Lighting is an art as well as a science, and both these elements were on top form to bring this extraordinary event together.'

Supported by CIBSE, of which the SLL is a division, NoHL was up against similar installations around the world, including Lumiere 2016, Rome's Colosseum Light Messages, San Francisco City Hall Centennial Celebration and the Manchester Festival of Light and Sound Art.

The awards are organised by *mondo*arc* and *darc* magazines.

Homebuyers could cash in on energy efficiency with new-style mortgage

EU homebuyers could be offered better borrowing rates on mortgages in return for buying more energy-efficient homes, or committing to energy-saving works, under a project pioneered by a partnership of banks, property valuers, energy efficiency businesses and utility providers.

The European Energy Efficiency Mortgage initiative, led by the European Mortgage Federation – European Covered Bond Council (EMF-ECBC), aims to create a standardised 'energy efficient mortgage' based on preferential interest rates for energy efficient homes and/or funds for retrofitting homes at the time of purchase. Partners include the Ca' Foscari University of Venice, RICS, European Regional Network of Green Building Councils, E.ON, and research centre at SAFE Goethe University Frankfurt.

The proposed mortgage could be key to the EU meeting its energy saving target of 20% by 2020, and delivering on the Paris Agreement, which was reached at COP21 last December. It will explore the link between energy efficiency and borrowers' reduced probability of default and the increase in value of energy efficient properties. For banks and investors, this could lead to loans representing a lower risk on the balance sheet, and so qualifying for better capital treatment. It could also ensure that banks recognise energy efficient assets in their risk profiling, which could help the market to price-in the added value of energy efficient real estate.

James Drinkwater, Europe regional director, World Green Building Council, said: 'We need innovative ways of financing energy efficiency in Europe's homes if we are to stand any chance of meeting the [Paris Agreement] goal.'

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Graduates stake their claim to Vegas

Annual event celebrates young engineers

Eight young engineers have been shortlisted for this year's CIBSE ASHRAE Graduate of the Year Award, with its first prize of a trip to the ASHRAE Winter Conference in Las Vegas in January.

The finalists are: Samantha Carlsson, Cardiff University/Hoare Lea; Katie Ewing, University of Bath/Atkins; Richard Garthwaite, Royal School of Military Engineering; Antoni Sapina Grau, Brunel University/WSP Parsons Brinckerhoff; Monica Madrigal, Universidad Politécnica Madrid/Foster & Partners; Scott Mason, University of Northampton/Lochinvar; Farai Mwashita, Loughborough University/Hilson Moran; and Samima Saqib, Heriot-Watt University (Dubai).

They will each give a short presentation to the judging panel at IMechE's headquarters in London on 13 October, when the annual ASHRAE Presidential Lecture will also be given by the Society's president, Tim Wentz.

To book your place, visit **www.cibse.org/yea**

For more information about the graduate award nominees, see page 24

BUSINESS STOCK / SHUTTERSTOCK

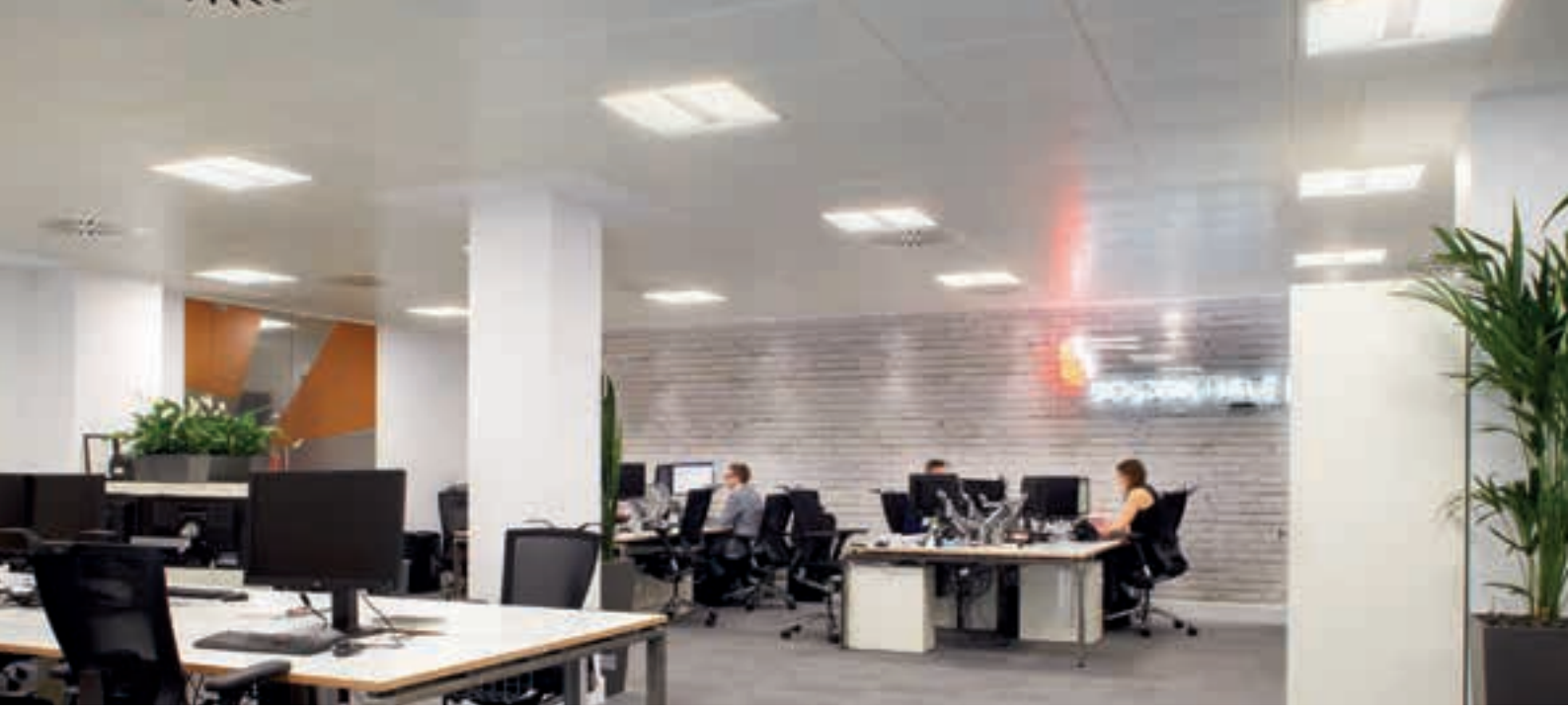
Solar-powered AC could cut energy use by half

The University of Nottingham and Shanghai Jiao Tong University, China, are working on a solar air conditioning system that they claim could cut electricity consumption by up to 50% compared with conventional vapour compression (VC) systems.

Their work is supported by the Royal Society and involves the use of a sorption thermal battery for temperature and humidity independent control (THIC), powered by solar energy. It will allow conditioned air temperature and humidity to be controlled independently, and its thermal battery combines heat and cold energy storage in one unit.

Dr Jie Zhu, from Nottingham's Department of Architecture and Built Environment, said a VC cooling system adopts a condensation dehumidification method to handle both sensible and latent heat loads.

'This means the system has to operate under lower evaporation temperatures, resulting in lower cooling capacity, lower coefficient of performance (CoP) and sometimes a reheating process is required to meet supply air requirements. We are proposing a temperature and humidity independent control technology to solve this problem. This system can save 25-50% electrical consumption and CoP improvements of about 40-60%.'



RIDI ARKTIK leads the way with more light from fewer luminaires.

ARKTIK offers a diffuse and subtle light source, with none of the normal harshness expected of LED luminaires designed for commercial spaces.

Inspired by the energy-enhancing and stimulating light found in the Arctic regions, ARKTIK emits a quality of light that increases alertness, well-being and productivity for all those who work beneath it.

The multiprismatic central diffuser and frosted wings establish shadow-free, even light distribution. A choice of warm or cool light maximises visual comfort for the end user.

With ARKTIK, fewer luminaires mean lower costs.

Careful design gives greater output from fewer LEDs. This translates to wider coverage which, in turn, means fewer luminaires and less cost.

Add in the rated component life of up to 50,000 hours and the potential savings are obvious.

Smart systems show the way to even greater savings.

ARKTIK is compatible with RIDI's highly efficient, IP-based control system. This can be controlled from your smart phone and autonomously monitors ambient light and occupancy levels.

5-star service

Our experienced Technical Advisors will guide you at every stage of your project, optimising the performance of your system to suit your needs. They'll show you how ARKTIK can deliver a better quality of light at the same time as lower costs.

Featured is the PSQ version of **ARKTIK**.
This is one of 4 versions available – see website.

RIDI

5-star service
German engineering
No extra cost

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Façade contest open for entries

The Society of Façade Engineering's international competition, FAÇADE2016, is designed to recognise, reward and promote excellence in façade design, engineering and application.

Entries are welcomed from individuals, companies and project teams, for any contract completed between 31 December 2014 and 31 December 2015 that has not previously been entered.

There are three awards for Façade of the Year in 2016 in the categories New Build, Refurbishment and Innovation.

The winners will be announced to an audience of leading architects and building engineers at the Glass Supper, on 1 December at Gibson Hall in the City of London. For more information and to enter, visit **www.cibse.org/sfe**

2015 winner Bombay Sapphire Distillery

New chair of ILEVE urges members to raise its profile

Growing Institute must demonstrate how a better qualified industry can create a healthier society

Jane Bastow has been sworn in as the new chair of the Institute of Local Exhaust Ventilation Engineers (ILEVE), the first woman to hold the post.

A ventilation engineer with more than 30 years' experience, Bastow is managing director of P&J Dust Extraction, and a founder member of ILEVE, having served as vice-chair of its steering committee for more than four years.

Addressing the AGM in her first engagement as chair, Bastow stressed that there is an enormous amount to be done to raise local exhaust ventilation as a public health issue. Noting the alarming number of health problems in the UK caused by poor ventilation in the workplace, she set out key areas that the industry must work on to increase its effectiveness and save lives. These include a clearer career path for engineers, better cooperation with other engineering fields and a higher profile for the ventilation industry.

Bastow (left) said: 'More than 150 bus-loads of people in this country die every year from industrial diseases. It is in our power to make a lasting dent in those numbers. By working with other institutions and professions, we can spread the message about the importance of proper ventilation as a critical health and safety issue.

'We have a growing Institute, packed with the most talented professionals in their fields. What we need to do now is to demonstrate that expertise, and show people how a better qualified ventilation industry creates a healthier society.'

President blogs about user feedback

The latest entry in the President's Blog covers occupant feedback, and how this can be used to improve the performance and design of buildings, as well as user satisfaction.

And don't forget to listen to the CIBSE #Build2Perform podcasts. In the most recent entry, building information modelling (BIM) consultant Carl Collins talks about the past, present and future of BIM, and there are details from a recent CIBSE West Midlands briefing on 'BIM in Action'.

Read the President's blog and listen to the podcasts at **www.cibseblog.co.uk**

Innovative employers in running for CIBSE award

- **Firms go head-to-head for large, medium and small employer categories**

Six companies have made the shortlist for the 2016 CIBSE Employer of the Year Award.

Atkins, Hoare Lea, TUV SUD Wallace Whittle, Max Fordham, Method and QODA Consulting have been recognised for their commitment to supporting young engineers.

The winners of the awards – for large, medium and small employers – plus an overall champion, will be announced at the CIBSE Young Engineers Awards at the Institution of Mechanical Engineers (IMechE) on 13 October.

Tim Dwyer, chair of the CIBSE ASHRAE Group and the judging panel, said: 'It is heartening to see firms of all sizes continuing to invest in young engineering talent, and the calibre of graduate engineers on show at our awards remains consistently high. We hope these young engineers and innovative employers will act as an inspiration to the sector.'

Double take: Services Design Solution (SDS) won in the small category, and were also the overall winners in 2015

The Employer of the Year awards recognise employers that have shown excellence and innovation in developing the engineers of the future. Together with the Graduate of the Year award, they form part of the CIBSE Young Engineers' Awards, and are supported by engineering institutions, CIBSE, ASHRAE and the IMechE.

Sponsored by Andrews Water Heaters, Ruskin Air Management and Waterloo Air Products, the awards are also supported by the CIBSE Patrons.

Seek out SoPHE for resilient buildings

In a world facing the problem of increasingly scarce resources, the Society of Public Health Engineers (SoPHE) is perfectly positioned to help resolve water and energy related challenges.

The design of sustainable water management systems helps save water and the energy associated with its use. From pumping and heating to sustainable drainage systems (SuDS) and water reuse, SoPHE's expertise in public health engineering helps clients to make their buildings more resilient.

The Society aims to raise the profile of public health engineers within CIBSE and the building services industry. It promotes best practice to other professional disciplines and the public, and offers a route to professional recognition for its members.

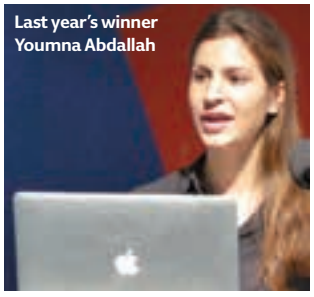
Regular technical meetings and networking opportunities are organised, and there is a growing young engineers group. Membership also offers unlimited and free access to CIBSE published guidance. For more information and to join SoPHE, go to **www.cibse.org/Society-of-Public-Health-Engineers-SoPHE**

Contenders for SLL Young Lighter named

The shortlist for the 2016 Young Lighter of the Year award has been announced.

Seven entries have made it to the second stage of the competition. They are: **Aisha Robinson**, *A visible light communication scheme for use in accent lighting*; **Aliz Sanduj**, *Chaotic order, ordered chaos*; **Cashel Brown**, *Lighting festivals and their role in urban economies and design*; **Eleonora Brembilla**, *Applicability of climate-based daylight modelling*; **James Duff**, *A journey towards change*; **Rebecca Hodge**, *Human-centric lighting*; and **Sofia Tolia**, *Variable lighting levels for highways – a different approach*. View their video blogs at **www.cibse.org.uk/sll**

The shortlisted entrants submit a written paper in early September, from which four finalists will be chosen to give a 15-minute presentation at LuxLive 2016, in November. A judging panel will announce the winner at the event. All the finalists receive a cash prize, plus a year's free membership of the Society of Light and Lighting.



Last year's winner Youmna Abdallah

BIM Roadshows aim to demystify digital tech

Despite the government requirement for the use of BIM Level 2 on its contracts, many firms working across the construction supply chain still lack understanding of building information modelling (BIM), competence in the processes, and knowledge of its application to their business structures and processes.

CIBSE's BIM Roadshows, being held across the UK and Ireland, are designed to address these requirements and to help delegates identify the shortfalls in their knowledge and skills, as well as plan how to incorporate and implement BIM in their business.

Presenters will use a project case study to demonstrate the real-world application of digital technologies and workflows, from pre-concept to completion.

CIBSE members can book their place at a 30% discounted rate. To discover more and to find a BIM Roadshow event near you, visit **www.cibse.org/BIMRoadshow**

To complement the BIM Roadshows, CIBSE has published the first chapter in its new Digital Engineering Series: DE1 Pre-Qualifications Questionnaires (PQQ).

It is also offering a free PQQ template for those who generate, complete or review PQQs using PAS 91:2013.

To download your copy and find out more information, visit **www.cibse.org/DES**

SLL announces Masterclasses on 'human responses to light'

LIGHTING DESIGN BY SUTTON VANE ASSOCIATES

Experts from the Society of Light and Lighting will tour the UK and Ireland from October to May 2017 as part of the Lighting Knowledge Series

The Society of Light and Lighting Masterclasses aim to deliver the latest information on important topics. Currently, there is a wealth of new research relating to human responses to light, with particular reference to LED lighting solutions, as well as circadian rhythms and light in relation to health and wellbeing.

In the new Masterclass series, the Society aims to deliver a full day of presentations, covering a variety of topics including physical, psychological, emotional, visual and cultural responses to light. Each presentation will be peer reviewed and based on the latest information and case studies. They will cover areas such as potential benefits of dynamic lighting on circadian rhythms; and the latest research into the effects of shift work on performance, safety and prevention of fatigue.

There will be case studies, which focus on the control and application of light within cultural spaces such as art galleries, also touching on accurate colour portrayal, location-based information services and conservation management to ensure a positive visitor experience.

Exterior lighting case studies will relate to the effects of outdoor lighting technologies on their surrounding environments and wildlife. Additionally, the perceived versus the measured effects of sky glow will be discussed.

The speakers will be looking at how lighting may affect the customer experience within a retail environment, along with studies into the effects of lighting within healthcare, among a number of other topics.

During his inaugural address, SLL President Jeff Shaw outlined the Society's role in relation to lighting education and being at the forefront of topical issues and research. The aim of the Masterclasses is to present new information to delegates, putting them ahead of others within their industry.

The Masterclasses will be touring the UK and will visit seven locations from October 2016 to May 2017 including, Dublin, Leeds, Birmingham, Manchester, Bristol, Glasgow and finally London.

Speakers will include Helen Loomes (Trilux), Chris Wilkes (Holophane), Roger Sexton (Xicato) and Iain Macrae (Thorn). Guest speakers for each Masterclass will be announced shortly. This series will also see the continuation of Lighter's Question Time, giving delegates the chance to interact with the speakers on current issues within the industry.

The Masterclass is a must-attend event for all those wanting to be informed and updated on lighting technology and application, offering an opportunity to stay ahead of the game while gaining valuable CPD hours.

The Society of Light and Lighting Masterclasses were introduced in 2004 in response to the demand for lighting knowledge regionally in the UK. Each series comprises seven one-day seminars, plus a shortened schedule held at the LuxLive exhibition every November.

For more information visit **www.cibse.org/SLL**

Dates

20 October 2016	Dublin
30 November 2016	Leeds
26 January 2017	Birmingham
23 February 2017	Manchester
30 March 2017	Bristol
27 April 2017	Glasgow
18 May 2017	London

Speakers

Iain Macrae FSLL, head of global lighting applications management, Thorn Lighting, has more than 22 years of design and technical experience at Thorn. He and his team offer customers product application advice and he tutors in the Thorn Academy of Light. He is a director of ICEL and past president of the SLL.

Roger Sexton MSLL, vice-president specifier service, Xicato, worked for Philips Lighting for 20 years mostly in the field of new product explorations. In 2008 he joined intelligent LED module manufacturer Xicato, where he works in a global product specification development and lighting designer support role.

Helen Loomes FSLL, business development director, Trilux, has more than 30 years' experience in lighting. Since her early years in a photometric laboratory, she has worked in a number of different sales and marketing roles at various architectural lighting firms. She now works with an international focus for Trilux Lighting as business development director.

Chris Wilkes MSLL, technical manager, Holophane, is a physics graduate. He has been in the lighting industry for 14 years working predominately in technical development and testing of luminaires; he currently manages the optical, photometric, and laboratory side of the business. He has contributed to the recent updated publication of LG6, and sits on the LIA LEDAC and ICEL committees.

Luceco product installation guide:

1. **Fit**
2. **Forget**

Luceco Platinum Downlights available with gloss or matt reflectors and a range of 10 bezels. Offering zero maintenance and over 60% energy & CO_2 savings; Luceco LED luminaires are the perfect cost saving replacement versus fluorescent.

50,000 HOURS | 5 year extended WARRANTY | 1 year on site WARRANTY | LED

Long life LED luminaires

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WHAT NEW REGULATIONS MEAN FOR BROADBAND AND SECURITY

New Building Regulations came into force in England last October covering security in new dwellings, while new provisions for broadband delivery will take effect in January 2017. **Hywel Davies** looks at the implications

A new Approved Document covering security of windows and doors came into force on 1 October 2015 – part of the coalition government's review of the Building Regulations and standards relevant to housebuilding. Existing projects, and those already approved, enjoyed a transitional period during which they did not have to meet the new requirements. With this period ending on 1 October 2016, those involved in specification of homes – including flats and apartments – will need to ensure that their designs satisfy the new requirements.

Part Q of Schedule 1 of the Building Regulations, Security, addresses unauthorised access to new dwellings. The specific requirement is set out in requirement Q1, which states reasonable provision must be made to resist unauthorised access to either (a) any dwelling; or (b) any part of a building from which access can be gained to a flat within the building.

The guidance in the Approved Document goes on to explain the functional requirements and relevant technical standards relating to windows and doors. It is worth reminding readers that the requirement, Q1, is what must be achieved. Guidance in an Approved Document sets out ways of complying that 'in the opinion of the Secretary of State' satisfy the functional requirement. However, alternative solutions that can be shown to satisfy the requirement are also acceptable. The key test here is to satisfy the Building Control Officer.

Readers who are working on residential schemes will want to be familiar with the details of AD Q.

Another aspect of the review of Building Regulations is the introduction of new provisions for broadband in homes. This is covered by the snappily titled 'Approved Document R – Physical infrastructure for high speed electronic communications networks'.

ALPHASPIRIT / SHUTTERSTOCK

> This might prove to be one requirement stimulated by the EU that should not be lost as we leave

This has been introduced in response to Article 8 of the 2014 Broadband Cost Reduction Directive, which sets specific infrastructure requirements aiming to reduce the cost of extending superfast broadband provision across the European Union.

Article 8 requires that all new buildings, and major renovations, have the necessary in-building physical infrastructure to enable them to be connected to superfast broadband. This infrastructure must also be technologically neutral to maintain effective competition.

Following a consultation, the government concluded that the introduction of Part R and the associated Approved Document is the most appropriate way to implement the requirements of the Directive in England.

Part R requirement R1 states that 'building work must be carried out so as to ensure that the building is equipped with a high-speed-ready in-building physical infrastructure, up to a network termination point for high-speed electronic communications networks.' It also requires that 'where the work concerns a building containing more than one dwelling, the work must be carried out so as to ensure that the building is equipped in addition with a common access point for high-speed electronic communications networks.'

