CIBSE JOURNAL

CIBSE

The official magazine of the Chartered Institution of Building Services Engineers

August 2011

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www.cibsejournal.com

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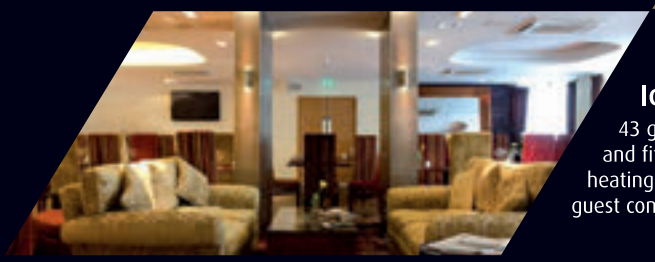

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PEOPLE, JOBS, EVENTS

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Cover photo: Courtesy of Olympic Delivery Authority

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Time to treasure this financial no-brainer

David Cameron's declarations that his coalition government will become the greenest ever are in danger of looking hollow, if he fails to overturn Chancellor George Osborne's ill-thought-out opposition to a proposed amendment to the Energy Bill, which is expected to become law in the autumn.

The amendment would make it mandatory for commercial buildings to hold a Display Energy Certificate (DEC) in the way that many public buildings are required to do. The change not only makes overriding sense in terms of cutting carbon emissions, it is also a financial no-brainer; which may explain why, in the face of the Treasury's obstinacy, three other government departments (Energy, Communities and Business) appear to be backing the proposal.

> There is no excuse for not amending the Energy Bill to extend Display Energy Certificates to the commercial sector as soon as possible

As CIBSE has pointed out, the use of DECs in government buildings has helped to save £13m from energy bills. The institution and other bodies have written to Osborne to press their case (see page 6); and the arguments are devastatingly simple. Many businesses do not know just how poorly their buildings are performing. DECs provide the data on energy use – information that is essential for a business to be able to look at exactly where energy is being wasted, and what needs to be done to make savings. It has been proven that the resulting lower energy bills will far outweigh the costs of DECs.

The payback is not just in financial terms. Cameron and Osborne should be concerned about their low carbon legacy – in short, how did they deliver on the highly challenging targets to cut Britain's emissions? The planned Green Deal and 'green bank' won't be enough. With 17% of the UK's emissions coming from energy used in non-domestic buildings, there is no excuse for not amending the Energy Bill so that DECs can be extended to the commercial sector as soon as possible.

Come on, George, you know it makes sense.

Bob Cervi, Editor
bcervi@cibsejournal.com

NEWS

All the latest news from around the building industry

In Brief

£2BN FOR SCHOOL REBUILDS
Education Secretary Michael Gove has pledged £2bn to rebuild 300 schools under Private Finance Initiative (PFI) schemes. He said the schools built under PFI would be expected to increase energy efficiency. Gove also confirmed the government would seek 'standardised specifications and drawings' for school buildings. **www.education.gov.uk**

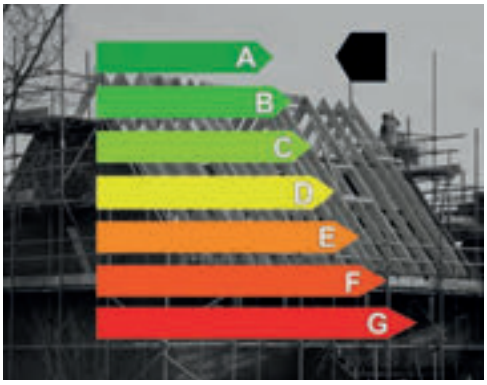
GLOOMY SECTOR FORECAST
A gloomy forecast from the Construction Products Association, predicting another two years of declining workloads, names London office building, energy projects and private housing as the only bright spots. Output this year is projected to fall by 0.5%, followed by a greater drop of 2.8% as public investment dries up. **www.constructionproducts.org.uk**

SYMPOSIUM GOES GLOBAL
More than 50 presentations have been approved for the first ever CIBSE Technical Symposium. Technical experts from all over the world will take part in the event at De Montfort University, Leicester, from September 6-7. **www.cibse.org/events**

ENERGY STANDARD REVIEW
The current BS EN 16001 energy management standard looks set to be replaced 'some time next year' with the first internationally recognised energy management standard BS ISO 50001. A full package of publications, training, certification, software and kitemark for energy reduction verification will be offered by the British Standards Institution (BSI). **www.bsigroup.com**

Campaign grows for roll out of DECs in Energy Bill

● CIBSE and other bodies write to Chancellor to lobby for wider application of certificates



CIBSE has written to the Chancellor, George Osborne, calling for the introduction of Display Energy Certificates (DECs) in the commercial sector.