This is now one of many pieces of legislation that have been adopted in response to EU Directives. However, it is worth noting that the Building Regulations are made under powers contained in the Building Act, 1984, and not under the 1972 European Communities Act. Part R is therefore enshrined in UK law.

It is a good example of legislation that originally met an EU requirement, but makes a provision that is beneficial to the vast majority. If all those building new dwellings had been making the required provision, then there would not have been a Directive or a new Regulation. The fact that it was needed shows that the market was not meeting this customer demand, making regulation essential. This might prove to be one requirement stimulated by the EU that should not be lost as we leave.

It is notable that former O_2 CEO Ronan Dunne, now heading Verizon in the US, said in his first interview since taking the new job that the UK faces a real risk of being left behind in the provision of the infrastructure for smart technologies.

While he was referring primarily to the provision of 5G networks, his is not the only voice calling for more action to deliver superfast broadband in England and the wider UK. If we have serious aspirations to develop 'smart cities', then this is a major issue for us to address.

Secure homes with good broadband access are important to all of us today and, for those members who design homes for others, they should also be a priority design consideration.

- AD Q can be found online at **http://bit.ly/2cCJGAB**
- AD R can be found online at **http://bit.ly/2covjDV**

● **HYWEL DAVIES** is technical director at CIBSE **www.cibse.org**

Feedback

A reader ponders the job title 'engineer', and CIBSE LinkedIn Group asks if it's better to tighten up the model or to manage expectations

Coming to terms

I frequently read comments on your opinion pages about the use of the term 'engineer' (Feedback, *CIBSE Journal*, September 2016, page 16).

I don't think we can swim upstream; children are going to school and learning in centigrade and kilograms and, in adulthood, reverting back to Fahrenheit and stone, so regulating the word 'engineer' – no chance!

Personally, I have no problem with the term; if someone asks me what I do, I say 'consulting engineer' and that is pretty well understood. If you are not a consultant, prefixes such as 'professional', 'chartered', 'incorporated', 'structural' and so on seem to work in conveying the meaning.

Geoff Carter, MCIBSE

CIBSE LinkedIn Group talk models

Nicholas Darling

Greater clarity on modelling input data and the sharing of information on projects would assist in the industry identifying the best way forward in addressing the performance gap.

RAWPIXEL.COM / SHUTTERSTOCK

Barriers to sharing data need to be lowered

Simon Owen

It's a shame that there is a commercial boundary between companies that can make it hard to share best practice at risk of losing a technical advantage.

Nicholas Darling

True, but when companies are working on the same project, the commercial boundary for sharing modelling input data should not exist because of intellectual property, as both parties are trying to deliver for the end client.

Ken Dooley

Standard design assumptions versus how a building will be used are very different things. Models typically assume general occupancy rates, such as: 'The building will be occupied from 0800-1800 at 66% occupancy.' Standard design assumptions are important when comparing two buildings from a benchmarking point of view. But it shouldn't be assumed that these will happen. If the building is speculative, an occupant-focused model should be done when the occupant is known.

> Personally, I have no problem with the term – if someone asks me what I do, I say 'consulting engineer'

Dan Widdon

Developer clients need technical expertise they value in-house to do three essential things: make timely and detailed appointments of project team members; require soft landings-type seasonal commissioning of building services; require the production of a dual-purpose building user guide and effective handover at each surrender of the premises to the client/tenant.

Barriers to commercial collaboration go deeper than superficial manipulation of model inputs and algorithms. To manage expectations as part of a strategy to close the performance gap, responsibility for the above lies with the property developer client.

CIBSE Journal welcomes readers' letters, opinions, news stories, events listings, and proposals for articles.
Please send all material for possible publication to: editor@cibsejournal.com or write to: Alex Smith, editor, *CIBSE Journal*, CPL, 1 Cambridge Technopark, Newmarket Road, Cambridge CB5 8PB, UK. We reserve the right to edit all letters.

YOUNG ENGINEERS AIM FOR JACKPOT

The CIBSE ASHRAE Graduate of the Year will be flown to Las Vegas to attend the 2017 ASHRAE Winter Meeting. **Ewen Rose** presents the talented young engineers who are candidates for the prize

Some of the world's biggest sustainable urban projects await the winner of the 2016 CIBSE ASHRAE Graduate of the Year award when he or she attends the winter ASHRAE Conference in Las Vegas next year.

The resort city may feature some of the brashest architecture in America, but – thanks to generous tax breaks from the state of Nevada – it has enjoyed a sharp rise in the number of sustainable buildings.

Hotel operators such as MGM Resorts International and Las Vegas Sands Corp are turning the desert city green as they pursue Leed certification in a new generation of mega-resorts, including MGM's CityCenter, and the Venetian, Palazzo and Sands Expo development.

One of eight young engineers will be in the running to visit Las Vegas and the ASHRAE Conference when they make their award presentations to an industry audience at the Institution of Mechanical Engineers (IMechE) headquarters in London on 13 October.

The theme this year is how digital technology is changing the industry, and the title of the presentation is: *Computers and digital technologies are transforming the way engineers work. What impact do you think this is having on innovation, professionalism, and traditional engineering skills?* The winner will be judged on the content of their talk and their delivery of it.

As well as the winner's trip to the ASHRAE Winter Meeting, cash bursaries from the Rumford Club will be given to two runners-up, while the Manly Trust will present cheques of £100 to the other finalists.

Under the banner of the CIBSE Young Engineer Awards, the CIBSE ASHRAE Graduate of the Year – now in its 21st year – takes place alongside the CIBSE Employer of the Year award, which has been running for eight years. See page 17 for shortlist.

CIBSE, ASHRAE and IMechE support the CIBSE Young Engineers' Awards 2016, which are sponsored by Andrews Water Heaters, Ruskin Air Management and Waterloo Air Products. The awards also receive support from the CIBSE Patrons.

Visit **www.cibse.org/yea** for more information and to book. **CJ**

CIBSE ASHRAE Graduate of the Year shortlist

Samantha Carlsson

Cardiff University/ Hoare Lea

A graduate sustainability consultant at Hoare Lea, Sam has an MSc in sustainable energy and the environment. She is a Breeam Domestic Refurbishment assessor and has written firm-wide technical SAP procedures. Her focus has been on new-build residential projects, Breeam assessments, and energy and sustainability strategies for planning applications.

More recently, Sam has broadened her knowledge in health and wellbeing in commercial buildings and the home. Her multidisciplinary background provides her with a holistic outlook to infusing sustainability measures into all projects.

Born in South Africa, Sam grew up in the Middle East before settling in the UK.

Katie Ewing

University of Bath and Atkins

Katie graduated with a Master's degree in mechanical engineering with German. During her degree, she completed a year-long placement with Centrax Gas Turbines, providing technical German translations and on-site interpretations in Germany.

She joined Atkins in 2014 as a graduate building services engineer and, recently, was bid manager for Atkins' competition entry to illuminate 17 bridges on the River Thames.

A STEM ambassador, Katie helped to organise a webinar explaining how girls think differently and how teaching can be tailored to engage them in STEM activities.

She has recently become RACE2 coordinator for Atkins in London and the South East. This is an Atkins initiative encouraging offices to improve their energy consumption, water and material use, and STEM and community outreach initiatives.

Richard Garthwaite

University of Durham/Royal School of Military Engineering

Having gained a degree in physics in 2004, Richard joined the British Army as an officer in the Royal Engineers and was deployed to Iraq and Afghanistan.

In June 2014, he started an MSc in military construction engineering (mechanical and electrical) and was seconded to civilian industry, spending eight months working for Carillion at Battersea Power Station Phase One as a building services manager.

Richard then spent seven months working as a consultant mechanical engineer for Bryden Wood, where his main responsibility was the replacement of a steam system at the London School of Hygiene & Tropical Medicine. He passed his MSc in July 2016 and is returning to the army to provide engineer support to the Royal Air Force.

Scott Mason

University of Northampton/ Lochinvar

Scott started at Lochinvar as a technical support apprentice in 2009, having left school at 17. The company sponsored him through a three-year advanced apprenticeship, then put him forward for a Higher National Certificate in engineering, and then a Higher National Diploma – which eventually led to Scott taking a degree in mechanical engineering.

He was recently appointed Lochinvar's UK senior technical sales engineer for integrated renewable solutions. This post is key to the firm's strategy for promoting solutions that integrate renewable technologies with traditional heating and hot water products.

Farai Mwashita

Loughborough University/Hilson Moran

Farai joined Hilson Moran's graduate programme and has since completed a Master's in low energy building services engineering. She was promoted to mechanical design engineer in one of the firm's multidisciplinary teams and is now contributing to some of the most prestigious and challenging projects in the business.

Farai is working towards her chartered engineer registration via the IMechE, but also finds time to be a STEM Ambassador; regularly visiting schools and colleges to promote building services engineering as a potential career to the next generation.

Antoni J Sapina Grau

Brunel WSP Parsons Brinckerhoff

Antoni joined WSP Parsons Brinckerhoff as a graduate engineer, having obtained an MSc in building services engineering with sustainable energy. He gained building services experience by working in Spain, Mexico and the UK before joining WSP/PB. He qualified as a Breeam Associate, Low Carbon Consultant and LCIBSE, and was also part of the team that won this year's Teambuild Construction Competition UK.

Antoni designs the services for major commercial developments and critical banking facilities. He also organises CPD training for WSP/PB's building services engineering department in the South East and is part of the Mechanical Forum Team.

Samima Saqib

Heriot Watt (Dubai)

Samima recently completed her BEng in architectural engineering with first-class honours. As a student, Samima took part in international competitions and internships with international companies. She entered the Solar Decathlon Europe 2014 and was awarded a Token of Appreciation by the British University for organising an Eco-House Development Workshop. She is project manager for the Heriot Watt team participated in the Solar Decathlon Middle East 2018.

Samima's final-year research on sand mitigation in natural ventilation systems looked at improving indoor air quality for building occupants in the Middle East and making spaces comfortable. She is also a student member of ASHRAE Falcon Chapter.

Monica Mondelo Madrigal

Universidad Politecnica Madrid/ Foster + Partners

Monica secured a Master's degree in building engineering at the Universidad Politecnica of Madrid; and a degree in architecture technology and construction management at KEA Copenhagen School of Design and Technology.

She has been working in the environmental engineering team at Foster + Partners for the last 17 months, initially as a BIM technician – working up to a lead coordination role – before moving on to work as a mechanical engineer.

She is interested in mechanical engineering, sustainable design, and BIM. She is working towards becoming a chartered engineer through CIBSE and earning Leed AP status.

XXXXXXXXXXXXXX / SHUTTERSTOCK

BUILDING ON THE PAST

From the miners' strikes and oil crises of the 1970s, to the 'boom and bust' of the 1980s and technological advances in the 2000s, the UK's industrial landscape has evolved radically over the past four decades. **Liza Young** asks former CIBSE presidents how building services has changed since the Institution began in 1976

This year marks the 40th anniversary of the creation of CIBSE, when the Institution of Heating and Ventilating Engineers (IHVE) amalgamated with the Illuminating Engineering Society.

As now, one of the most pressing issues facing the new institution was the UK's relationship with Europe. However, unlike today, the debate was around the challenges and opportunities of Britain's closer ties with Europe – 'Brenter' rather than Brexit – following the 1975 referendum decision to remain in the European Economic Community.

In his 1976 presidential address, Alec Loten, IHVE President, spoke of the standardisation of construction benchmarks across Europe, and of the benefits of working with engineers from overseas. He said: 'In many ways, we can learn from the expertise, knowledge and work of foreign engineers and... we should do so readily, without shame and to our ultimate

RULES BRITANNIA

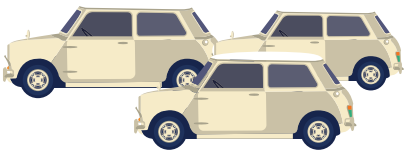
A selection of regulations introduced in the UK from 1976 to 2016

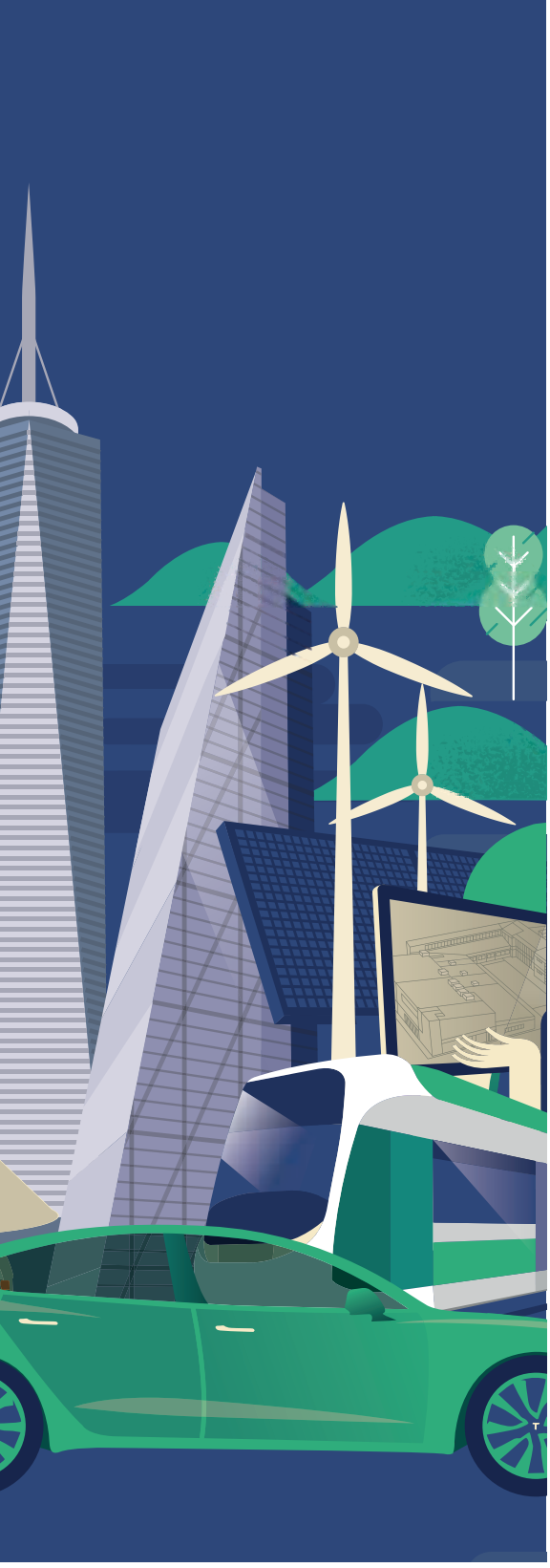
70s & 80s

- 1976 Energy Act
- 1978 Nuclear Safeguards and Electricity (Finance) Act and Energy Conservation Demonstration Projects Scheme
- 1981 Energy Conservation Act
- 1983 Asbestos (Licensing) Regulations
- 1984 Building Act incl functional performance standards (Approved Documents)
- 1985 Initial Approved Docs to Building Regs, Rio Earth Convention – Article 21
- 1987 Montreal Protocol – banned chlorofluorocarbons in aerosols and fridges
- 1987 Brundtland report *Our common future*
- 1988 Control of Substances Hazardous to Health (COSHH) Regulations
- 1989 Noise at Work Regulations
- 1989 Electricity at Work Regulations

90s & 00s

- 1992 Earth Summit in Rio (Agenda 21)
- 1992 Workplace (Health, Safety and Welfare) Regulations – suite of regulations
- 1994 Construction (Design and Management) Regulations 1
- 1995 Sizewell B nuclear power station goes critical
- 1996 Construction (Health, Safety and Welfare) Regulations
- 1997 Kyoto Protocol (came into effect in 2005)
- 1998 Gas Safety (Installation and Use) Regulations
- 2000 UK Emissions Trading Scheme (until 2006)
- 2002 Building Regulations update (Part L Domestic and Non-Domestic)
- 2003 EPBD adopted
- 2003 Building (Scotland) Act
- 2006 Climate Change and Sustainable Energy Act
- 2006 Building Regulations major update – SBEM and SAP inclusion





2006 F-Gas Regulation 22
2006 Code for Sustainable Homes
2007 Construction (Design and Management) Regulations 2007 version
2008 UK Climate Change Act (put Kyoto agreement into law – 80% reduction in CO_2 by 2050 compared with 1990)
2009 UK Low Carbon Transition Plan
2010 Building Regulations update
2011 Energy Act, basis for Minimum Energy Efficiency Standards
2012 SAP
2013 Green Deal
2013 Building Regulations update (England)
2014 Building Regulations update (Wales)
2015 Building Regulations update (Scotland)
2015 Paris COP 21 Agreement
2016 Fifth Carbon Budget 2028-2032 adopted

advantage.' How times have changed.

Britain in 1976 was a time of miners' strikes, oil shortages and severe drought. Punk – not Bieber – was in the music charts, and *Charlie's Angels* graced the TV screens. Despite the huge social, economic and environmental shifts since, some things haven't changed. Hinkley Point B came online four decades ago and, last month, Prime Minister Theresa May announced its replacement – Hinkley Point C.

Although nuclear power had been established by the 1970s, the UK still relied on oil and coal as its main fuel sources, followed later by gas after the discoveries in the North Sea (see fuel mix graph on page 29).

In 1976, the current CIBSE President, John Field, was designing the nuclear power reactor for Sizewell B, which was only connected to the grid 20 years later. 'The nuclear industry was not looking very promising, and that's part of the reason I left to work in renewables,' says Field. 'The main problem at the time was scarcity of supply, in terms of fuel, and where it was going to come from.'

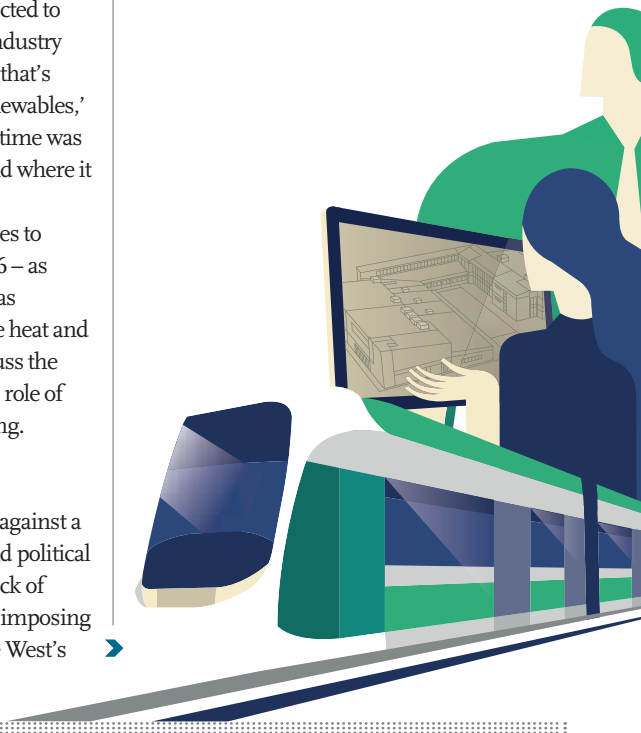
This feature will explore the changes to the UK's energy landscape since 1976 – as coal and oil gave way to gas – as well as developments to the way in which we heat and power our buildings. It will also discuss the socio-economic factors that led to the role of the building services engineer evolving.

Uncertain times

In the 1970s, Loten's words were set against a backdrop of significant economic and political changes in the UK. The oil-price shock of 1973 – caused by Arab oil producers imposing an embargo as a punishment for the West's

BY D.MEYER CC-BY-SA-3.0

Tim Dwyer says the TI-30, with an LED display, was the 'real beast' of the time, which was craved by all



Technology in 1976

***CIBSE Journal* technical editor, Tim Dwyer, reflects on technology in 1976:**

The kit of the 'advanced tech' 1976 building services design consultant was based around the mini-computer – probably operated by an enthusiastic CIBSE member in a cupboard fitted with a simple wall-mounted fan to help maintain a moderately reasonable room temperature.

Geeky early adopters, confined to the often unpleasantly warm computer room – or connected through a very limited, and probably proprietary, network – used dedicated terminals. Text-based, green-screened cathode ray tube interfaces, with expensive purpose-made keyboards or punch cards, fed information into calculation software packages such as ENDSOP in coding languages such as Fortran.

Modelling was still a physical art, confined to architects' offices and research centres keen to explore practical fluid dynamics. Output was printed on dot-matrix printers, with the gifted users able to coax technical symbols and crude 'graphics' from the clattering devices. The mouse was confined to the few pioneering users of the Xerox Alto computer, while the 'Arpanet' was limited to specialist users – and the now universal @ sign was a wasted typewriter key to most engineers. The 'personal computer' was just appearing as the microprocessor became a mass-market commodity, and the first commercially successful operating system for microcomputers, CP/M, also appeared, soon to be eclipsed by Microsoft's MS-DOS. It was also in 1976 that the Apple computer was born .

support of Israel in the Yom Kippur war against Egypt – and subsequent coal miners' strikes in 1974, led to blackouts across Britain.

To conserve electricity, the Conservative government introduced a three-day week from 1 January until 7 March 1974, during which commercial users of electricity were limited to three specified consecutive days' consumption each week. 'There was a high degree of uncertainty about what the future held – not just for the construction industry, but for society as a whole,' says Doug Oughton, who was an engineer at Oscar Faber & Partners (now Aecom).

'The three-day working week threw a spotlight on energy consumption and use.

'At that time, it became quite a resonant feature in our approach to design and operation of buildings. It probably also started the coming together of architects and building services engineers, who were beginning to think of buildings as an entity, and combined their designs so they could perform in terms of comfort and energy use.'

Ant Wilson, who was working on a water interceptor on the River Avon in 1976, agrees: 'In parallel with today, one of our biggest concerns was security of supply and making sure the power didn't go out.'

After the so-called 'winter of discontent' in 1978-79, the then Prime Minister Margaret Thatcher took on the mining unions. This – plus the deregulation of the energy industry and discovery of gas in the North Sea – brought an end to the widespread blackouts that had plagued Britain.

Water conservation was also high on the agenda in the 1970s, because – in the summer

Progress in lighting

Global application lead at Philips Lighting, Mike Simpson, explains the developments in lighting over the past 40 years:

When I joined the lighting profession, the Illuminating Engineering Society was merging with IHVE to form CIBSE, and the role of the independent lighting designer hardly existed.

The 1974 energy crisis focused minds on creating low-energy light sources and, in 1979, the first compact fluorescent lamp emerged to replace the tungsten one. However, it would take another 30 years – and changes in legislation – for it to become the lamp of choice. Throughout the 80s and 90s, new light sources would shave small percentages off energy use. However, the big step forward came in the 2000s, with the introduction of the LED, which has revolutionised lighting.

With the current focus on climate change, lighting can make a big contribution to reducing emissions and, with low-power LED, we can bring electric light to those who have had to rely on kerosene lamps.

The lighting designer is now a recognised professional and part of many design teams.

of 1976 – Britain experienced an extreme heatwave and severe drought. Heathrow recorded 16 consecutive days – from 23 June to 8 July – when the temperature exceeded 30°C and, for 15 consecutive days, it reached 32.2°C somewhere in England.

Anglian Water Authority, among others, announced a hosepipe ban in an effort to conserve the water in its reservoirs, which were losing nearly six million gallons a day through evaporation.

Air conditioning was still in its infancy. According to newspaper reports, only Debenhams department store in Southampton had had it installed – at considerable cost, eight months earlier – but it was too expensive to switch on. An hour's use would exert the same strain on the electricity tariff as maximum demand for an entire month, costing the then unimaginably extravagant sum of £2,500.

So prolonged was the hot spell in 1976 that CIBSE's TM49 *Design Summer Years for London* uses the year as one of its extreme weather files.

Industry changes

In the mid-1950s, nearly all the work in the building services industry was carried out by design and build contractors, who undertook both project design and installation.

Graham Manly, who was contracts director at family firm A G Manly and Co, says consultants started to come on the scene in the 1960s. 'But the majority of these consulting engineers had come from – and been trained by – contractor apprenticeships.'

Oughton, who was also contractor-apprenticed, adds: 'It was a very good way of training people; contractors had access to sites and workshops, and carried out both installation and commissioning.'

By the 1970s, however, consulting engineers were becoming dominant, with almost the entire membership of the institution coming from the design fraternity.

Manly says: 'The way in which people worked together attracted me to the industry. Because many consultants had been trained by contractors, the relationship between the two was very good and, if problems arose, they were sorted by mutual agreement.' This cohesive environment only started to deteriorate during the next decade, he adds.

The 1980s was a period of a major uplift in construction, especially in the commercial sector. But with this boom, Manly says, came confrontation within the industry between engineers and contractors: 'There was a new breed of designers who had not come from a contracting background, so had no practical experience – and their designs just weren't up to it. Many projects ended up in the courts because jobs didn't get finished on time or within budget.'

EVENING STANDARD / GETTY IMAGES

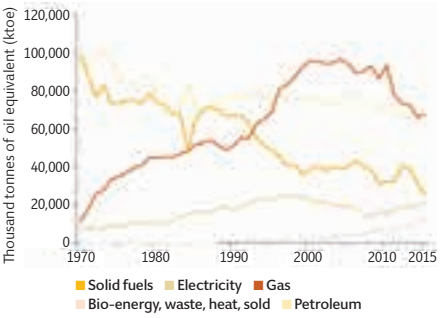
A picket questions a driver leaving West Drayton National Coal Board Depot at the height of the miners' strike

Another industry pressure came in the form of a supply and demand imbalance. Unlike in the 70s, when half of all construction projects were publicly funded, the 1980s brought an onslaught of government cutbacks to capital investment. The situation was compounded by the 1983 recession, which forced firms to lay off staff. Oughton says: 'People took up completely different jobs, so – when the industry picked up again in 1985 – the pool we were drawing from had significantly reduced.'

The skills shortage was a recurring theme throughout the decades, adds Oughton, who served on the CIBSE careers panel for more than 10 years. 'One of the biggest challenges for the Institution has always been promoting building services as a career to young people.'

But, as the 1990s approached, London's

Final energy consumption in primary energy equivalents by fuel type



The changing mix of fuel sources on a primary energy basis, and total consumption

Source: BEIS ECUK table 1.10

CIBSE: What next?

CIBSE is committed to continue developing, maintaining and sharing knowledge about building engineering to support its members and to champion building performance. This commitment is set out in its 2020 vision statement, soon to be published.

CIBSE will continue to champion the contribution to building performance that its members make, promoting their high standards and professionalism. The vision also recognises the value of strengthening partnerships and growing membership worldwide, particularly while the UK is redefining its links and business relationships globally.

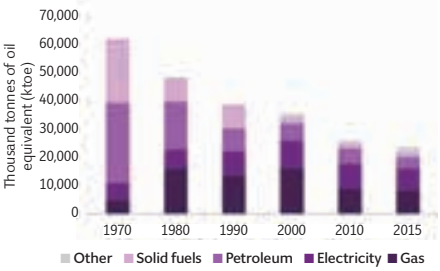
Building performance continues to be a priority, with CIBSE leading the drive to improve the performance of our built environment through a whole life-cycle building approach. Knowledge remains key to CIBSE's work as we continue to provide best practice guidance to improve building performance. We will also further develop our Knowledge Portal, aiming to launch an update within the next three years.

Digital processes will be a key area of CIBSE's work, in terms of looking at how it runs its own operations, as well as supporting industry – and member – adoption of digital processes and technologies.

CIBSE looks to support the property and built environment sectors – and its members – by developing resources that deliver comfortable, valuable and sustainable buildings.

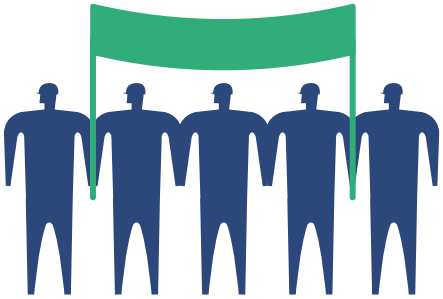
FRANK BARRATT / KEYSTONE / GETTY IMAGES

Total industrial consumption by fuel mix



The general fall in consumption reflects the shift away from heavy industry to more energy-light industries

Source: BEIS ECUK table 4.01



skyline was again peppered with towering cranes. 'People couldn't turn out the work fast enough; jobs got behind and corners were cut,' says Manly. 'This led to client dissatisfaction, complaints and contract clauses being invoked.' The reduced workforce meant organisations were employing anybody, so compliance and professionalism suffered.

After a second recession in 1993 – which levelled off the supply/demand imbalance – the next decade was stable. Most people 'could plan for next year', says Manly.

Energy mix

In the early 1970s, most major projects used heavy fuel oil – a thick, tar-like substance that was cheap and unrefined, and which replaced the 1920s coal-fired boilers. 'Coal was dirty, and required a lot of manual labour to shift and stoke it day and night, so it was being replaced with heavy oil in the 60s,' says Manly.

After the coal miners' strikes, North Sea gas was discovered. 'The 70s saw the growth of gas,' says Manly. 'Plant – including the boiler I was working on for the 20,000-bed Epsom Hospital, serving five mental health clinics – was being converted from heavy fuel oil to dual fuel [light oil and gas].' (See graph, above).

Oughton adds: 'Gas had considerable advantages in terms of lower emissions, flexibility, and less stringent requirements for chimney design. But it didn't provide a reserve supply so, quite often, dual fuel boilers that ran on gas with oil as backup were installed.

'Over time, the need for reserve oil was reduced, and gas became the primary supply fuel because it was seen to be a reliable source.'

Between the late 1950s and mid-1970s, district heating was a popular system for many projects. Hot water was piped from boiler houses – running on heavy fuel oil – to each block of flats. But a lack of monitoring and control, as well as pipe corrosion and leaks, moved the focus away from district heating.

'With the advent of gas came a shift from central generation of heat to individual gas boilers for every flat,' says Manly.

Efficiency

In the 70s, no-one was thinking about energy efficiency across the board. 'Fuel choice was mostly based on cost – that is, what's cheapest – and how easy it was to manage,' says Manly, who adds that there was a tendency to 'over design'. 'You designed by working out what the demand was and added 10-20% to it just to be sure. You never wanted anything to be too small.'

In the era of property indemnity insurance, you covered yourself by 'adding on', says Manly. 'No-one considered the effect on equipment performance or energy use, even though – throughout most of its life – plant was working at half speed.'

However, there has been a gradual shift towards energy efficiency, which took off during the early part of the new millennium and in the 2006 revision of the Building Regulations. 'It has taken 15 years for it to become the norm,' says Manly.

The merger

By Royal Charter, the Institution of Heating and Ventilating Engineers and the Illuminating Engineering Society were amalgamated in 1976, to form the Chartered Institution of Building Services (the word 'Engineers' was added in 1985). This was the first use of the term 'building services', after a realisation that the industry was doing more than just heating and ventilating.

According to Mike Simpson, global application lead at Philips Lighting, a strong driver for the merger was the Property Services Agency, which looked after government property. 'There was a big push for the building services profession to become chartered and gain a level of professional recognition – but its scope was not wide enough. So the IHVE and IES merged,' he says.

At that time, independent lighting designers did not exist, Simpson adds. There

Evolution of engineering jobs

IT and technology, and a focus on sustainability, have transformed the roles available to building services engineers, says Richard Gelder, Hays building services director.

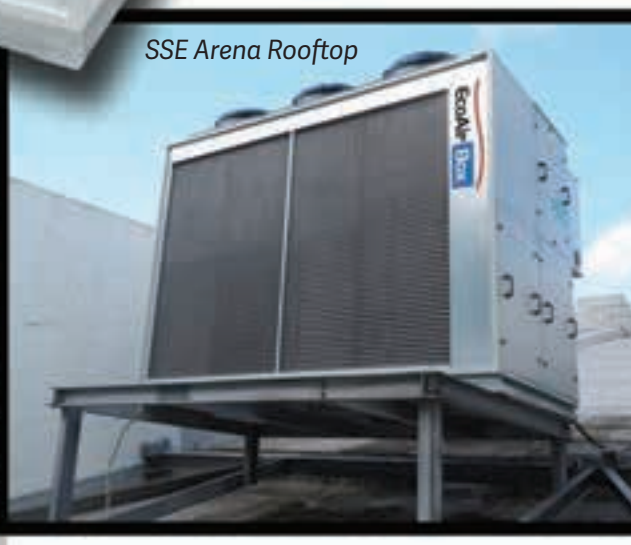
Typical building services roles in 1976:
- Drawing office manager
- Draughtsman
- M&E superintendent/chargehand
- Borough engineer
- Design technician

Typical building services roles in 2016:
- Digital engineer
- Energy manager
- IES modeller
- Revit/BIM technician

Bespoke Rooftop Packaged Units

EcoAir Box

SSE Arena



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were manufacturers – who did a lot of the design – and electrical engineers, who did the calculations. 'Architect Derek Phillips pioneered the discipline of independent lighting consultancy in the UK when he started his own lighting design practice in 1958. Now, there are many hundreds of people in the UK – and around the world – solely from a lighting background,' says Simpson.

'Somewhere down the line, the attitude towards lighting changed and it became important enough to become a specialised sector. With the advent of LED technology, we are getting a crossover between the engineering, entertainment and architecture sectors, sharing knowledge and experience.'

After the merger, Oughton says the institution became more welcoming towards its members. 'The Young Engineers Network is a good example of how it has become less elitist and more open to the young members and those who have come through the associate grade.

'Other CIBSE societies – such as Façade Engineering – have got a wide membership and are not dominated by building services engineers. The fact that CIBSE has opened up the work of the Institution to a wider group only benefits its members.'

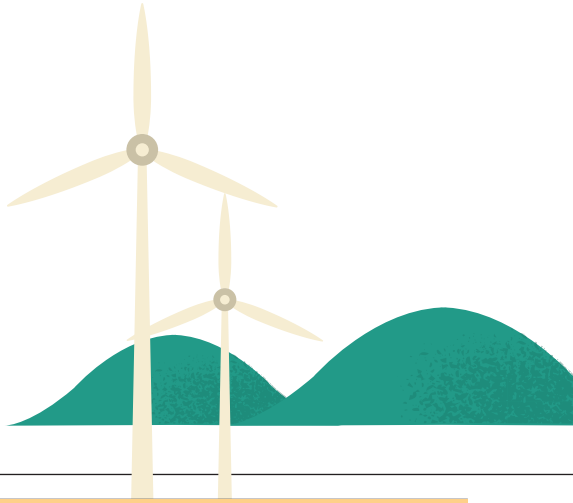
Oughten adds: 'There has been recognition across the board of the importance of having a good environment for people – not just in terms of temperature and humidity, but also by taking into account the whole building design and its facilities to provide comfort and good air quality.

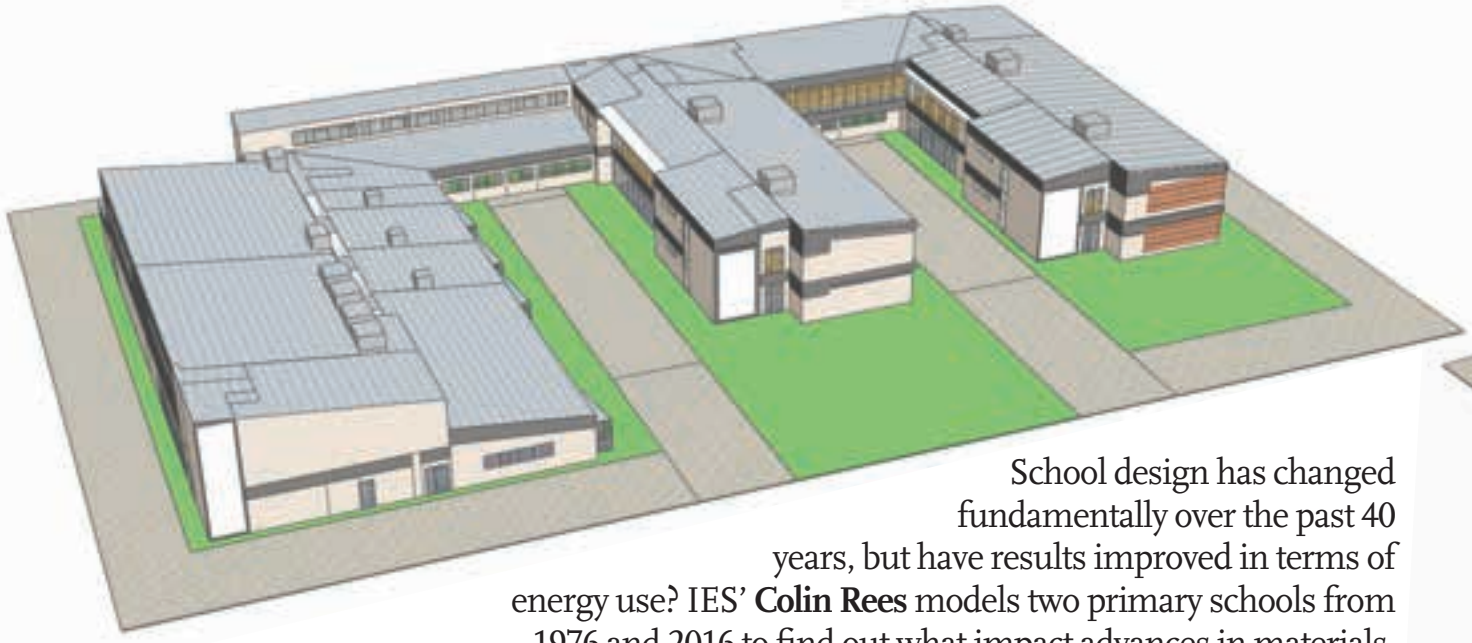
'Engineers now need to have a broader skill set – drawing on knowledge from many different sectors – to look at projects holistically and deliver great places for people.'

Despite the UK's vote to leave the European Union, engineers still need the international skills pool, says Field, who believes much of what Loten said in 1976 still rings true today. 'We must engage with Europe, the Middle East and America, and streamline our way of working with other nations because, if we do not, the industry will be generalised – it will become Uberised and Amazonised,' he says.

'We need to be a part of the social media and blog-related way of working, and do it globally. It's a fantastic opportunity to make real changes to the industry, but we have to do that cooperatively with international colleagues.' **CJ**

LED technology has transformed the industry





School design has changed fundamentally over the past 40 years, but have results improved in terms of energy use? IES' **Colin Rees** models two primary schools from 1976 and 2016 to find out what impact advances in materials, systems and IT have had on energy consumption

PRIMARY EVIDENCE

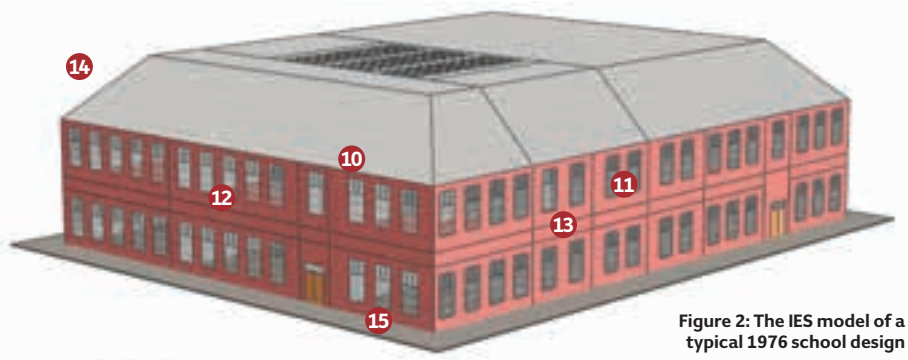


Figure 2: The IES model of a typical 1976 school design

> With its protruding wings containing classrooms, the 2016 school's form has been optimised to meet shading and ventilation needs

In terms of schools design, perhaps one of the most significant events to have taken place was the formation of the Apple Computer company by Steve Jobs and Steve Wozniak. It was a sign of things to come, but – in 1976 – few people foresaw the massive impact IT would have on everyone's lives, least of all those concerned with the design of schools. Now, IT is an essential teaching aid and a key part of the classroom environment for teachers and pupils alike.

The pervasiveness of computers is just one of the factors to have changed the design of schools over the past 40 years. In that time, regulations have also become more rigorous; there has been a revolution in lighting technology, and advances in computer modelling have helped our understanding of energy use and effective ventilation.

To see how primary schools of the past and present compare, 3D performance analysis software company IES modelled the energy use in a 1976 school and measured it against a 2016 scheme. This is what its study found...

Energy

Energy consumption has dropped overall by 50%-60%. This is the result of a significant reduction in heat losses. There has also been a drop in auxiliary energy consumption – such as that used by fans and pumps – as the use of variable speed drives has become more common. Alongside a reduction in fabric heat losses, lighting electrical loads have fallen significantly too, as a result of advances in lamp technologies. However, this reduction in lighting loads is offset by an increase in electrical loads, particularly from computer equipment, which did not feature in the school of 1976.

Building form

Compared with the 1976 school – which was, effectively, a two-storey box – the design of the 2016 school is a much more considered form and response to the building's orientation. With its protruding wings containing classrooms, its form has been optimised to meet shading and ventilation needs, to ensure a comfortable, low-energy facility.

The window-to-wall area ratio is also marginally reduced to limit solar gains, but the openable window area is now treble – and, in some cases, quadruple – that of a 1976 school to meet air quality standards.

Rooms are now generally smaller, but there are more of them and they include the specialist teaching spaces, such as computing. There is also more office and admin space allocated.

Figure 1: IES model of a typical 2016 school design

Section views of 2016 school design

Building fabric

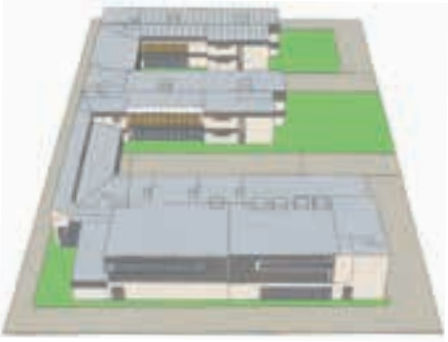
Energy performance gains have been substantial, with some U values improved by up to 80%. This has resulted in a 65% reduction in heating demand. Solar gain is also managed more effectively. In the past, large, single-glazed windows dominated; now window areas are smaller, double-glazed and often contain solar-performance glass. As a result, there is up to 66% less solar gain, which reduces the possibility of classrooms overheating in summer, while ensuring sufficient solar gain to compensate for winter heat loss in these highly insulated buildings.

Lighting

There has been a revolution in lighting technology, first with low-energy bulbs and now with LEDs. Luminaires are also more efficient at distributing light, helped by a trend towards brighter internal finishes. Lighting schemes are now designed to maximise the use of daylight, and include daylight sensors and dimmers to control levels of artificial light, and to ensure lights are turned off when conditions allow. Presence detectors also prevent lights from remaining on when rooms are unoccupied. These advances have resulted in a reduction of 40% to 50% in the energy used for lighting.