The move is part of a growing campaign in the sector, with the UK Green Building Council and others also writing directly to Osborne to press for the roll out of DECs to non-domestic buildings.

DECs already apply to public buildings and there is growing evidence that they are helping to reduce public spending on energy bills, according to CIBSE. The government has recently announced that it has cut carbon emissions from its estate by 13.8% in the year to May – signficantly exceeding its own target of a 10% reduction.

The fall, which was achieved across 3,000 government buildings, cut government energy bills by £13m.

There have been widespread calls to introduce DECs for larger business premises, and the Committee Stage of the Energy Bill showed cross government support for DECs, and a strong appetite for using the Energy Bill as a vehicle for introducing the necessary enabling legislation, according to CIBSE.

'But there have been concerns in government that DECs would be a burden, not a benefit,' the institution said. 'The savings of £13m far exceed the costs of the certificates, making them a significant net benefit, not a cost burden. CIBSE is therefore calling on Mr Osborne to support the amendment of the Energy Bill to include provisions for DECs in the commercial sector.

'Energy not being a core concern for businesses, DECs are unlikely to be taken up voluntarily'

'With energy not being a core concern for many businesses, DECS are unlikely to be taken up voluntarily.'

The UKGBC letter to the Chancellor argues that 'mandatory DECs [for commercial buildings] will increase investment in low carbon services and products, contributing to growth, and are a vital component of the retrofit programme that is needed across our built environment'.

For more information visit:
www.cibse.org

Building services 'key to zero carbon'

The key to producing zero carbon non-domestic buildings by 2019 lies in the creation of better building services, according to a report by the Department for Communities and Local Government.

The report, *Zero Carbon Non-domestic Buildings Phase 3*, calls for the setting of minimum standards for energy efficiency relating to building fabric elements and building services.

But it says that, because there are no advantages to be gained by using standards higher than those outlined in Building Regulations Part L 2010, improvements in efficiency must come from building services.

The report adds: 'Overall, the analysis suggests that improvements to the efficiencies of building services provide a cost-effective means of meeting zero carbon. The minimum energy efficiency values will be significantly influenced by the Energy Related Products Directive. This is expected to require national implementation of new system-based building services energy assessment methodologies, and minimum standards of performance prior to 2019, although we may choose to select higher minimum standards of performance. In the absence of the new approach, we have proposed component-based minimum performance criteria as currently used in Part L.'
www.communities.gov.uk

LEARNING THE ART OF BIM

Birmingham City University is adopting a building information modelling (BIM) approach to the design of its planned campus within the city centre. The first phase of construction will be for a new home for the Birmingham Institute of Art and Design, depicted here. The university says it will also adopt the principles of the BSRIA Soft Landings framework. (See BIM story on page 9.)

Zero carbon definition 'closer'

New proposals issued for achieving 'allowable solutions' for dwellings

The industry is moving closer to achieving a definition of 'zero carbon', according to an independent advisory body that has published a new report on the issue.

The Zero Carbon Hub has produced a new 'framework' document on delivering 'allowable solutions', which relate to a range of energy-saving measures on and off site.

'The proposed framework shows how developers will be able to reach the zero carbon standard set for 2016,' the Hub said.

'At present the government has yet to define what will constitute an Allowable Solution, however on-site, near-site and off-site carbon-saving projects are expected to be available. The framework sets out the mechanism by which affordable, verifiable carbon savings projects might be funded and how they might be delivered in a way that encourages additional investment, limits the impact on those who are making allowable solutions payments, encourages innovation and fair competition and, crucially, gives the option for local choice in the projects that are funded.'

Hywel Davies, CIBSE technical director, said the report clarified the mechanisms for delivering allowable solutions, and added: 'There needs to be more work done to develop the list of options. For near-site solutions there seems to be limited scope to refurbish existing buildings, which is currently limited to communal buildings. This really needs to encompass a wider range of refurbishment buildings.'

'The framework shows how developers can reach the zero carbon standard'

The Hub said that it had produced the report in response to the government's call for the industry to work together to produce a workable approach to allowable solutions. Ministers were accused of 'watering down' the zero carbon policy in March after the announcement that carbon savings would not have to be made from plug-in electrical appliances.

For more information visit:
www.zerocarbonhub.org

NUCLEAR WHITE PAPER SETS OUT RENEWABLES 'ROADMAP'

The government has set out a 'Renewables Roadmap' as part of a White Paper committing the UK to nuclear power.

The document says: 'Renewables will be a key part of the decarbonisation of the energy sector necessary by 2030, alongside nuclear, carbon capture and storage, and improvements in energy efficiency.'

It focuses primarily on eight technologies that have the greatest potential to make a difference by 2020 and in the following decades. These are onshore and offshore wind, marine energy, biomass electricity and heat, ground and air source heat pumps, and renewable transport.