Equipment

IT equipment did not feature in the school of 1976. Now computers are ubiquitous. Interestingly, IT loads appear to have reached a peak several years ago and are starting to decrease because equipment efficiencies have improved and smaller, flat-screen, laptop and tablet technologies have become the norm.



Classroom wings maximise daylight in 2016 school

1976 v 2016 – HOW SCHOOL DESIGN HAS EVOLVED

Key to 2016 primary school (Figure 1)

1 Stack (wind catcher) ventilation
2 Low-level ventilation through louvred unit below the window; sometimes these can be integrated with the classroom heating system
3 High-level and middle-level windows for temperature control. High-level open first
4 Middle-level windows are used when maximum window-opening area is required at peak times
5 Window areas are smaller, double-glazed and with solar-control glass
6 External shading canopy provides solar protection and minimises glare potential
7 Glass area is optimised with shading unit to allow good daylight levels, to benefit the internal environment for occupant comfort and enable electric-light dimming to reduce energy
8 Highly insulated, airtight façades to prevent heat losses and minimise air infiltration
9 Classrooms arranged in wings to maximise daylight and ventilation

Key to 1976 primary school (Figure 2)

10 High-level opening windows deliver single-sided, wind-driven ventilation
11 Large areas of single glazing without shading and a high window-to-wall ratio
12 Lighting has no daylight controls/dimmers
13 U-value and airtightness of façades poor compared with today's Building Regulations
14 No attention paid to orientation – all the façades are treated identically
15 Classrooms are generally larger and identical ; very few specialist teaching spaces

Ventilation

Uncontrolled ventilation through fabric leakage has decreased significantly, from 0.7 air changes per hour to less than 0.2, as a result of airtightness testing.

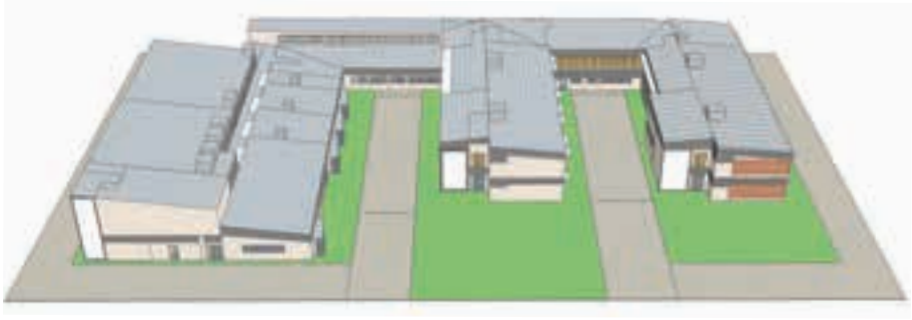
The approach to providing fresh air has also undergone a transformation. The government's Priority School Building Programme includes baseline designs and Performance in Use requirements for things such as maximum levels of CO_2 in classrooms, and minimum and maximum temperatures. In 1976, classrooms were reliant on wind-driven ventilation to supply fresh air – usually from windows on a single elevation, which was not always effective. The focus now is on ensuring comfortable environments through the use of crossflow ventilation using ducted stacks or wind catchers positioned on the side of the classroom opposite to the windows, to increase the airflow rate.

The opening area of windows and low-level louvres has also been optimised to suit the size of the space. Under the control of the building management system (BMS), low-level louvres are designed to open to manage background CO_2 levels, while top-lights open to help control temperatures.

For this exercise, natural ventilation is the selected comparator; however, a mechanical ventilation system with heat recovery could also have been modelled. These are popular in schools close to roads or airports, where noise control and acoustics can be an issue.

Systems

Heating and domestic hot water systems have undergone significant technological change, alongside better insulation and improved controls. Systems that were 60% efficient are now at more than 90%. **CJ**



Future of modelling

Modelling techniques have come on in leaps and bounds. In the past, the focus was on assessment for compliance; now it is on 'in use' operation matching design intent.

Parametric modelling and design optimisation techniques

The big change over the next few years will be quicker simulations using a central cloud server. Simulation tools will, through the concept and design stages, test a model's performance to find optimal settings before developing the design further. This will produce more data, but it will be efficiently handled so important results are filtered through to the design team.

Future weather scenarios

Buildings need to be resilient to adapt to future climate trends. Models will need to demonstrate how future retrofit options will meet energy and comfort needs, if warmer decades arrive.

Technology integration

Being able to model new technologies and approaches is crucial to ensure their fit and use in improving operational performance.

Expanded HVAC modelling

Plant optimisation will be key to efficiency. Over-estimation of plant size will no longer be seen as acceptable because of increased capital and running costs. Being able to model plant efficiency characteristics and investigate ventilation rates, heat recovery and other new heat exchange technologies will enable HVAC designs to be exploited.

Climate-based daylighting modeling

CBDM will replace the static daylight factor approach by letting designers see how local climate, building orientation, surrounding buildings, topography, local shades and glass types combine to influence the amount of captured daylight. It will demonstrate captured useful and sufficient daylight, but also highlight daylight levels that could lead to glare.

In-use energy optimisation – intelligent data analytics

In so many cases, building plant is not operating to the intended standard and occupant satisfaction is rated poorly. Taking the model from design stage, and working with a calibrated setup, will extend the model life and create the necessary benchmark to reduce the performance gap. It will then live with the building for continual measurement and cases where building retrofit become available.

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To mark CIBSE's 40th anniversary, industry figures reflect on how the challenges of urbanisation will be met in the next four decades

> We need leaders with vision and tenacity to direct this transformation
>
> **Patrick Bellew**

'The age of great men is going; the epoch of the anthill, of life in multiplicity, is beginning,' wrote the Swiss moral philosopher Henri-Frédéric Amiel in the mid-19th century. His words somehow anticipate the global population explosion and the shift of people to the city in the 20th century. Might they also reflect the lack of greatness in global leadership in the 21st century? That is, perhaps, a different train of thought, but a lack of strong, consistent leadership of our nations – as well as of our cities – is, no doubt, one of the causes of the current environmental problems we face.

Intensification of the city – in terms of more people per hectare, rather than our urban areas necessarily just getting bigger – will continue all over the world. This phenomenon is already evident in the great cities, perhaps no more so than in London, where increases in building height and population density, usually around transport nodes, have been witnessed in recent decades.

For the most part, these developments tend to be piecemeal, and there are relatively few global cities where joined-up thinking about structure and infrastructure with planned urbanisation, is more than half-hearted. Singapore may be the only one that comes anywhere close to working to a plan.

As a designer, it is all too easy to project a future in which the big energy and transport problems have been solved by technology; in which micro-fusion reactors generate our power, and dynamic energy storage and smart driverless electric cars have relegated pollution and CO_2 emissions to non-issues. In this world – where our new buildings are intelligently and passively designed around virtuous cycles – we integrate into their skins the ability to produce food and more fuel through algae and sunlight. Our all-electric buildings and cars are joined through a distributed network of domestic battery storage systems, which allow supply and demand to be regulated and controlled to ensure that the fusion power plant is sized correctly.

These smart environmental systems are tuned to our lifestyle and demands, through a global network that is geared to meet our comfort and physiological needs in the most efficient way possible. The circular systems that manage water and rainwater ensure that no citizen goes thirsty and our social structures, while still hierarchical, ensure access to a healthy and pleasant life for all.

It's all very straightforward really

A more dystopian version of the same future has us scrambling for ownership of increasingly scarce resources – energy, water and materials – in cities that are choking on emissions and baking under the heat-island effect. Social divisions are rife between the haves and have-nots and it takes a heavy hand from national security forces to prevent civic unrest and a breakdown of society.

In practice, I believe the future will sit somewhere between these extremes, and that we will forge a slightly inefficient – and no doubt circuitous – path to a future that is mostly environmentally better than today. It will have got better through a continuation of the incremental improvements of the past 35 years, rather than by conforming to some grand plan or design. Grand plans usually require great people to inspire and deliver. Was Amiel right? Recent governments in the UK have done nothing to make us believe that the future will be any better than the past, retreating as they have from delivering leadership and vision in the environment and energy space.

Most cities are already too big to superimpose some of the utopian visions of a future world within the next half-lifetime. So the application and evolution of technology will bring the biggest changes – and it will be down to our ingenuity as designers to find the new norm that is better, stronger and more resilient to climate change.

Regulations and standards have been vital to improving sustainability in built environments, and UK standards have come a long way since the Energy Performance of Buildings Directive. Post-Brexit, it is going to need leadership at local and national level to reinvigorate our ambitions.

The past decade has shown us we need leaders with vision and tenacity to direct this transformation. We need to set a course and stick with it. Moreover, we must build capacity to implement the things we know make better cities. Not so straightforward, but certainly not beyond us.

● **PATRICK BELLEW** FCIBSE MASHRAE is the principal and founding director of Atelier Ten

FUTURE CITIES

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By the late 1950s, engineers were comparing the viability of the coal industry with that of the oil industry, and realising that coal was in decline. The politicians did not react for nearly 30 years, until 1984. By 1973, the limit on the global supply of carbon fuel was brought firmly to our attention; we have been living with that reality ever since.

In 1995, about one billion people were burning carbon fuels, at about 600 tons per second. The population of the world is expected to stabilise at about 10 billion people, leading to a commensurate increase in demand for energy. Increasing urbanisation will present challenges that we must confront with fortitude. Engineers can – must – play a leading role. Many lessons learned over the past 40 years can illuminate our way forward.

In 2016, it is clear where we should be looking to initiate and propagate change for the future. Carbon fuels enabled the industrialisation of our society towards the end of the 18th century, but these fuels are becoming exhausted and will need to be replaced. It appears we have not yet grasped fully the seriousness of that proposition.

The clear conclusion is that, to meet these challenges, the carbon demand for energy should be reduced to zero by 2050. Currently, politically agreed targets are unrealistic. The consensus of opinion is that this drastic change is not feasible, but design thinking has to start with a proposition and then figure out what it implies.

So how do we reduce the carbon demand for energy to zero? This is a science fiction question of course, but we should think of the implications in its asking. Where do we begin? All viable renewable energy is going to be expensive, but the cost has to be judged in the context of the problem. It will reduce once we take the technology – and the problem – seriously.

Most zero carbon renewable energy comes as work/power (rather than heat). It is generated from PV electricity, wind turbines, hydroelectricity and tidal energy. We could generate more by following the French example of building barrages and create one on the Avon and Humber. Of course, nuclear is also being considered, but is it sustainable enough? All these options are realistic by 2050; the financial viability has been demonstrated in other parts of Europe.

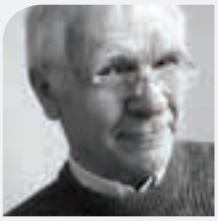
The other aspect of the solution is the reduction of heat demand. We have to realise that heat and work are not the same kind of energy. The demand for winter heat can be reduced almost to zero by thermal insulation, control of ventilation – such as employing Passivhaus airtightness principles – heat from human respiration, the consumption of food, the electrical work we use that is passed on as heat, and natural light.

The industrial revolution brought work energy to help benefit our society and effect changes to our environment that we tolerated. Now the new energy supplies will bring adjustments to our environment that we will surely have to accept – whether it be onshore wind turbines, or saltwater estuaries being replaced by freshwater inlets as we build tidal barrages (opponents of these might consider that Minsmere, the renowned freshwater nature reserve in Suffolk, was a saltwater estuary until a 14th century storm cut it off from the sea).

Our rational European neighbours have accepted changes to their townscapes and landscapes, and so must we. Climate change is more important than the aesthetics of the landscape.

Society does accept major changes when the urgency is made apparent, but – as engineers – we should not sit idly by when the thermodynamics of the planet are being disrupted by uninformed attitudes. Our intellectual and technical abilities will be crucial in dealing with the challenges of urbanisation, of a scale imagined 40 years hence. What we must do is have greater prominence in the conversation about this future, so the political inertia that has brought us to this point doesn't outweigh our capacity to deal with it.

The generation of electricity by burning carbon fuels will not be a sustainable process when 10 billion people are alive. This prediction is a certainty for 2050.



> We should not sit idly by when the thermodynamics of the planet are being disrupted by uninformed attitudes
>
> **Max Fordham**

● **MAX FORDHAM** FCIBSE is the founder of Max Fordham

> The major roles of the designer will be the strategic parts that cannot be automated
>
> **John Field**

Looking at how the engineering of buildings and cities will develop a fair way into the future helps us prepare for and deal with the inevitable changes. One could study engineering for the extreme future of a *Mad Max* world – this holds plenty of morbid interest, but is not very helpful. So we avoid post-apocalyptic scenarios resulting from environmental catastrophes, wide-scale conflict or, say, runaway development of artificial super intelligence.

The built environment will be characterised by super-conurbations, some on multiple levels – and, with a reduced need to work in an office or factory, there will be extensive residential communities covering large land areas. Ambient temperatures and sea levels will be significantly higher, with the ice caps going – or gone – and more extreme weather.

Much longer active and total lifespans will accelerate the increase in population. Shortages of energy supply and the globe's ability to handle the energy waste may have been resolved technically, to some extent, but will have been followed by more serious shortages of water, natural food and materials of all types. These will drive the circular economy, with extremely high application of the 'reduce, reuse, recycle' principles.

The march of information technology will have continued so that permanent, widespread connectivity is taken for granted; lifestyles and work practices will be changed entirely with the universal application of augmented reality to provide context-sensitive information. Commerce will be unrecognisable after the logical extension of business models exemplified by Amazon, Ocado, TripAdvisor and Uber. Likewise, leisure and social interaction will have progressed radically from Facebook, Twitter, WhatsApp and dating websites, not to mention Pokémon Go.

Society's view and use of the professions will be changed greatly, with professionals' expertise and contribution largely available from the cloud. Work, travel and leisure will converge, and there will be a blurring of buildings and communities, which will affect both urban and building design.

In a circular economy, buildings will be highly efficient in operation, taking to extreme limits the design requirements for efficiency trends of the past decades. Increased ambient temperatures and extreme weather will place further emphasis on effective design and efficient operation. Buildings will combine materials efficiency with designed-in flexibility, long life and recyclability, to reduce the mine-and-dump fraction to a few per cent of the process, or less.

Incorporation of plant life into community spaces and buildings will be highly valuable and may be the preserve of the wealthy elite – but hopefully, with enough design attention, it will be widespread or nearly universal.

Permanent connectivity will offer huge potential for feedback from building occupants and community members – integrated fully and automatically into buildings and services with what might be called adaptive ergonomics. Similarly, building operators will have customised and analysed feedback from plant. This will all be needed to achieve the required levels of efficiency and lack of resource use.

As the professions become shaped by the online availability of customised information, advice and guidance, they will need to consolidate into fewer bodies and increase cooperation. Automated plug-and-play design will predominate and will extend into the operational phase and all parts of the life-cycle. At the design stage, products, equipment and plant will have data files that allow the great majority of design to be automated. Basic implementation work stages will be progressed by machine. This will include not just modelling of performance and behaviour, but the initial creation of the fully specified and serviced design.

The major roles of the designer will be the strategic parts that cannot be automated, and the generation of the product data interaction protocols and the data files themselves.

Then there is the possibility of cutting out the middleman – that is, one of us, as independent professionals – from the briefing-design-construction-operation cycle. In principle, the steps between the briefing stage and occupancy could be short-circuited, and an owner or developer could simply specify that a building must provide accommodation for so many occupants who give, say, 90% positive feedback, with the building using no more than a specified amount of energy.

Looking at future developments identifies big opportunities – or threats, depending on how you look at them. It is up to us to prepare for these changes in a fearless, creative and collaborative way.

● **JOHN FIELD** FCIBSE is founding director of Native-Hue and CIBSE President

The world's population is set to rise from 7.3 billion to 9.7 billion by 2050, according to UN projections, with Africa accounting for more than half of the growth. An additional 2.5 billion people are expected to live in towns and cities by the middle of the century, and 90% of this urban increase will be in Africa and Asia.

The figures are stark and it can be worrying to contemplate the implications. Countries where sanitation, water treatment, waste disposal, pollution controls, energy efficiency and recycling are now neglected will experience huge rates of expansion, with some poised for a doubling of their populations over the next 35 years. Many seem ill-equipped to cope.

There is, however, equal potential for optimism. Cities and city regions can be planned, controlled and influenced much more effectively than dispersed settlements, particularly when they are governed by strong, city-wide authorities. In some European cities, for example, car use is in decline as a result of improved alternatives and initiatives such as congestion charging.

By extension, one can imagine city authorities using their power to transform conurbations into models of urban efficiency. Over the next 40 years, they could drive the installation of infrastructure that creates a more flexible backdrop for commerce – from transport networks and information super-highways to energy distribution hubs.

Urbanisation in the developing world also offers the potential for 'leapfrogging' – that is, skipping stages already supplanted in the developed world. For example, some countries missed out landline phone networks and moved straight to the mobile internet. In a similar fashion, emerging cities and districts won't be hampered by the need to redevelop legacy buildings and infrastructure, instead benefiting from more modern thinking in urban planning and building engineering.

In the western world, we face the problem of how to layer smart environments over existing 18th-, 19th- and 20th-century infrastructure. As building engineers, we will have to focus on how to upgrade the performance of existing stock with minimum intervention, and how to plan future interventions in an optimal way.

What is unarguable is that tomorrow's cities must manage available resources more effectively. This will take many forms, including the harvesting of solar energy from every suitable surface and the efficient organisation of spaces within buildings.

This philosophy can be extrapolated to neighbourhoods and cities, where there is huge scope for improving efficiency if a city and its suburbs can be managed as a whole, using smart networks. To take one example, energy harvested from solar panels on a domestic roof peaks at midday, whereas home energy use peaks in the evening. With a smarter grid, this mismatch becomes an asset; excess energy could be channelled to businesses, where demand is highest during the day, or stored in batteries that allow generated energy to be held locally until it's needed.

Improved transport and data infrastructure will encourage more agile working. Businesses stand to benefit if they can empower a more widely distributed workforce to collaborate effectively and focus on what they do best. However, it is vital to take a broad, system-wide view. Increased home working may reduce pressure on an overstretched transport network, but it could have negative consequences for efficiency if homes need to be heated for more of the day. Flexible arrangements may encourage staff to live further afield, increasing transport demands on the days they commute.

Artificial intelligence, machine learning, data collection and the Internet of Things will loom large over the coming decades, and provide the tools for creating smarter buildings. These trends are fuelling the emergence of autonomous vehicles and other concepts that once seemed pure science fiction and are now becoming mainstream.

Technology will learn more about human behaviour than we may understand ourselves, helping us to design and produce incredibly efficient systems. As individuals, we will need to learn to rely on each other and work more collaboratively, as teams become increasingly global and the learning process is accelerated.

Today, it is hard to believe what was once accomplished with little more than pens, pencils and fax machines. Tomorrow's tools will make CAD systems seem equally antiquated. Our ability to conceive and deliver in the built environment will be magnified immeasurably. Most importantly, as the world's population grows, we will learn to use our resources more efficiently. That may be the hardest change to deliver, but it will also be the most effective one.

> Emerging cities and districts won't be hampered by the need to redevelop legacy buildings and infrastructure
>
> **Sasha Krstanović**

● **SASHA KRSTANOVIĆ** FCIBSE is a director, building engineering, at Aecom

> While the world may be more polluted, our cities could actually be less so
>
> **Tomás Neeson**

Experts cannot predict what will happen at the next election, so being asked to fix the future, 40 years hence, is a big task. But here I will look at some of the developments, opportunities and threats around the future of building services

There will be an increasing focus, in the developed and developing worlds, on health over and above the accumulation of wealth. The wellbeing of people at work, developments in medicine and medical treatment, and tackling disease – particularly issues, such as obesity and diabetes, linked to sedentary lifestyles – will become more important. This will impact upon the built environment – in the creation of indoor and outdoor spaces designed to promote physical and mental wellbeing, as well as in the facilities for prevention and treatment that we build.

Even assuming the growth of a circular economy – and a move away from the use-and-dispose world of today – production and use of already overstretched resources will require technological changes, to match them with predicted population growth. The engineer is already heavily involved in such aspects as water efficiency and re-use, but their role will become more important in such developments, to make more from the finite resources that we have.

Solar and renewables will win. Growth in nuclear capacity, globally, has slowed since the Chernobyl disaster and now started to decline (Source: World Nuclear Association). While countries such as China and Russia have plans for large nuclear expansion, this is being offset by more countries decommissioning existing plants and stalling development plans. Apart from the environmental and safety considerations, a growing issue is the operating cost of nuclear in a market of low oil (energy) prices and competition from alternative sources – renewables, tar sands and the like.[1] The growth in PV solar, when combined with emerging developments in battery storage and output efficiency gains, will lead to widespread off-grid electrical use, with implications for how we engineer buildings.

Population flow to urban areas will continue across the globe and, with it, the continued growth of mega cities.[2] Cities of 40 million people will exist, with adjoining sub-cities of five to 10 million.

Global warming will probably have increased temperatures by three degrees by 2050,[3] but this could be balanced by cleaner cities. The current clampdown on vehicles, more cyclists and electric cars, and more efficient buildings mean that, while the world may be more polluted, our cities could actually be less so. In the past 10 years, the number of cars entering London has dropped from 120,000 per day to 60,000 per day, whereas the number of cyclists has gone from 15,000 to 30,000 per day. Predictions are that, in the next 10-20 years, there will be more cyclists than cars in the city (Source: Transport for London).

The need to provide habitable accommodation in the face of increasing global temperatures and competition for resources will require the development of more efficient construction methods, giving many opportunities for innovative engineering solutions.

Some say global warming is not happening but, year on year, the highest temperatures ever recorded are being logged and global sea levels are rising.[4] The environment in which we live is changing and our buildings will have to adapt to this. For example, we need to find better ways to control internal temperatures and air quality – in everything from private residences to hospitals – to cope with increased summer heatwaves. We'll also need to enhance green landscaping and urban drainage to improve heat and flood resilience.

A lot of this we already know, but engineers will have to be more innovative, more forward-thinking and braver to meet the increased demands.

Our work needs to respect the health and wellbeing of humans and the natural world, in a future where there will be ever-more competition for space and resources. There is a pressing demand for the public to understand that how they live now, as consumers, will have major implications for those who follow.

There is an even greater need for us to inspire a generation of engineers who can make the most effective and efficient use of the decreasing resources. Our buildings need to lead by example through clever engineering solutions and long-term thinking.

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1 The World Nuclear Industry Status Report 2016

2 UNDESA, 2014

3 NASA/GISS

4 National Ocean Service

● **TOMÁS NEESON** is managing partner at Cundall

> Many developing cities have energy strategies that condemn them to a relatively high carbon future
>
> **Tim Chapman**

Urbanisation is an unprecedented challenge. By 2050, it is predicted that the world's population will reach more than nine billion, with 75% of the Earth's inhabitants living in cities. The first cities emerged around 4,500 years ago, but all that remains of these ancient settlements are piles of stones being picked over by archaeologists. Many of our modern great cities were founded comparatively recently, so how will the cities of tomorrow thrive?

Cities are valued for the quality of life and opportunities they offer, not just for the economic benefits. Services can be provided more efficiently – and, increasingly, in a lower carbon way. So what makes a city that people want to live in?

Professor Brian Collins, of University College London, recently summarised the five key characteristics necessary for a city to thrive: it must be courteous; it must be active and inclusive; there must be much public space; it should be healthy; and it must be evolving. Behind these, there needs to be supporting soft and hard infrastructure to connect places, services and – critically – people. We, as engineers, must facilitate that great system of systems to accomplish all of these things.

These infrastructure structures must be resilient, with very low levels of outage, because so many people depend on them to function effectively. A total failure of infrastructure can create severe problems for urban dwellers within 24 hours; people will have no water to drink or to wash away waste, and food in warm fridges will start to decay. In addition, the hugely complex logistics chains will quickly grind to a halt when transport is curtailed.

A recent UK example of a total infrastructure failure occurred in Lancaster in December 2015.[1] Fluvial flooding submerged a key transformer just outside the city, leaving 61,000 homes and surrounding businesses without power – and all supporting infrastructure failed. It was six days before the city returned to normal, thanks to huge pumps airlifted into position by the RAF and massive standby diesel generators. In the meantime, the population faced a very worrying time, deprived of all the usual information sources – TV, radio, the internet – that would have provided reassurance. Many cities in the developing world face far worse, such as earthquakes, mudflows, sinkholes and extreme flooding hazards, and need to be made to withstand these comfortably.

An even bigger challenge for humanity is how to cope with resource scarcity and the effects of our profligate carbon pollution. This threatens to change our climate significantly, and only the rich world will be able to adapt adequately. Engineers have addressed similar pestilences before – think 'the great stink' of the 19th century and the 'pea-soupers' of the 20th, when better infrastructure and regulation led to respite. We are leading the way in devising efficient solutions to these carbon problems, so the key question is whether they will be implemented in time.

In the developing world, many cities are growing out of control, with rudimentary infrastructure that cannot keep pace with ballooning population growth. In the developed world – where, generally, we are coping with established cities growing relatively slowly – there is an obligation to help. Initiatives such as the C40 network of global megacities[2] and the Rockefeller 100 Resilient Cities[3] show how knowledge can be shared productively for the good of all of humanity.

The choice of power sources is key, since many developing cities have energy strategies that condemn them to a relatively high carbon future. The dominant transport mode is also important; it needs to connect people's homes to jobs, education, health, culture and their social lives. Other 'hard' networks – water, waste, data and urban protection – complete the big infrastructure tableau.

Urban masterplanning is reaching maturity, with the key ingredients for urban vitality much better understood. However, creators of infrastructure systems are only sometimes seizing the chance to produce cities that are successful, resilient and low carbon. Engineers need to contribute far more to the overall approach. We have a vital role to play in how cities develop over the next 35 years, but we need to be more assertive with planners, politicians and the media in advancing the urbanism agenda. We need to make sure that society recognises the huge role that those systems have in turning our great cities into even better places to live.

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1 Living without electricity, Royal Academy of Engineering, May 2016 **http://bit.ly/2cJoQEM**

2 C40 Cities Global Leadership on Climate Change **www.c40.org/**

3 100 Resilient Cities **http://bit.ly/2cIDZ9f**

● **TIM CHAPMAN** is director and leader of Arup's Infrastructure London Group

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PHOTOS: HÉLÈNE BINET

For 200 years the historic HMS Namur lay forgotten under a wheelwrights' shop at The Chatham Historic Dockyard. Now it's the star of an exhibition on the age of sail in a Grade I restoration. **Alex Smith** reports

SAFE HARBOUR

The *HMS Namur* was a remarkable ship. It was in the service of the Royal Navy for 47 years during the 18th century when the British Empire was establishing its furthest frontiers.

Launched at Chatham naval dockyard on 3 March 1756, the 90-gun, two-deck sailing ship fought in nine battles across the Seven Years War, American War of Independence and the Great French Wars. It fought at close quarters in numerous engagements such as the Battle of Lagos in 1759, where it was badly damaged, though not so stricken that it could not put to sail in time for the Battle of Quiberon three months later, which saw the French fleet vanquished.

The ship touched the lives of major literary figures including Jane Austen, whose brother Sir Charles John Austen was captain from 1811-1814, and Olaudah Equiano, a slave on the ship whose searing memoir made him a sensation in literary circles and helped promote the cause of the abolitionists.

Despite its service to the Crown, the *Namur* had an ignoble end – broken up without ceremony at Chatham, its timbers used as floor joists under a shipwrights' building. There it would have remained undisturbed, if not for its discovery in 1995 during routine conservation work.

Maritime experts quickly realised the importance of the find, hailing it the most 'significant naval archaeological discovery since that of the *Mary Rose*', and the The Historic Dockyard Chatham Trust pledged to make the Namur's timbers the centrepiece of a major £9m conservation project.

The Command of the Oceans project, designed by Baynes and Mitchell Architects, is the result. The remains of the *Namur* can now be accessed by visitors via a new steep pitched-roofed building that connects the wheelwrights' shop with another Scheduled Ancient Monument building – the mast house and mould loft. [see diagram right]. The buildings now feature exhibition galleries and retail and catering facilities, and form the main entrance to the dockyard.

The preservation of the 260-year old *Namur* timbers was the priority for the building services consultant Skelly & Couch. They were involved in the project from the start,

PROJECT TEAM

- **Client:** The Chatham Historic Dockyard Trust
- **Building environment and services engineer:** Skelly & Couch
- **Architect:** Baynes and Mitchell Architects
- **Project manager:** Artelia UK
- **Exhibition designer:** Land Design Studio

and worked with specialists to ensure that the environmental conditions necessary for the preservation of the ship's timbers were embedded in the design.

That was difficult in itself, but the client was also committed to reducing energy bills in the restored buildings, which was a challenge considering that the mast house and mould loft are constructed from timber, have large, ill-fitting external doors, and are Grade I-listed.

To determine the *Namur*'s environmental requirements, the project team consulted a timber specialist, who told them they should replicate the conditions the ship had been subjected to for more than 200 years. This meant the undercroft that housed the timbers had to be unheated and thermally separated from the heated wheelwrights' ship above, and from the new linking building.

> The drama of the ship's history is brilliantly evoked through the lighting design – every cut, notch, nail and ropemark is vividly displayed

Some ventilation in the undercroft was necessary to account for heat and moisture generated by visitors. Skelly & Couch calculated that a gap of 50mm to the underside of the old timber doors would allow cross-ventilation and supply adequate fresh air for occupants – the historic fabric made the specification of a louvre unacceptable.

To account for future fluctuations in temperature and moisture, allowances have been made for a fan to be installed in the store under the link bridge next to the undercroft. The client is monitoring moisture and temperature levels in the undercroft closely to check whether ventilation plant is required.

Couch says that the British Standard for the storage and exhibition of archival materials BS5454 was not adhered to, as the cost of equipment required to meet the standard was prohibitive and there would have been nowhere to put it.

To enable public access to the *Namur*, the architect has raised the wheelwrights' floor above the timbers and dug out a circulation route, which enables visitors to view the relics from a waist-high vantage point.

The drama of the ship's history is brilliantly evoked through the lighting design, which casts great contrasts of dark and light across the timbers, so that every cut, notch, nail and ropemark is vividly displayed. Low-level lighting creates the shadows that help make the texture of the wood visible.

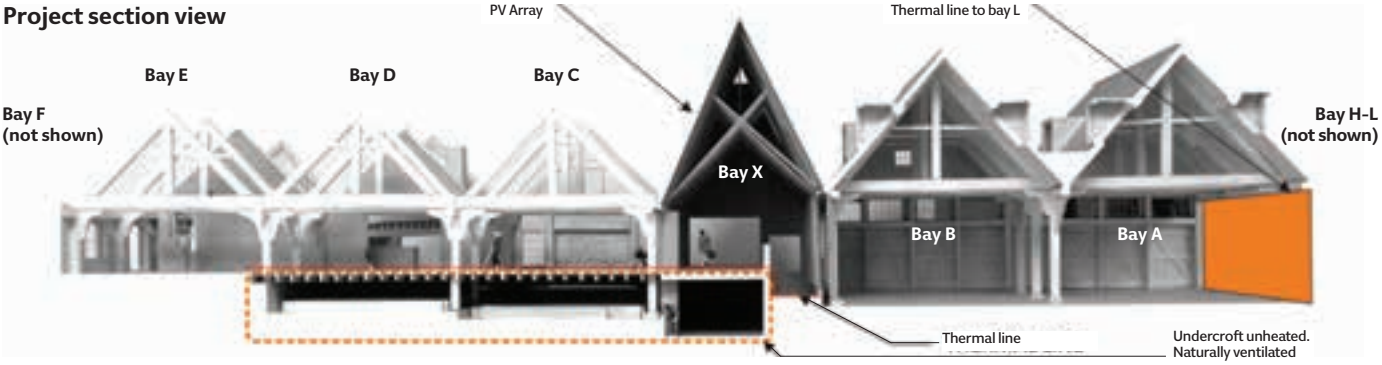
For longer views along the timbers, linear lenses have been used to emphasise the length. 'This type of lighting really accentuates the timber. We didn't want flat light. We wanted to create crypt-like lighting,' says lighting designer Jono Kenyan at ZNA.

For the services designer, the challenge was to hide the containment routes and to ensure that future access to services did not put the timbers at risk. For example, where smoke detectors had to be positioned above the timbers, the services designer had to consider how they were to be maintained without disturbing the exhibit.

The containment routes, discussed with the project team at an early stage of design, meant holes and notches could be preformed in the steel columns used to jack up the floor above the ship's timbers.

Although the bays above and adjacent to *Namur*'s undercroft are heated, many of the other bays in the mast house and mould loft are not. Of the 11 bays, five had heating decommissioned, while two bays in the mast house and three in the wheelwrights' shop had heating installed and their thermal performance upgraded. These bays, heated primarily for the staff, include the café and shop, which are important revenue generators.

Project section view



Boiler room heating schematic

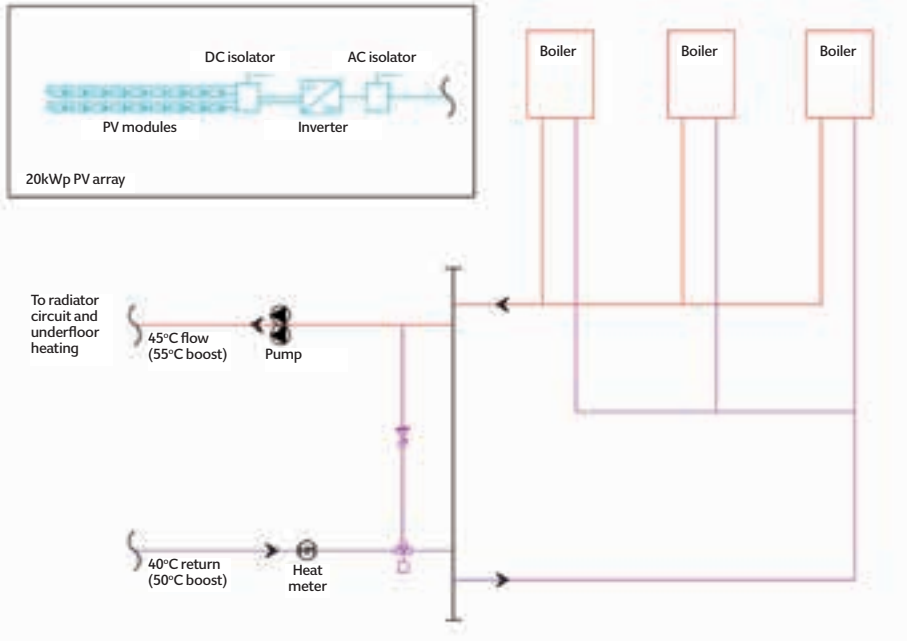
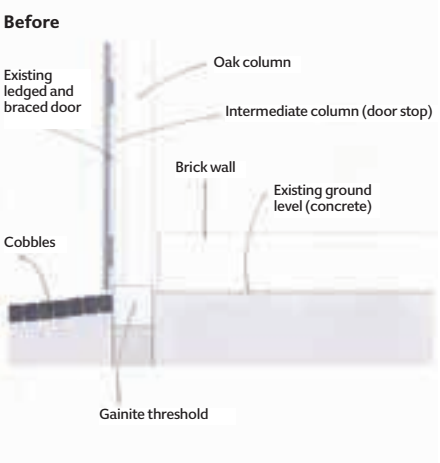


PHOTO: RICHARD PERRET

***HMS Namur* at the Battle of Lagos**

Ventilation for *HMS Namur* undercroft

Openings have been made in the original timber doors to cut heat and moisture generated by visitors



Skelly & Couch director Tristan Couch says Chatham Historic Dockyard Trust had a sensible attitude towards energy efficiency. 'It had a heating system that was very inefficient, and there was no insulation, so it took the pragmatic view and removed heating from a number of the bays.'

Further reductions in energy use have been achieved by reducing the setpoint to 16°C in the refurbished bays. As a result, the flow and return is 45/40°C, which makes the condensing boilers very efficient. Having low setpoints allowed for low temperature radiators to be used in visitor areas, which the Trust wanted for safety reasons. A proportion of existing cast iron radiators were refurbished and reused to minimise waste.

In the new bay, underfloor heating was specified because the architect wanted an uncluttered space that did not compete aesthetically with the adjoining historic bays.

In the wheelwrights' bays, rooflights are openable to provide ventilation. This is required because the raised floor that created the viewing area for the *Namur* reduced the volume of the space, and because of the higher occupancy rates in the shop and café. Rooflights are not openable in the large gallery bays as the existing air gaps under doors ensure ample ventilation.

Insulation and a vapour barrier were fitted between the original rafters, and the barrier was faced with timber boarding to match original weatherboarding. Insulation was added between heated and non-heated bays.

Rooflights were either double glazed or had secondary glazing fitted. Not all the improvements were passive; on the south-facing pitched roof of the new bay there is a 20kWp PV array.

The original boiler house to the north of the shipwrights' buildings has three Remeha Gas 110 Eco condensing boilers. These supply upto 195kW of heat to the bays and the boiler house kiosk, which serves food to the playground at the east of the boiler house. (See schematic above). The boiler house also contains CCTV equipment, the building management system, pumps for the car park drainage, and a switchpanel for car park lighting.

Converting lighting in the traditional fittings to LEDs in the shipwrights' buildings was harder than expected. 'Light levels are lower than CIBSE recommendations, partly because we found it really hard to get high output LED lamps,' says Couch.

'Originally we had 55W compact flourescent lighting, but of course they weren't historic,' he says. 'We could not find visually acceptable compact fluorescent nor LED lamps to achieve the 200 lux light level with a sensible number of fittings. If you had a shade covering the lamp it would have been fine, but with the coolie light fitting you can see the lamp. We settled on an 18W LED and agreed a lower light level with the client.'

The attention to detail extends to the containment trays for the lighting and controls. As they were visually exposed Skelly & Couch worked closely with the architect to ensure they were in visual harmony with the historic fabric of the buildings.

The restoration of the dockyard buildings is an exemplar museum restoration. The Trust has used the renovation to greatly improve the sustainability of the shipwright buildings, while giving the public the opportunity to view one of the Royal Navy's most historic vessels.

'In my mind it's good basic engineering and sustainable design,' says Couch. 'These are 250-year old timber buildings that have been brought up to a modern standard.' **CJ**

FREDFROESE / GETTY IMAGES

This month: Design guidance on cold water systems, condition monitoring of water quality, dry pipe sprinklers and pumps in Stockholm

TAKING THE HEAT OUT OF COLD WATER DESIGN

Overheating in cold water systems is increasingly becoming widespread. Aecom's **Richard Beattie**, **Damien Kane** and **Steve Vaughan**, all MCIBSE, look at the causes and offer design and operational guidance based on their experiences

LEARN FROM SoPHE

The Society of Public Health Engineers (SoPHE) has a wealth of expertise in the design of sustainable water management sytems. The society aims to raise the profile of public heatlh engineers within CIBSE and the building services industry. For more information see page 17, visit **http://bit.ly/2dko4Kml** or contact **Richard.Beattie@aecom.com**

Maintaining water movement within a cold water system prevents overheating and helps to maintain a healthy, hygienic system. Stagnation exacerbates overheating and may contribute to contamination by micro-organisms. Recent sustainability initiatives – aimed at reducing water usage by encouraging devices such as flow limiters, spray and percussion taps, and low flow appliances – have reduced peak water demands in buildings, and so cut flow rates.

To promote movement of cold water within systems, there has been a recent move towards adopting strategies that were not traditionally incorporated into cold water pipework design, such as a secondary cold water return circuit and end-of-line solenoid flush (dump) valves.

These are an added expense and contribute to wasted water and/or energy, so should be considered carefully when incorporating them into domestic cold water systems (DCWS), taking into account other contributory factors such as: the building water usage and turnover; higher building airtightness standards coupled with smaller service voids, meaning more potential for overheating; and sanitaryware specification.

These mitigation measures include:

- Introducing a cold water return circuit, combined with automatic balancing valves, to maintain water movement within the system
- Installing automatic dump valves at the system extremities/sentinel points
- Installing a refrigeration system with pumps

Flexible pipes are easier to install but could potentially harbour bacteria

and a plate heat exchanger to chill water within the cold water storage tanks, to ensure that the water is stored at an appropriate temperature – or connect to a building chilled water circuit if one is available.

Overheating

Increasingly, temperatures greater than 20°C are being recorded, thereby exceeding the maximum temperature for cold water systems, as recommended by HSE L8[1]. In several instances it has proven difficult to achieve temperatures of less than 20°C because of the temperature of the incoming mains water supply and absorbed ambient heat.

Several potential factors may contribute to overheating of DCWS (see panel, left). Relatively straightforward measures can alleviate the risk of overheating – or at least indicate where further investigation could be beneficial. As well as design recommendations (see panel, page 54), effective commissioning, monitoring and maintenance is needed.

Potential alleviation measures

DCWS and low temperature hot water (LTHW) systems must be commissioned appropriately and then monitored, to ensure heating set points and time schedules are set properly, and DCWS are maintained at safe temperatures. Seasonal commissioning should be included in the contract to allow systems to be adapted to seasonal variations and changes in user need. Site supervision and quality control procedures must include thermal insulation of pipes, valves, flexible pipe connections and relevant heat-emitting equipment, such as LTHW radiant panels.

A 'soft landings' approach should ideally be in place to help users and operators understand the building and the associated systems' design intent and operation.

Appropriate controls and sensors should

Reasons for overheating

From the mains water supply network

- A rural location of a building on a radial service; water temperatures can increase because of the distribution routes from the reservoir/pumping station and potential low rates of water draw-offs
- In older buildings, the incoming mains water pipeline from the site boundary to the cold water tank room can be at a shallower burial depth
- Water storage tanks located above ground or in semi-buried configurations.

From water conservation measures

- The introduction of rainwater/greywater/blackwater recycling for water conservation
- Use of percussion taps and low-flow fittings
- A lack of regular flushing of the system as a management procedure.

From higher void temperatures

- Increase in the amount of building insulation and a higher level of airtightness raises the temperature around the pipework
- Centralised plant can introduce additional heat-emitting mechanical/public health-related services in the voids that are common with the DCWS pipework
- Reduced periods of occupancy.

From design and management

- A lack of temperature monitoring within the cold water tank, incoming mains and at the extremities of cold water pipe distribution
- Oversizing the cold water storage volume
- Reduced periods of occupancy and demand, such as at weekends and holidays
- Heat-generating plant and equipment within ceiling voids
- DCWS pipelines should be kept a minimum distance/orientation from any hot water and LTHW heating pipelines within void spaces
- If the plantroom where the cold water storage tanks are located is unventilated, there may be the potential for cold water storage temperatures to increase when there are periods of low usage
- A lack of quality control or legislation, particularly with thermal insulation of plant and equipment
- Insufficient separation between the heat-generating plant and equipment
- If occupancy levels after handover is less than envisaged at design stage, a lack of domestic water draw-off, and infrequently used outlets, may raise temperatures
- The end user not implementing risk assessments and procedures to control the risk of legionella.