Energy Secretary Chris Huhne said: 'Taking the actions outlined in the White Paper will not only help drive deployment across the UK, but will also be key to reducing the costs of renewables, enabling technologies to mature so that over the medium to long term they no longer need additional support to compete on a level playing fields against other low carbon technologies.' **www.decc.gov.uk**

In Brief

SCOTLAND TO BE PART OF RHI
The Renewable Heat Incentive scheme (RHI) is to be extended to Scotland, enabling large producers of renewable heating to be paid for every unit of energy produced. Householders will also receive support for the installation of technologies like heat pumps, solar thermal or biomass boilers under the Renewable Heat Premium Payment. **www.scotland.gov.uk**

CARBON PRICE 'IS HOT AIR'
The government's carbon floor price policy could add £1bn to bills while doing nothing to reduce emissions. *Hot Air*, a report from the Institute of Public Policy Research (IPPR), says that instead of reducing emissions, the Carbon Price Support Scheme due to come into force in 2013 to guarantee a minimum price for carbon, will simply move the problem elsewhere while making carbon more expensive for UK companies. **www.ippr.org**

NEW ENERGY GUIDES
The Carbon Trust has launched a new Expert in Energy series of free, low carbon business guides, web advice and webinair sessions to help businesses save money and cut energy use. Monthly topics – in guides designed to be straightforward, objective and easily digestible – include refrigeration, energy management and renewables. **www.carbontrust.co.uk**

ASSISTED-LIVING ADVICE
A new publication, *A guide for assisted living, towards LifeHome 21*, has been prepared by experts from BRE, 3DReid Research and the Royal Institute of British Architects. It covers housing standards, ergonomics, access, space requirements and digital connectivity, in practical guidance on appropriate design, specification, construction and adaptation of assisted living enabled buildings.

CRC scheme 'simplified' to cut down on red tape

Government responds to complaints over carbon reduction scheme's complexity

Ten thousand organisations are to be removed from the Carbon Reduction Commitment Energy Efficiency Scheme (CRC) and businesses will have to report on usage of just four fuel types, as opposed to 29.

The CRC is to be streamlined, the Department of Energy and Climate Change has announced, after businesses and industry complained about the scheme's complexity.

Fuels that will continue to be monitored are electricity, gas, kerosene and diesel.

There had also been concern from affected companies that the levy has been turned into a 'stealth tax'. When changes to the CRC were announced, following the government's spending review in the autumn of 2010, they met opposition from some quarters because the money raised from a levy on carbon emissions was to be claimed by the government.

'We have got to help businesses reduce their emissions, not strangle them in red tape'

Previously, the money was to be redistributed among the companies in the scheme, with those who reduced their emissions effectively getting a rebate, while the worst offenders would pay the levy in full.

Climate Change Minister Greg Barker said: 'Businesses have made clear to me their serious concerns about the overly complex and bureaucratic CRC scheme. We've got to help business reduce their emissions, not strangle them in red tape.


Retail chains are part of the new CRC

'We've already taken 10,000 organisations out of the scheme, but we've got to do more to make it easier for those organisations taking part.'

Some of the organisations that are now exempt are already having their emissions monitored through other government schemes; others are low-level polluters.

In a ministerial statement, Barker said: 'We have looked at the interplay between the EU Emissions Trading System and UK regulation; in particular now the UK can best implement the provisions in the directive that allow for smaller emitters to opt out.'

For more information visit:
www.decc.org.uk

MEPs block move to raise carbon target

Two initiatives aimed at cutting carbon emissions have been voted down by the European Parliament.

The Energy Roadmap 2050, which would have set targets of a 40% cut in emissions by 2030, 60% by 2040 and 80% by 2050, was vetoed by Poland when it was brought before the Parliament.

Separately, another EU initiative to cut emissions – which would have seen emissions driven down by 30% on 1990 levels by 2020 – also fell due to lack of support from MEPs.

But a new draft directive on energy efficiency, proposed by Energy Commissioner Günther Oettinger, is making progress.

The directive seeks to address concerns that the EU is not on course to meet its 20% energy saving target by 2020.

The draft document explores, among other things, the idea of capturing waste heat. The European Commission wants all new and refurbished thermal electricity facilities fitted with heat recovery equipment.

The Commission has suggested that electricity generated by combined heat and power (CHP) services should benefit from priority grid access, in common with electricity generated from other renewable sources.

Graham Meeks, director of the CHP Association, said: 'Energy efficient solutions are among the most cost effective ways of reducing emissions, and this directive seeks to drive a step-change in energy efficiency across the EU.'

He added: 'We very much welcome the direction of travel, and can see the obvious benefits from CHP becoming the norm for new energy plant. However, we question whether the measures set out in the directive on their own will be sufficient.'

The directive also argues for an annual renovation target of 3% for public buildings above 250 sq m.