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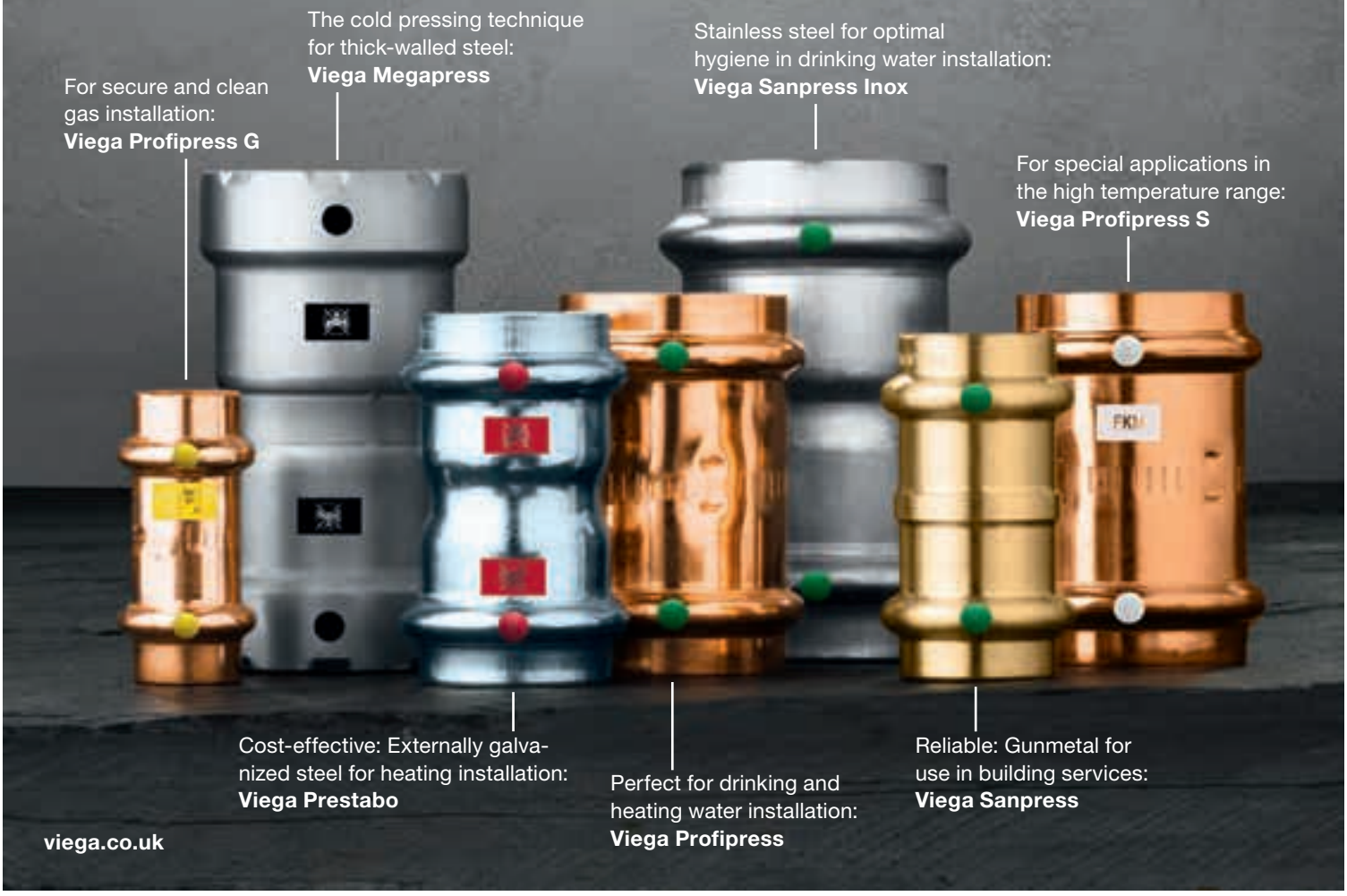

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Pressgun 5

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be installed to monitor domestic cold water consumption and cold water temperatures in the system. Clients should be encouraged to carry out post-occupancy evaluation to learn how systems are performing. Building operators should log data, which can be used to inform standards and guidance updates.

Once the system is operational, implement an appropriate management strategy, which includes manual flushing of mains and cold-water pipework to all remote outlets on a daily routine, and identifying infrequently used outlets to be included in the flushing regime.

The facilities management team needs to be provided with sufficient training and background information relating to the running and operation of the DCWS systems. The benefits of seasonal commissioning and soft landings should also be explained.

Developing standards

Promoting a culture of collaboration and knowledge sharing should be an objective for all. As such, industry experience and academic research should be harmonised. There should also be a review of standards relating to the design and sizing of cold water systems, drawing on the experience of industry professionals and available live data across a range of buildings and sectors. **CJ**

● The issues raised in this article have accumulated through several resources and do not reflect any specific project or Aecom design. The issues and mitigation measures have been compiled from the experiences of multiple engineers, from many consultancies, over several years.

References:

1 UK Health and Safety Executives L8: 2013, Approved Code of Practice and Guidance, *The Control of Legionella Bacteria in Water Systems*

● **RICHARD BEATTIE** MCIBSE MSoPHE is a senior mechanical engineer at Aecom Edinburgh **DAMIEN KANE** MCIBSE is an associate director at Aecom Glasgow **STEVE VAUGHAN** MSoPHE MCIBSE is a public health regional director of Aecom London

DESIGN BEST PRACTICE

- Ensure pipe sizing is carried out as close as possible to the expected demand to ensure good flow and to minimise stagnation and potential heat gain
- External MWS pipework between the site boundary and plantroom should be at a depth of 750mm
- To improve water turnover to demand, isolate and drain down one cold water storage tank section if provided with central division if the total turnover is not as designed
- Increase the thickness of insulation on the cold water system pipework
- Provide a delayed-action, adjustable-height ball valve in water storage tanks to allow stored volumes to be adjusted
- Consider reducing cold water storage levels within buildings appropriate to the building type, and anticipate demand (reduce from 24hr to 12hr storage)
- The addition of a water treatment system, as described as an alternative to temperature regime in L8 Approved Code of Practice and Guidance, *The control of Legionella Bacteria in Water Systems*, to the domestic water services systems. This solution will assist in eliminating legionella within systems, but will not address the issue of water temperature
- Enhance void ventilation movement by introducing high- and low-level grilles to induce airflow through the ceiling voids

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TESTING THE WATER

Unseen corrosion in pipework can have a huge effect on the efficiency of heating and cooling systems. Continual monitoring of water quality helps identify issues at an early stage and helps maximise HVAC performance, says Hevasure's **Steve Munn**

When corrosion occurs in heating and chilled water systems, there are many damaging consequences, not all of which are immediately obvious. Yes, a leak because of wall perforation of pipework is normally spotted fairly quickly – although even this can be missed when it happens overnight or at weekends, resulting in considerable water damage.

Even when leaks do not occur, unseen corrosion on the inside of pipes and HVAC components may produce large amounts of corrosion products – especially magnetite sludge, which can have a serious impact on the efficiency of heat exchangers and pumps, while contributing to the wear of valves and other components.

Occupants of buildings are often seriously inconvenienced and may have to move out while the problem is fixed. Either way, costs are considerable and, recently, there have been several high-profile cases in which the total bill for system replacement, collateral damage, investigation charges and legal charges have exceeded £1m.

Despite the efforts of organisations such as CIBSE and BSRIA, there remains considerable misunderstanding of the causes of corrosion in HVAC systems and of the best way to prevent it from happening.

The primary cause of corrosion in closed water-based heating and cooling systems is dissolved oxygen. Without it, the cathodic half-cell reaction of oxygen reduction cannot drive the anodic part (the dissolution of metals). The use of chemical inhibitors has its place, but should be considered a

RON ELLIS / SHUTTERSTOCK

secondary line of defence, not a substitution for resolving oxygenation problems.

An example of the corrosion of a steel pipe brought about by excessive dissolved oxygen (DO) can be seen in Figure 1. If we accept that dissolved oxygen is the primary issue, what causes this and how can it be prevented?

There are three main ways oxygen can enter a closed heating or chilled water system:

- From aerated water – initial water fill, flushing or fresh make-up water during operation
- From pressurisation problems – negative pressures at the top of systems results in air being drawn in through air admittance valves (AAVs) or seals
- From oxygen diffusion – through the use of non-barrier plastic pipework.

Aerated water from the initial fill cannot be avoided but, providing there is carbon steel in the system, the high levels of dissolved oxygen – around 10ppm depending on temperature and pressure – are quickly consumed, resulting in a superficial 'flash rusting'. Some installers are tempted to use stainless steel pipework, but this can make the problem worse by allowing the DO to remain high, and focusing corrosion on other components with little surface area, such as brass valves.

Also, although flushing with water is usually necessary to clean the inner surfaces of debris, repeated flushing should be avoided because each flush introduces yet more oxygen into the system.

Systems need to be pressurised properly throughout the 24/7 cycle. Expansion capacity needs to be specified correctly, alongside system pressures, and these need to be maintained over the system lifetime. If they aren't, system pressures may exceed the pressure relief valve (PRV) settings, resulting in water losses and the need to top up with fresh, aerated water. However, if system pressures are too low, this could result in air being sucked into the system.

Microbial influenced corrosion (MIC) – primarily caused by the presence of sulphite-reducing bacteria (SRB) – is also responsible for a lot of pipework degradation. Although treatment with biocides is common practice, what is probably not appreciated is that oxygen-induced corrosion is often a prerequisite because this leads to sites – rough textures and nodules – where colonisation of bacteria can occur.

Figure 2 shows the cleaned surface of a steel pipe with a high density of tiny pits – so-called 'pepper-pot' corrosion – which is typical of MIC.

Solutions

In the UK especially, water treatment (pre-commission cleaning and dosing with biocides and inhibitors) has been the preferred approach. BSRIA guidelines require water samples to be taken at regular intervals during commissioning and, after handover, use of the analysis to judge the condition of the system and the water treatment required. Although this approach has merit, and BSRIA guidance should be followed, water sampling alone has several significant deficiencies:

- It is prone to misinterpretation
- It is only a snap-shot view, which can miss sudden and catastrophic changes
- It only highlights a potential problem and not its root cause – especially mechanical integrity issues
- It requires semi-skilled operatives to visit site at regular intervals.

During 16 years of failure investigation,

> The use of chemical inhibitors has its place, but this should be considered a secondary line of defence, not a substitution for resolving oxygenation problems

Data captured remotely from a monitoring station

Figure 1: Steel pipe corrosion caused by high DO levels

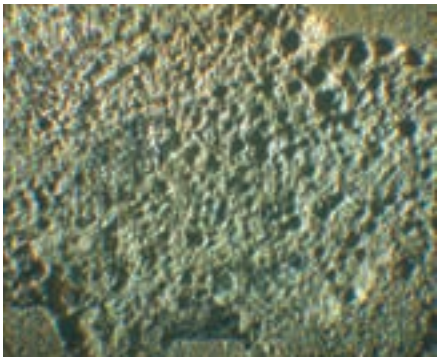

Figure 2: Microbial-influenced corrosion on steel

Midland Corrosion Services has come across many cases where the water analysis suggested all was well, but severe corrosion to pipework and components had occurred.

One of the main reasons for misinterpretation is that low readings for dissolved solids – particularly iron – is taken as evidence that corrosion is not occurring. However, because it is insoluble, magnetite does not get detected by water analysis when it forms in HVAC systems.

What is needed is an approach that determines the condition of an HVAC system accurately, while overcoming the deficiencies of water analysis. This is where continual and remote monitoring of system parameters comes in. Such an approach will not only inform commissioning and maintenance companies of the condition of their client's HVAC systems but – if implemented properly – will identify the root cause of any problems.

Ideally, monitoring equipment should be fully integrated and easy to install. It should provide regular measurement of all key parameters of a system, and send out alerts if critical levels are exceeded before any damage occurs. A monitoring system can check continuously on engineering aspects, water characteristics and corrosion rates (see tables 1, 2 and 3).

Clearly, there are several benefits to continuous monitoring of HVAC systems. Risk of failure and the associated costs are substantially reduced, while recording key parameters produces hard evidence to support organisations facing unfair claims of incompetence, if anything does go wrong after their involvement.

Finally, the significant efficiency losses that occur if systems degrade is avoided, benefiting the environment and the company's finances. Water sampling and treatment has its place, but condition monitoring is surely the way forward. **CJ**

STEVE MUMM is managing director at Hevasure

System parameter	Importance of monitoring
Dissolved oxygen	Need to maintain very low levels
Pressure	Positive pressures must be maintained throughout the system at all times to prevent air being drawn in, but should never exceed the PRV setting
Make-up water	The intake of fresh make-up water into a system indicates a planned maintenance activity (such as a flushing operation) or an unplanned event, such as a leak. Either way, it contributes to increased dissolved oxygen levels
Temperature	This is a key parameter of any HVAC system and needs to be checked constantly to ensure it is operating at the intended level
Flow	The correct flow through different parts of the system is vital for efficiency. Changes to flow rates may indicate blockages or wear of control valve seats

Table 1: Engineering aspects of an HVAC system that require monitoring

System parameter	Importance of monitoring
Conductivity	For systems dosed with an inhibitor or glycol, conductivity is directly related to concentration. Measuring this parameter is essential to ensure that minimum thresholds are maintained, otherwise inhibitors are ineffective and glycols offer insufficient freeze protection. Conversely, over-dosing is environmentally unacceptable and an expensive waste
pH	For most systems, pH should be above nine but, if they contain aluminium (for example, heat exchangers), it is important that the pH of the system water does not exceed 8.5, otherwise corrosion will occur because of passivity breakdown
Biofilm risk	Biofilms forming on pipework can lead to oxygen concentration cells, encourage the growth of sulphite-reducing bacteria (SRB) and reduce the effectiveness of biocides and inhibitors. Left untreated, SRB can lead to microbial influenced corrosion (MIC)

Table 2: Water characteristics that require monitoring

System parameter	Importance of monitoring
Galvanic currents	The galvanic current flows between different metals within a system (for example, steel and copper). Maintaining low galvanic currents is indicative of low oxygen levels and/or good inhibition of metallic corrosion
Crevice corrosion	Crevice corrosion can happen even if general corrosion rates are low. It occurs in localised regions (weld seams or under debris) because of differential aeration effects, and is often a cause of pitting and pin-holing
Corrosion rates	General corrosion rates of specific metals (usually steel) can be measured by use of LPR devices and probes. These normally give a reading of corrosion rates in mpy or (mm y-1), but are not usually set up for measuring remotely

Table 3: Corrosion aspects of an HVAC system that require monitoring

> The primary cause of corrosion in closed water-based heating and cooling systems is dissolved oxygen

Scientists back tests

The Francis Crick Institute has recently taken possession of a £650m biomedical research facility at St Pancras, London.

In April 2015, Laing O'Rourke employed Hevasure to monitor the LTHW and CHW during the commissioning phase of the building. This gave all parties confidence that there were no significant issues and provided hard data on all parameters at handover.

Now that the building is operational, with up to 1,600 scientists, the Institute has commissioned Hevasure to continue the monitoring for a further year.

The Institute is a partnership between six of the UK's most important scientific bodies and research will take place on finding new ways to treat, diagnose and prevent illnesses, such as cancer, heart disease and infection.

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COLD RELIEF

Dry pipe sprinkler systems are recommended where pipes are exposed to freezing temperatures such as loading bays and cold-storage warehouses. Tyco's **Gijsbert van Rooyen** explains the role of dry pipe valves in such systems

Dry pipe sprinkler systems are generally used in areas exposed to freezing temperatures, where water-filled pipes cannot be used

One of the most significant challenges facing fire protection engineers is how to design and specify a risk-based fire safety strategy that protects life, assets and the environment, while also being cost-effective.

Protecting extreme environments – and in particular cold and unheated spaces – poses further challenges when designing an effective fire suppression solution based on the specific needs of the hazard. Cold spaces cover a wide range of applications, including cold-storage and unheated warehouses, multi-storey car parks and loading docks, each with distinct design complexities for both fixed and manual fire protection.

Refrigerated warehouses can contain a wide variety of hazards, including flammable products and combustible packaging materials, which pose a significant fire risk. The construction materials of these cold storage areas also typically feature insulation, such as polyurethane and expanded polystyrene foam, to ensure the cold air remains within the required area.

While newer buildings will include much safer materials with a fire-safe insulation core – including mineral fibres, treated polyurethane or polyisocyanurate (PIR) – the problem remains that older buildings may still use more combustible materials. From an insurance perspective, although these building products tend not to be the cause of fires, they can contribute to a fire event becoming a total loss.

Cold and unheated spaces present a unique challenge for fixed fire suppression systems. These areas are particularly subject to intense and rapidly developing fires, with the added complexity of requiring a fire protection solution robust enough for cold environments.

Storage configuration and building layout within warehouses are conducive to fire spread, and can limit the effectiveness of fire suppression systems that are not designed for the appropriate hazards.

Dry pipe sprinkler systems are generally used in unheated warehouses, parking garages, loading docks and other areas exposed to freezing temperatures, where water-filled pipes cannot be used.

When commissioned for service, the dry pipe sprinkler system is filled with air (or nitrogen), which prevents damage to the piping system by avoiding the freeze/thaw cycle. The subsequent loss of pressure, when a sprinkler is exposed to heat from a fire, causes a dry pipe valve to open and allows a flow of water to be discharged into sprinkler systems.

The dry pipe valve is a differential type valve that uses a substantially lower system (air or nitrogen) pressure than the supply pressure to maintain the set position. Used automatically to control the flow of water into dry pipe fire protection sprinkler systems, it also provides actuation of fire alarms upon system operation.

Dry pipe valves are designed with a variety of inlet and outlet connections, and can be supplied pre-trimmed and semi-assembled for ease of installation.

These products are a critical part of an effective fire sprinkler system. By placing greater emphasis on these systems, design engineers and owners can take responsibility for the safety of cold-storage and unheated warehouses, multi-storey car parks and loading docks to safeguard their operations and reputation. **CJ**

GIJSBERT VAN ROOYEN is the product manager for valves and devices at Tyco Fire Protection Products

IN THE LOOP

To connect the largest shopping mall in Scandinavia to the local district heating and cooling network in Stockholm, 200 pumps had to be installed. **Paul Jones** reports

The Mall of Scandinavia in Stockholm is the biggest shopping centre in the Nordic region, covering an area of 101,048m² and comprising 224 shops and restaurants. The specification of 200 in-line pumps indicates the scale of the project, which opened in November 2015.

The mall is heated and cooled using district heating and cooling from the Norrenergi energy firm. The air in the ventilation system is either heated or cooled, depending on outdoor temperature. The building is so complex that two plant rooms are needed to take water in, and the heating or cooling is exchanged to the building system and circulated into the primary loop by pumps.

The 200 Xylem pumps included main pumps for heating, cooling and domestic hot water, and the smaller circulation pumps in all mixing modules throughout the building.

Dry running – rather than wet rotor – circulation pumps were selected because of their superior efficiency and greater operational reliability. Pumps with dry motors can be more expensive to purchase, but their efficiency and – in particular – greater operational reliability in systems make their use more profitable in the long term.

The main pump groups on both hot and cold systems consist of three pumps: two larger models that run alternately, and one smaller pump to cover low load periods. 'The largest pumps on the cooling side are 37 kW in-line models,' says Ralf Lundqvist at installer Sandbäckens Rör AB.

Two of 150 mixing modules with in-line pumps feeding the ventilation battery with hot and cold water

He says: 'The primary loops feature mixing modules that supply the ventilation batteries with water at the ideal temperature – ensuring that the air supplied into the building is at the optimum temperature for the mall environment.' There are around 150 mixing modules in the entire building, and each module is fitted with an in-line pump.'

A mixing module is the link between a primary and secondary loop in a hydronic heating and cooling system. In the mall, they constitute the link between district heating/cooling and the circuits supplying the ventilation system heating/cooling coils. The secondary loop often operates with different temperatures and flows to those of the primary loop. The mixing module is fitted between the two loops, to ensure that the correct temperature is achieved in the secondary loop.

All pumps are controlled via the building's control and monitoring system and the main pumps are revolution-managed to ensure the most economical operation. **CJ**

Pump systems training

The British Pump Manufacturers Association (BPMA) is running a one day training course on pump systems.

The course examines factors that need to be considered in desiging pump systems. The course features:

- Common types of pump systems
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- System design and operation

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Delivering value-engineered building services solutions

This module focuses on some of the drivers for 'value' in building services engineering, and considers the application of the comparative net present value technique

When designing and installing building services, there is always a case for seeking out best value. Value is, of course, a term that can be interpreted in many ways. This CPD will explore some of drivers for value and, as an example of one of the available tools, explain and apply the comparative net present value technique.

In many a time-constrained design-and-build process, there might be greater 'value' to the project in reducing the time of assessment, design and implementation so that the works are completed earlier – possibly to a standard that just meets the essential elements of the client's brief, but which, in other ways, may still be considered less than ideal. At the other extreme, the (possibly unachievable) 'perfect' solution is practically useless if it is delivered so late that it is impossible to implement for the client's proper benefit– or is just so expensive that it could never be constructed. To deliver holistic 'value' is undoubtedly challenging and – as with many engineering processes – should come down to informed and suitably analytical solutions, based on good practice and innovative thinking and application. 'Value management' techniques have been developed to provide a systematic approach to delivering value.

The formalisation of the techniques of value analysis and value engineering at General Electric in the USA, in the mid-20th century are widely attributed to Lawrence D Miles. His concepts – recognised as an approach to problem-solving through function-based techniques – found their way to many parts of the world and into many environments – including industry, healthcare, and government services.[1] Miles' approach was outlined in his book *Techniques of Value Analysis and Engineering*: 'Created for one specific purpose – the identification of unnecessary costs – value analysis is a system, a complete set of techniques, properly arranged, for the sole purpose of efficiently identifying unnecessary cost before, during, or after the fact.'[2] His book still offers a wonderful set of examples – many focused on manufacturing rather than building services engineering specifically, but is useful reading nonetheless.

In building services engineering, it is particularly important that Miles' quest to root out 'unnecessary costs' should go beyond simple financial expenditures, and would include issues of performance – such as comfort, productivity, health and wellbeing – that are influenced by the many parameters defining the building environmental system.

In her recently published book, CIBSE fellow Jackie Portman[3] highlights that 'building services engineers should have the mentality to make value engineering judgements as part of the design and development process. However, due to the fragmented nature and complex interactions characteristic of the design process, value may get lost.' Importantly, as well as commending the early adoption of a value engineering process, Portman offers a reminder that the 'resulting decisions from the process may result in changes to the original design'.

BSRIA's *Getting value from function*[4] emphasises the need for 'value engineering' to be a continuous process throughout the project, and highlights that 'true value engineering is not cost-cutting, but continued application of cost-effective engineered solutions'. And to ensure that the innovative practices are properly rewarded, BSRIA goes on to recommend that policies should be adopted 'whereby the contractors keep their ideas and benefit from them by securing the project'. It would be prudent to extend this to suppliers and manufacturers.

A precautionary note in CIBSE's AM11 stresses the need properly to account for 'design changes, including any value engineering during construction of buildings that may have a significant impact on

Year	0	1	2	3	4	5	6	7	8	9	10	....	20	30
PV	£100	£97	£93	£90	£87	£84	£81	£79	£76	£73	£71		£50	£36

Table 1: The present value of a single £100 expenditure projected some years into the future

energy efficiency. An update to the predicted energy demands based on the constructed and commissioned building should also be provided, which can then be inserted into the appropriate section of the building log book.'[5]

This whole process will probably resonate with the advocates of building information modelling (BIM), who will be able to identify that many of the attributes inherent in integrated BIM vastly extend the reach of value assessment. Through parametric modelling enabled by BIM and associated software, there are likely to be far more extensive opportunities for undertaking value engineering and sensitivity analyses.

There are many publications that provide a complete value-management process applicable to projects associated with building services engineering. Although 20 years old, BSRIA's *Value Engineering of Building Services*[6] creates a solid starting point.

As an integral part of the value-management process, there is inevitably a need to compare the relative costs of solutions.

Net present value (NPV) technique

It can be misleading to compare the real impact of costs by using simple payback (the sum of all the capital expenditure [capex] and operating expenditure [opex] costs over a project's life), as this does not take account of the benefit of those costs if, for example, that same money had been invested from day one. The basis of an NPV comparison is that money paid out now (capex) is more valuable than the same amount expended later in the life of the project (typically opex). A discount rate is used to convert future expenditure to 'present values', so that different scenarios can be compared on an equal basis. The discount rate, r, is an estimate of what annual benefit the money could gain, so can be used to produce a figure to compare how much money would be invested in the present time, to cover the cost over the specified life of a particular variant of a project.

	Boilers	Cylinders	Pipework	Total capex
Continuous-flow	£5,010	–	£250	£5,260
Indirect-fired storage	£3,827	£3,368		£7,445
Direct-fired storage	£7,600			£7,850

Table 2: Estimated capital costs for the three systems

The present value, D_n, at the middle of year 0, of a payment of £1 made at the middle of year n is given by:

$$D_n = \frac{1}{(1+r)^n}$$

The UK government recommends a discount rate of 3.5%[7] (for projects up to 30 years).

For example, if £10 was paid out in five years' time, the present value of that £10 would be:

$$\frac{10}{(1+0.035)^5} = £8.42$$

The same calculation can be applied for all expenditures over the life of the project. The diminishing present value of, for example, a single expenditure of £100 spent in a particular year is shown in Table 1. So, to spend £100 in 20 years' time, would mean that there was a (theoretical) investment of £50 today.

The significance of the method is highlighted by the statement on the UK Cabinet Office's web page that 'NPV is the primary criterion for deciding whether government action can be justified'.[7] The NPV provides a summation of the present values of the capex and opex over the chosen project life.

The method is only useful as a comparative tool as, for example, if a 10-year life project had two options:

Option one – capex £200 and opex £7 per year, plus a £72 cost (for example, a new filter) in years four and eight.

Option two – capex £210 and opex £20 per year with a 'long life' no-change filter.

By using the multipliers (as established previously for Table 1), the NPV of the two options can be calculated:

NPV option one = capex + opex PV + filter replacement PV = 200+(6.76+6.53+6.31+6.10+5.89+5.69+5.50+5.32+5.14+4.96)+(62.7+54.7) = £376

NPV option two = capex + opex PV = 210+(19.32+18.67+18.04+17.43+16.84+16.27+15.72+15.19+14.67+14.18) = £376

In this case, the NPV of both options have the same value, so the decision would have to be made on the other qualitative assessments. The NPV model can be enhanced if, for example, opex costs were thought to increase yearly. Then, in place of using a constant opex for each year, the sum (before being brought to a PV) would be increased accordingly (for example, by 3% per year).

The final result is sensitive to the chosen discount rate – in this case, a higher discount rate would have favoured option one, since the impact of the present value of the future expenditures (the filters) would have been lessened.

Applying NPV

To illustrate how that NPV can be applied in the comparison of alternative hot water heating systems, consider a (simplified) system for a shower block in a holiday camp, operating 150 days a year, with six showers and four basin taps. Figure 1 shows a traditional indirect-fired storage hot-water system, Figure 2 a direct-fired storage system, and Figure 3 a system with a continuous-flow water heater. (As the pipework is short, there was no need for a recirculating return pipe). These provide the basis of a comparison to determine the lowest NPV over 20 years (based on the calculation

	Heat input per day (kWh)			Gross thermal efficiency	Gas per day 3.115p per kWh		Electricity per day 11.8p per kWh			Total energy cost per day	Total energy cost per year (150 days)	Initial annual maintenance cost
	Delivered	Storage losses	Pipe losses		kWh	Cost	Primary pump (kWh)	Fans and controls (kWh)	Cost			
Continuous-flow	188.10	–	0.48	95%	198.51	£6.18	–	1.56	£0.18	£6.36	£955	£325
Indirect-fired storage		3.46		89%	215.77	£6.71	0.34	0.89	£0.15	£6.86	£1,030	£240
Direct-fired storage		11.43		96%	208.35	£6.48	–	0.83	£0.10	£6.58	£988	£240

Table 3: Estimated operational costs for the three systems

	Continuous-flow	Indirect-fired storage	Direct-fired storage
NPV	£28,706	£30,874	£30,499

Table 4: Net present value comparison of the three systems

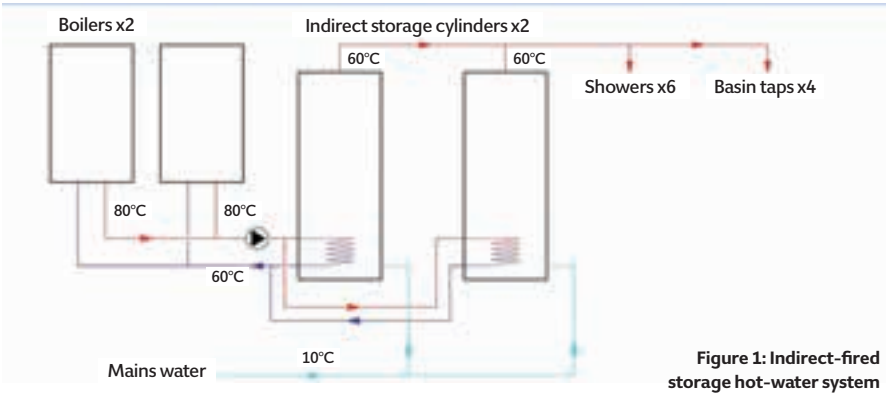

Figure 1: Indirect-fired storage hot-water system

in an independent report produced by a consultant for a manufacturer[8]).

From an analysis of the 'loading units' of the appliances, an overall design flow rate of 0.5 $L \cdot s^{-1}$ was determined that, if mixed to 40°C, would equate to an instantaneous heat input of approximately 63kW (from mass flow rate x specific heat capacity x temperature rise, assuming the mains water entered at 10°C). An hourly usage profile for a typical day was assumed, with a total daily usage of 5,400 litres of water at 40°C and a peak hourly usage of 1,800 litres. The boilers' electrical load was taken as 15W in standby and 60W when operating (that is, to cover controls and combustion fans). For the energy required to deal with the instantaneous hot-water demand, the analysis assumed that the bulk of the hot-water demand would come from the showers. Each shower would typically have a flow rate of around nine litres per minute, which – at an outlet temperature of 40°C – would equate to a load of around 19kW each.

For the indirect-fired storage option, the analysis was based on a pair of 40kW natural gas boilers heating a pair of 400-litre cylinders. The factory-insulated cylinders have a standing heat loss of 72W with water stored at 60°C. The boilers were assumed to have a gross efficiency of 89%, based on flow of 80°C and return of 60°C. The specific pump power of the primary pump was assumed as 75W per $L \cdot s^{-1}$.

For the direct-fired storage option, the analysis was based on a pair of 230-litre cylinders with integral burners, each with around 37kW output, and standing losses are 240W per cylinder, based on water being stored at 60°C. The gross thermal efficiency was assumed to be 96%.

For the continuous-flow option, the analysis was based on four modular water heaters that each have a nominal output of 48kW. For this particular application, because there is a

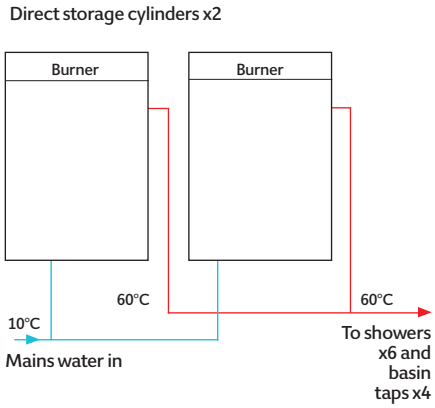

Figure 2: Direct-fired storage hot-water system

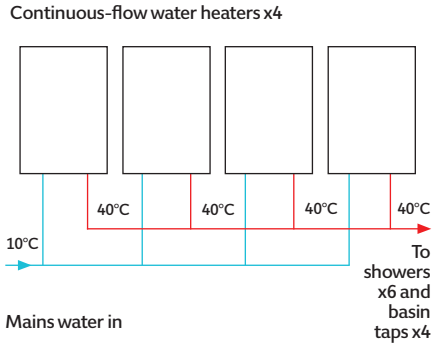

Figure 3: Continuous-flow hot-water system

very short run of pipework between the water heaters and the fixtures, it was deemed possible[8] for the water heaters to generate water at 40°C, and the risk of Legionella would be dealt with by regular flushing of the system. For the load of one shower (19kW), a single continuous-flow water heater would operate with an efficiency of 95% – based on the manufacturer's performance curve – and, as the hot water demand increases, it was assumed that the modular nature of this particular configuration would allow 95% efficiency to be maintained for the bulk of the demand.

The NPV analysis included the initial capital costs, projected annual fuel costs, and estimated annual servicing costs. End-of-life costs have been ignored, as the residual scrap value of the equipment would typically be offset by the cost of removal and disposal.

The capital costs were taken from standard pricing tables and manufacturers' literature, and are shown in Table 2.

The annual fuel cost assumes the daily fuel consumption occurs for 150 days each year (the summer holiday season). The servicing costs are based on £130 a year per boiler, and £160 a year for a boiler and cylinder, and where there are multiple units, the service cost is discounted by 50% for each subsequent unit. The servicing costs were assumed to increase by 2% each year.

The annual operating costs are shown in Table 3.

The usage profile for this case study is particularly suited to continuous-flow systems – that is, high but infrequent demand over the day – which is why there is an advantage in fuel consumption over the storage systems.

The resulting NPVs were calculated in the same way as the earlier example, applying a discount rate of 3.5%. The comparative NPV of the three systems is summarised in Table 4, which shows the NPV of the continuous-flow system is around 6% to 7% lower than those of the two storage systems, based on a 20-year analysis period for this particular installation.

Further reading:

For some wonderful historical perspective on the overall approach and techniques, the e-book version of Lawrence D Miles' *Techniques of Value Analysis and Engineering: 3rd Edition* is full of great examples. Beyond that, there is no shortage of texts available via the web. A great place to learn about parametric analysis is the PhD thesis and subsequent writings at **www.danieldavis.com**

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1 **minds.wisconsin.edu/handle/1793/301** – accessed 24 August 2016.

2 Miles, L D, *Techniques of Value Analysis and Engineering: 3rd Edition*, Lawrence D Miles Value Foundation (Kindle Edition 2015).

3 Portman, J, *Building services engineering: after design, during construction*, Wiley, 2016.

4 See **gov.uk/guidance/f-gas-in-refrigeration-air-conditioning-and-fire-**

5 CIBSE AM11 *Building performance modelling.*

6 Hayden, G W and Parsloe C J, BSRIA AG 15/96 *Value Engineering of Building Services*, BSRIA 1996.

7 **data.gov.uk/sib_knowledge_box/discount-rates-and-net-present-value** – accessed 24 August 2016.

8 *Life-cycle study of continuous flow water heating* – report for Rinnai by Aecom, 2016 (available by request from Rinnai).

Turn over page to complete module

Module 100

October 2016

Rinnai
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1. What or who is the source of the quote that 'due to the fragmented nature and complex interactions characteristic of the design process, value may get lost'?

- ☐ A BSRIA's *Getting value from function*
- ☐ B BSRIA's *Value engineering of building services*
- ☐ C CIBSE's AM11
- ☐ D Jackie Portman
- ☐ E Lawrence D Miles

2. What is the NPV discount rate currently recommended by the UK government for a project of 25 years' life?

- ☐ A 0.5%
- ☐ B 1.5%
- ☐ C 2.5%
- ☐ D 3.5%
- ☐ E 5.5%

3. Applying the NPV method, approximately how much would notionally be required to be invested today to be able to spend £150 in 10 years' time, if the discount rate was 5%?

- ☐ A £87
- ☐ B £92
- ☐ C £97
- ☐ D £102
- ☐ E £107

4. In the example of the shower block, which of the following were not included in the model?

- ☐ A End-of-life costs
- ☐ B Estimated annual servicing costs
- ☐ C Gross thermal efficiency of the systems
- ☐ D Initial capital costs
- ☐ E Annual fuel costs

5. When the NPV comparison was applied to the example shower-block systems, what was the approximate difference in costs between the lowest and highest net present value?

- ☐ A 1%
- ☐ B 3%
- ☐ C 5%
- ☐ D 7%
- ☐ E 9%

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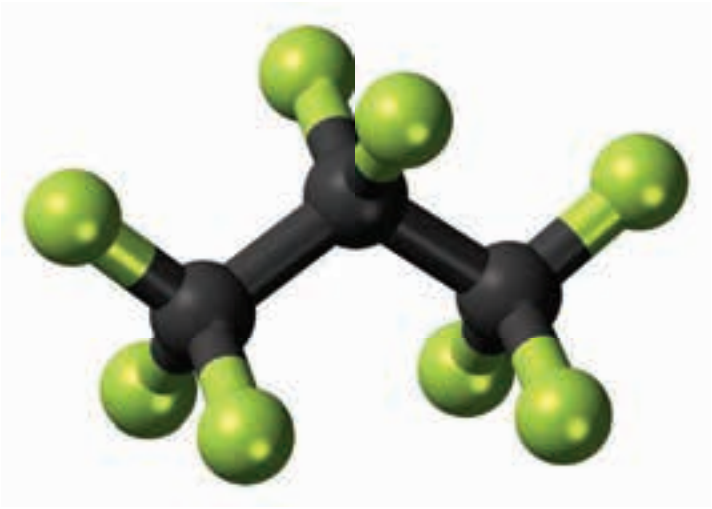

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Dunham-Bush trench heating system installed at Amp Technology Centre

Dunham-Bush trench heating systems offer a successful solution for keeping heat in – and cold out – of commercial buildings. They combat the effects of down draughts on cold surfaces – such as large glazed areas and outside walls – and have been installed in Building 3, a new facility at the Advanced Manufacturing Park Technology Centre in Rotherham.

'Dunham-Bush HTA trench heaters were specified both for their aesthetic qualities and their high energy performance,' said Russell Entwistle, of M&E consultants WYG.

● **Email phil.bell@dunham-bush.co.uk or info@dunham-bush.co.uk**

Aquatech Pressmain says update your water supply system to save money

By installing up-to-date water supply equipment, you can increase efficiency, benefit from an improved system and save money.

For flats at Hammond & Dickson houses in Stoke-on-Trent, Aquatech Pressmain visited the site and produced an in-depth proposal, including bespoke solutions for JPR Engineering, a local mechanical and electrical company.

JPR Engineering installed pressurisation units, two water boosters and three circulating pumps – all designed and built for the project by Aquatech Pressmain.

● **Call 01206 215 121, email sales@aquatechpressmain.co.uk or visit www.aquatechpressmain.co.uk**

Advanced Air completes package for project Nova Victoria

Fan coils, valve sets, diffusers, fire smoke dampers and control panels worth a total of £2.5m, have been supplied by Advanced Air to Mace for the Nova project in London's Victoria.

The urban campus features 5.5 acres of mixed development, and commercial and residential buildings are air conditioned by four-pipe cooling and heating fan coils from Advanced Air.

Overall, 1,350 horizontal chassis units, type ECO255, were used for the commercial building and approximately 1,000 vertical units, EPIC280 and ECO255, for residential application.

The fan coils were subjected to extensive independent testing at BSRIA and SRL test centres. The residential fan coils had a complete downstream package comprising a specially designed plenum/attenuator, which connects directly to the architecturally designed flowline diffuser. These deliver air to a shadow gap/slot, so just a simple slot in the ceiling is seen – creating the aesthetics essential for these luxury apartments.

● **Call 07767 776 843 or email tchambers@advancedair.co.uk**

FDS appointed to first phase of £1bn regeneration scheme

Smoke ventilation contractor Fire Design Solutions (FDS) will supply fire safety systems to the Morello development – the first phase of a £1bn regeneration project in Croydon, south London.

Appointed by Menta Redrow, FDS will design, install and commission a number of its systems to ensure the development meets all of the required fire safety Building Regulations.

Mechanical smoke ventilation systems (MSVS) will be installed in all four of the development's blocks. Each 0.5m² shaft will protect the common areas by removing smoke in the event of a fire, providing a clear escape route for residents and assisting the fire services. To maintain comfortable temperatures during everyday use, FDS will install a chiller system connected to the MSVS, which delivers chilled air into the common areas via the MSVS's smoke shafts.

● **Visit www.firedesignsolutions.com**

How can we make adiabatic systems more energy efficient?

Achieving clean indoor air means using clean water in your adiabatic humidifier. To eliminate the risks from hard water, a water purifying system – used in conjunction with a humidifier – is ideal.

HygroMatik's products have been developed to be used autonomously or in harmony with one another. By combining the HPS/LPS and WaterLine RO systems, users can combat mineral deposits effectively to supply only the cleanest air.

HygroMatik's adiabatic humidifiers offer hygiene, high humidification and very low energy consumption.

● **Call 02380 443 127, email info@hygromatik.co.uk or visit www.hygromatik.com**

Condair at HVAC 2016, UK construction week

Condair will be previewing the world's first condensing gas-fired steam humidifier at UK Construction Week, which takes place at the NEC Birmingham on 18-20 October. It will be on stand 502 in the HVAC hall.

The new Condair GS recovers heat from exhaust gases to pre-heat its incoming water supply, saving energy and making it a highly efficient gas-fired humidifier.

It is the latest in a series of product developments by Condair, formerly JS Humidifiers, over the past two years – and these will also be showcased at the exhibition.

● **Visit www.condair.co.uk**

AET adds energy-saving heat meters to its range

Underfloor air conditioning systems provider AET has announced an exclusive distribution deal with Italy-based DAE Energia and introduced its latest energy-saving product range. This features heat-metering solutions for residential and commercial applications.

With demand for heat interface units growing significantly because of the requirements for low carbon energy solutions, the AET range consists of single-plate and twin-plate, wall- or floor-mounted units, with associated controls.

● **Email steve@aetenergy.co.uk or visit www.aetenergy.co.uk**

Elco's Nexus units – receive WRAS approval

The Nexus Futura Bitherm heat interface units (HIUs) from Elco have received WRAS approval, making them suitable for a wide range of residential applications.

Nexus Futura Bitherm units are indirect wall-mounted modules, which provide central heating transfer up to 19kW and instantaneous hot water services (HWS) up to 70kW. The approval was granted after rigorous mechanical and water-quality testing, during which the Nexus Futura Bitherm HIUs demonstrated compliance with the relevant regulations.

● **Visit www.elco.co.uk**

EcoMESH adiabatic air inlet cooling

EcoMESH is a unique wet mesh concept that intermittently sprays water directly from the mains to reduce energy consumption and eliminate high ambient problems for any make/model of air-cooled chillers, dry coolers, condensers and refrigeration plants.

EcoMESH's patented water-spray technology has solved problems in units worldwide. Once fitted, it is virtually maintenance-free and has been found to pay back in one cooling season.

● **Call 017332 44224 or visit www.ecomesh.eu**

BIM (Revit) files now available from Luceco website

Luceco has recently launched a suite of BIM files created in Revit, covering its range of commercial LED luminaires. This enables clients to download the information they need to aid the design process and create building models.

Building information modelling (BIM) is a collaborative way of working that is intended to increase the speed of the construction industry using digital technologies. BIM uses product data and a 3D computer model that can be applied throughout a project life-cycle.

● **Call 07890 320 152 or email Zoe.nh@luceco.com**

DRU Fires strengthens team with key appointments

DRU Fires has made two new appointments in its UK subsidiary company, Drugasar.

Andy Phelps has become area sales manager for the South, South West and central areas of England, and Wales. Phelps has spent his entire career in the UK gas appliance industry, and previously worked for British Gas.

Gerard Parker has been promoted to customer services manager. He has been with DRU since 2012, having originally worked as a customer services assistant.

● **Visit www.drufire.co.uk**

Crick sticks its neck out to pioneer biomedical research

The new Francis Crick Institute has a commanding position within a cluster of science-based organisations near St Pancras in central London. Named after Sir Francis Crick – famed for his contribution to the identification of the structure of DNA – the interdisciplinary medical research institute will conduct studies on why disease develops and look at ways of preventing and treating illnesses such as cancer, heart disease and neurodegenerative diseases.

A wide range of pumps from Grundfos will be supporting this development. These solutions form an integral part of this precision building application approach, and include various Grundfos products that will help to support the heating, cooling, water supply, pressure boosting and pressurisation requirements.

The Francis Crick Institute is a consortium of six of the UK's most successful scientific and academic organisations, which invested £700m to establish the institute.

● **Call 01525 850 000, email grundfosuk@grundfos.com or visit www.grundfos.co.uk**

Air quality gold for Kingspan pipe insulation

Kingspan Industrial Insulation has again displayed a commitment to manufacturing excellence, after products in its Kingspan Kooltherm FM Pipe Insulation range were awarded a best-in-class Eurofins Indoor Air Comfort Gold certificate.

The certification recognises Kingspan Kooltherm FM Pipe Insulation as an outstanding material, according to the VOC Indoor Air Quality emissions regulations.

It has achieved an A+ under the French VOC Regulations, a pass under AgBB, and compliance for Breeam and Leed V4 on European projects, including the UK.

● **Call +44 (0) 1544 388 601, email info@kingspaninsulation.co.uk or visit www.kingspanindustrialinsulation.com**

Double CHP arrival at Imperial College London

The £32m in energy savings set to be made by Imperial College London moved a step closer recently, when the project team – led by Vital Energi – took delivery of two 4.5MWe combined heat and power (CHP) engines, which will be installed at the heart of the new energy centre.

The 44 tonne CHP engines completed their journey from Innsbruck, in Austria, to London where they were carefully manoeuvred into the college's basement energy centre.

Mike Cooke, regional director for Vital Energi, said: 'Imperial College London wanted to reduce its carbon emissions and save energy costs, and we are delighted to have worked in partnership with the college to realise these ambitions. It will now receive guaranteed savings of £32m and carbon reductions of 100,000 tonnes over the next decade.'

All savings are being guaranteed under an energy-performance contract provided by Vital Energi.

● **Visit www.vitalenergi.co.uk**

Mikrofill helps fuel savings at Old Stocks Inn

The Old Stocks Inn is a Grade II listed hotel in the picturesque town of Stow-on-the-Wold, in Gloucestershire.

During a full condition survey, Ridge & Partners concluded that the existing low pressure hot water (LPHW) and the hot water system (HWS) needed upgrading.

Ridge designed new circuits to incorporate two Mikrofill Ethos 90kW condensing boilers complete with frames, Mikrovent low loss header and a Mikrofill 150 pressurisation package. The LPHW and HWS strategy has contributed to the hotel's significant savings on its gas consumption.

● **Call 03452 606 020 or visit www.mikrofill.com**

Luceco lights up Central Mall at Khalifa City, Abu Dhabi

Central Mall is one of the major shopping destinations in Khalifa City, Abu Dhabi. Luceco supplied a full LED lighting solution for the project, the main product for which was the LED Indus linkable high-output linear luminaire. This offers 50,000 hours of maintenance-free operation.

The contract confirms Luceco's position as a LED lighting solutions supplier in the United Arab Emirates, and represents a milestone as the first shopping mall in Abu Dhabi to be fully equipped with LED lighting technology.

● **Call 07890 320 152 or email Zoe.nh@luceco.com**

Plate heat exchangers perfect for palace

Atlantic Boilers has reduced the heating plant distribution costs for the seven satellite plantrooms at Buckingham Palace, London.

The project uses Atlantic RS Turboflow plate heat exchangers, which substantially increase economic heat transfer, allowing the boiler flow temperature to reduce to 85°C for space heating and 65°C for domestic hot water.

As a result, the palace's energy bill has been reduced by 10-15%. The installation will also allow the introduction of carbon-neutral fuels to the boiler house.

● **Call 0161 621 5960, email technicalsales@atlanticboilers.com or visit www.atlanticboilers.com**

Ruskin extends slot diffuser options

Ruskin Air Management has extended and enhanced the options available with its FlowBar range of high-capacity linear slot diffusers.

Manufactured by Ruskin brand Air Diffusion, FlowBar diffusers are designed to combine very high air handling capacity with maximum flexibility. They are suitable for ceiling and sidewall applications.

The company has increased the slot width options available by adding 63.5mm and 76mm widths (FL25 and FL30) to cater for applications requiring higher air volumes where the diffuser length is limited.

Air Diffusion has also added two more border styles (55 and 11) across the entire range and new flange profiles to suit ever expanding installation requirements.

The discrete and stylish look of these diffusers allows them to blend into a design, becoming almost invisible, if required, or even part of the interior design because of their sleek lines. As a result, they are popular with architects, interior designers and their clients.

● **Email sales@air-diffusion.co.uk or visit www.ruskinuk.co.uk**

Oventrop delivers Passivhaus standard

Oventrop UK has supplied 18 Solcos solar thermal systems to a Teign Housing development in Layne Fields, Christow, within Dartmoor National Park. The development, comprising 18 homes, will be built to the Passivhaus standard, one of the highest in environmental building.

Oventrop UK worked tirelessly with the architect, Passivhaus consultants and mechanical contractors, Radiate Plumbing and Heating, to develop and deliver high-efficiency systems to meet the rigorous Passivhaus criteria.

● **Call 01256 330 441, email info@oventrop.co.uk or visit www.oventrop.co.uk**

Trilux Akademie UK releases new training programme

Trilux Akademie is set to start its 2016 autumn training season with a new programme. Running from September to December, the programme includes seminars, webinars and theme days dedicated to the latest lighting trends and branch topics, ranging from light management to human-centric lighting.

Highlights of the programme include a DIALux for Beginners one-day course designed for graduates and those new to light planning. Participants will become familiar with the fundamental functions of DIALux, including creating projects, selecting and implementing luminaires, and calculating planning results.

At the Lighting & the Digital Revolution event, on 27 October in Manchester, Trilux Akademie will provide a fascinating insight into the future of light and look at its role in the digital revolution.

Renowned experts and Trilux specialists will discuss future lighting technologies.

For full details of all the training modules, go to our website or download the programme.

● **Visit www.trilux.com/uk or www.trilux-akademie.com/uk**

Wieland offers a wide range of solutions for lighting technology

Wieland Electric offers a comprehensive portfolio of products, designed to provide intelligent and efficient lighting solutions.

They range from simple system connectors to lighting connection systems and a variety of pluggable installation options for indoor and outdoor applications.

The products are supported by Wieland's flexible busbar system, the award-winning gesis NRG, for energy supply and lighting control, plus gesis Flex, the modular and pluggable system for room and building automation.

● **Call 01483 531 213 or visit www.wieland.co.uk**

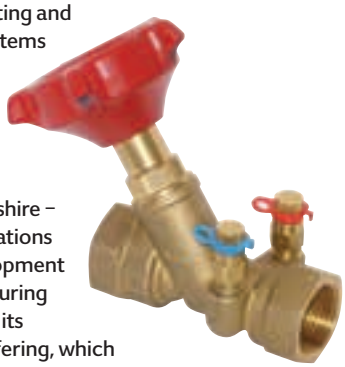
Open protocol control solution takes centre stage at theatre

An open protocol control solution from global energy and building controls specialist Resource Data Management (RDM) is helping Edinburgh Playhouse to deliver optimal environmental conditions and comfort for its visitors, while reducing its energy consumption and carbon footprint.

Controlling multiple aspects of the heating and ventilation system, the solution uses the RDM range of intuitive controllers and free license PLC software, TDB. The installation was completed by J Fletcher Engineers.

● **Call 0141 810 2812 or email rebecca@resourcedm.com**

Pegler Yorkshire completes static valve offering



To ensure heating and ventilation systems work to their optimum efficiency, valves are a key element.

Pegler Yorkshire – with its foundations in valve development and manufacturing – is increasing its static valve offering, which incorporates ultra-low and medium-flow static products to complement all flow variables.

Within the Ballorex Commercial Valves range, the Pegler 1260 fixed-commissioning, double-regulating valves incorporate a fixed plate orifice for accurate flow measurement and regulation. The design includes an oblique pattern body and easily accessible test points.

● **Call 01302 560 560, email brochures@pegleryorkshire.co.uk or visit www.pegleryorkshire.co.uk**

Industry expert appointed as a non-executive director

Titon Holdings – manufacturer and supplier of ventilation systems and window and door hardware – has appointed Kevin Sargeant as non-executive director, with effect from 1 September 2016.

Sargeant (right) is a well-known and respected figure in the ventilation industry. In 1990, he joined Vent-Axia – a subsidiary of Smith Industries – where he was instrumental in its growth until 2002, when Volution Holdings was created. He has held many senior strategic-development roles with major players.

● **Visit www.titon.co.uk**

Sanha fits in with renewable company

Sanha press-fit technology has been used by woodchip-drying machines manufacturer Woodtek Energy in its biomass heating systems.

The Sanha Nirosan press system has performed consistently for Woodtek Energy, saving time and unnecessary labour thanks to the simplicity of its installation, while providing a high-quality finish.

The renewable company has been using the Sanha press system for many years, starting on large commercial heating installations in chicken sheds.

● **Visit www.sanha.com**

Evomax 150 packs power into a small package

When a high-output wall-hung condensing boiler is needed for a commercial installation, look no further than Evomax 150 from Ideal Commercial Boilers.

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S&P product news

S&P's RHE high-efficiency heat recovery ventilation range is now available in horizontal and vertical configurations, and features: thermal wheel heat exchangers; EC plug fans; plug & play controls; integrated bypass; and a variety of heating options with balanced airflows up to 10,000m^3/h.

The company also offers a remote-monitoring option on all its commercial heat recovery ranges. This automatically sends an email or text message when filters or fans require maintenance or attention. Revit files are available on request.

● **Call 08454 700 074**

Thermal energy storage (TES)

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It also offers smaller roof space and full standby capability using +8~15ºC phase change material (PCM) containers for conventional chilled water applications.

● **Call 01733 245 511**
or visit www.pcmproducts.net

Myson LST radiators – quality from top to bottom

Not all LST radiator manufacturers offer a 10-year warranty on the casing and the product. However, Myson is so confident of the quality of its product that it offers a 10-year guarantee on its LST radiator and the casing, giving it full cover against faulty materials or manufacturing.

The Myson LST radiator is perfect for commercial projects where safety is key and, with the quality guarantee, you get the peace of mind you need for your project.

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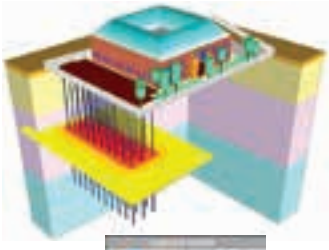

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Joshua Eckett, Buro Happold (progressed from LCIBSE EngTech to MCIBSE IEng in 2014).

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- International agreement (Dublin Accord) overseas qualifications.
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To find out if your qualifications meet the academic standard contact membership@cibse.org

Applications for LCIBSE EngTech can be submitted anytime.

Interviews for alternative route applicants are held across the UK and Ireland, Hong Kong, UAE, Qatar, Australia and New Zealand.

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Get in touch by emailing **membership@cibse.org** or call **+44 (0) 208 772 3650**

MENTORING THE NEXT GENERATION

Troup Bywaters + Anders' award-winning apprentice scheme is benefiting the firm and young people. **Peter Anderson** explains how the programme is changing company culture

Building services consultant Troup Bywaters + Anders (TB+A) has been attracting plaudits for its apprenticeship scheme, which offers on-the-job education and chartership for school-leavers. The firm was crowned winner of the Excellence in Social Responsibility (up to 249 employees) category at the Investors in People Awards this year and, in 2015, building services design technician apprentice Caitlin Stuart was named Apprentice of the Year at the Women in Science, Technology and Engineering (WISE) Awards. Apprenticeships are now the main route into TB+A and they are helping the company work towards its target of making 30% of its starters female. Now in its fifth year, the scheme has employed 27 young people (with a further 12 apprentices starting this year), which represents 20% of the workforce.

Why did TB+A start an apprentice scheme?

TB+A has always been about nurturing and developing people and has organically grown to be a national practice. In 2009, two things happened that made things difficult for young people; higher university course fees discouraged those from disadvantaged backgrounds from starting degrees, and the recession meant firms were not recruiting. The press were talking about a 'lost generation' and we wanted to make a difference. That's part of our partnership ethos. We didn't start apprenticeships because we needed people; there was a recruitment freeze at the time – we were looking longer term.

How did you establish the scheme?

Over a number of years the colleges were not offering courses suitable for the building services industry needs.

> Our focus on growing people is about investing in the future generation

We partnered with them to develop and tailor the content of the qualifications, and worked with the Technician Apprenticeship Consortium and CIBSE to get a structure in place. Our first intake was in 2012 and these young people have excelled in their NVQs and gone on to study at degree level as part of our apprenticeship scheme. Their achievements have been impressive.

What are the benefits for apprentices?

We offer a route into a profession. Many firms take apprentices on but only ever train them to EngTech and leave them as technicians – they then get graduates from elsewhere. Our commitment has always been to support apprentices through their industry training to fully qualified engineer status. They begin studying for a BTech and NVQ at one of the national colleges we partner with on day-release basis, and then go on to a degree or HND at university.

We will then support them through chartership. We want them to be part of our business and, potentially, become partners. From 16, we can instill in them the culture and ethos, and get them thinking how they can influence the business. We have an apprentice academy, enabling them to have a say in their education, training and have an input in management decisions.

They learn fast and have shown great skill and aptitude which means they are able to run their own projects gaining experience as they go. A lot of our established engineers want to give something back. It's not all about money. When they mentor apprentices they find it fulfilling.

Why is diversity so important?

As a policy, we try to get a diverse mix of apprentice engineers. We realise that men are predominant in our industry and we want to make a difference; our female intake is now close to 30%. The more we employ, the easier it is to recruit women. If you have people with broader socioeconomic backgrounds it promotes a better workplace. I would like to take someone who may not have achieved at school. You see so many kids who have desire but have not had chances in life. Our apprentices are really keen to be involved in mentoring such a person.

How are apprentices helping Troup Bywaters + Anders?

We're a people business – we sell people not widgets. We put a lot of time and effort into helping them to be the best they can be and, by training them, they will be imbued with our partnership ethos. I believe our staff retention rates for apprenticeships will be far higher than through any graduate scheme.

At 22/23 , the apprentices have so much experience under their belts and, with the mentoring and guidance, understand the different contractual relationships; they are much more rounded because they have worked for such a long time. Their presentation skills are amazing. They are so confident yet measured, without being cocky. It's life skills you build into them from the age of 16 – and they never lose them.

We were very pleased when Caitlin Stuart was asked about her ambition after winning the WISE award; she said she wanted to be the first female partner. She sees her future at TB+A.

Our focus on growing people through our unique apprenticeship scheme is about investing in the future generation and therefore our business.

● **PETER ANDERSON** is managing partner at Troup Bywaters + Anders

Events & training

NATIONAL EVENTS AND CONFERENCES

CIBSE Young Engineers Awards 2016
13 October, London
Comprising the Graduate of the Year and Employer of the Year prizes.
www.cibse.org/yea

CIBSE Building Performance Conference and Exhibition
17-18 November, London
The annual conference returns to the QEII Conference Centre, with a programme that again promises to inform and inspire. Speakers include Max Fordham and Patrick Bellew. Visit the website for details of the full programme and to book.
www.cibse.org/conference

CPD TRAINING

For more information, visit **www.cibse.org/mcc** or call **020 8772 3640**

Sanitary and rainwater design
5 October, London

Practical HVAC controls
5 October, London

Energy building regulations: Part L
6 October, Manchester

Emergency lighting to comply with fire safety
7 October, London

Lighting design: principles and application
12 October, London

Electrical distribution design
13 October, London

Energy strategy reports
18 October, London

Mechanical services explained
19-21 October, Manchester

Building drainage explained
20 October, London

Electrical services explained
25-27 October, London

Building services explained
26-28 October, London

ENERGY ASSESSOR TRAINING

For more information visit **www.cibse.org/events** or call **020 8772 3616**

Air conditioning inspector training
4 October, London

LCC design and EPC
4-5 October, Sheffield

LCC building operations and DEC
11-13 October, London

Heat networks
12-13 October, Birmingham

ISO 50001
20-21 October, London

CIBSE GROUPS, REGIONS AND SOCIETIES

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

FM Group: Electrical safety and arc flash for data centres and critical environments
5 October, London
Andrew Hogan will present an overview of modern electrical safety and a structured analysis to arc flash.
www.cibse.org/fm

HCNW: Debate
6 October, London
Annual Home Counties North West debate, with expert panel.

North West and SLL: Dialux evo lighting software
11 October, Manchester
Seminar explaining how DIALux evo, the BIM-orientated design software, supports the designer in producing an integrated lighting layout.

CIBSE ASHRAE 40th anniversary seminar
12 October, London
Anniversary seminar, titled: Defining, delivering and assuring building environments that are truly fit for use.
www.cibse.org/ashrae

West Midlands: Technical seminar on new Lift Standards EN81-20 and EN81-50
12 October, Birmingham
CPD seminar on new lift standards.

HCNW: Building physics and optimised design – design by algorithm?
18 October, High Wycombe
Debate on current technologies and developments in BIM, looking at the possible trajectory where 'deep learning' and quantum computing may have the potential to automate building services design.

CPD event – Energy, economy, environment: The Event Horizon
19 October, Dublin
Presentation by Chris Jones, MCIBSE, CIBSE Home Counties North West chair.

Daylight Group: Temporal influences on glare response
19 October, London
Presentations by Sergio Altomonte and Michael Kent from the University of Nottingham.
www.cibse.org/daylight

West Midlands: Breathe easy – engineering air quality solutions now
21 October, Birmingham
Event looking at the problems and practical engineering and policy solutions to address UK air quality challenges.

Young Engineers Network ball
22 October, London
www.cibse.org/yen

Society of Façade Engineering technical evening
25 October, London
www.cibse.org/sfe

West Midlands: Dialux evo lighting software
26 October, Birmingham
Seminar explaining how DIALux evo – the BIM-orientated design software – supports the designer in producing an integrated lighting layout.

Energy Performance Group AGM
27 October, London
www.cibse.org/epg

Joint HCNW, SLL and CIBSE Heritage Group event: By gaslight tour
1 November, London
A guided walking tour by Rebecca Hatch, with commentary on gas lighting in Westminster.

West Midlands: ISO 50001 implementation and benefits
2 November, Birmingham
Technical seminar.

FM Group: Power over Ethernet (PoE)
2 November, London
Powered ethernet is a technology that continues to push accepted limits. This presentation covers the extensive research undertaken with De Montfort University.

CIBSE membership and registration briefing session
3 November, London
Focusing on applications for the Associate and Member grades and Registration with the Engineering Council at the Incorporated Engineer and Chartered Engineer levels.

SoPHE 13th anniversary dinner
3 November, London
Society of Public Health Engineers anniversary dinner.

Scotland Region annual dinner
4 November, Glasgow
The evening will also celebrate the region's 80th anniversary.

FM Group: Building legislation and compliance
8 November, London
Event hosted by Clyde & Co, with speakers Rod Hunt and Jo Harris.
www.cibse.org/fm

Jonathan Speirs Memorial Lecture

6 October, Edinburgh

The Society of Light and Lighting (SLL) will be holding the third annual Jonathan Speirs Memorial Lecture on 6 October, in Edinburgh.

This year's speakers will include Malcolm Innes (pictured), senior lecturer at Edinburgh's Napier University and author of *Lighting for Interior Design*, as well as Cashel Brown, lighting designer for Nulty + and 2014 recipient of the Jonathan Speirs Scholarship fund.

During his time as a director of Speirs + Major, Jonathan Speirs earned a reputation for creating lighting schemes that exuded the power of the creative and controlled use of light to transform structures and spaces.

Over the years, Speirs also received many personal awards, including the Royal Incorporation of Architects in Scotland (RIAS) Lifetime Achievement Award, an honorary membership of the IALD and, in 2011, was given the Professional Lighting Designers Lifetime Achievement Award. In 2009, Speirs was given Honorary Fellowship of the Society of Light and Lighting and delivered its centenary lecture. Along with Mark Major, he was also made a Royal Designer for Industry in 2012.

In 2014, SLL established an annual lecture to mark the life and work of Jonathan Speirs.

The lecture will be held at Dovecot Studios, Edinburgh. Refreshments will be provided following the talk, when there will be an opportunity to network.

For more information, visit **www.cibse.org/sll**

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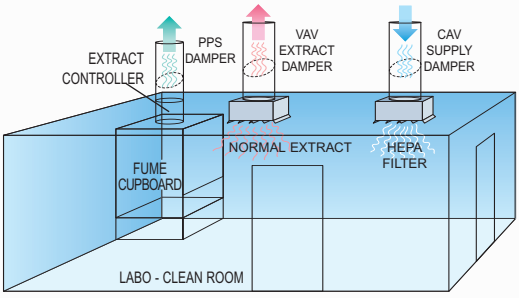

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