Insulation will need to double, warns climate change body

CCC also stresses that the fall in emissions is mainly due to the economic slowdown

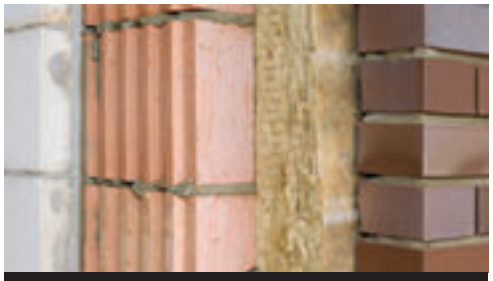
The rate of cavity wall insulation will need to double to more than a million homes a year during this decade, if the UK is to meet its carbon reduction target.

That's the view of the Committee on Climate Change (CCC), an independent government advisory body, which also argues that a 34% cut in the 1990 levels of carbon emissions is required by 2020.

In its *Third Progress Report to Parliament*, the CCC says that expected levels of loft and cavity wall insulation have taken place, but that the aspirations were too modest. The CCC found that emissions have dropped by 8.6% over the past year, but that this was due mainly to a reduction in economic activity caused by the recession, coupled with increased energy prices.

The CCC also calls for more clarity on funding for the national programme to encourage energy efficiency measures in homes. It says the government should specify how householders will be incentivised to make their homes more energy efficient, and what role energy companies, businesses, local authorities and private landlords will have in helping to achieve this.

The report also notes that 'limited progress' was made in 2009 on solid wall insulation, energy efficiency improvements among small businesses, and renewable heat generation. It says work in these areas will need to be accelerated to meet the 2020 target.



Alterfalter/Shutterstock.com

The commission highlights insulation as a key issue

CCC chairman Lord Turner said: 'The recession has created the illusion that progress is being made to reduce emissions.'

He added: 'We are repeating our call for new policy approaches to drive the required step change, in order that the UK can ensure a low carbon recovery. Given new approaches, we are confident that individuals and business will respond, taking advantage of the affordable opportunities available to reduce emissions.'

For more information visit:
www.theccc.org.uk

GOVERNMENT TO TRIAL GREEN DEAL INCENTIVES

Measures to help home owners and landlords save energy by retrofitting houses are to be trialled as a precursor to the government's Green Deal programme.

The proposed trials include:

- A subsidised loft-clearance service to reduce costs and encourage owners to make improvements to their insulation;
- A trial to investigate the effect of behavioural feedback on consumer energy use;
- A trial testing the impact of offering rewards for residents who buy energy-efficiency measures; and
- High street businesses, including Homebase and B&Q, teaming up with local authorities on some of the trials.

According to ministers, the Green Deal will ensure that home owners can invest in energy efficiency improvements at no upfront cost, with improvements being repaid through anticipated savings on energy bills.

BIM roll-out 'will make key savings in the long term'

A roll-out of building information modelling (BIM) for public contracts could cost £4m, but should save at least 5% on building costs, according to a report by the BIM Industry Working Group.

The adoption of BIM would allow those working in the construction industry to design, build and operate a building 'virtually' on a digital prototype, allowing more accurate cost modelling and the opportunity to iron out problems before construction takes place.

A report, *The Government Construction Client Group Building Information Modelling (BIM) Working Party Strategy Paper*, recommends a 'push-pull' strategy between suppliers on one side and clients on the other. The government, it says, should support all suppliers 'to reach a minimum performance in the area of BIM use in five years'. Clients need 'to specify, collect and use the derived information in a value-adding way over a similar timescale'.

The report puts forward the idea of an implementation group, with members drawn from industry, which would identify demonstration projects and put together a funded plan for the roll-out.

Separately, a BIM Academy has been launched by Ryder Architecture and Northumbria University to train students and provide support to construction professionals ahead of the expected roll-out.

CIBSE NEWS

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All in the detail

Don't forget to keep your contact details up to date – it is easy to do via the members' area of the CIBSE website. Ensuring we have your correct contact details for you enables the Institution to keep in touch.

You can also update your preferences – join CIBSE Special Interest Groups, subscribe to the regular enewsletter, and let us know more about your main areas of interest so we can keep you up-to-date with news and information relevant to you.

CIBSE would also like to hear from anyone who is able to volunteer a few hours of their time, either for their local region or for CIBSE HQ. This might involve mentoring young engineers, assisting with interviews or contributing to publications.

Anyone interested in volunteering, or who would like some more information, contact Marie Dignan, director of membership, on **mdignan@cibse.org**

Phone hoax warning

We would like to make members aware that we have recently received reports of hoax phone calls to members. These calls may offer you free places at CIBSE training events, conferences or awards. Please be aware these are not genuine calls and should be treated with caution. We would advise anyone receiving one of these calls not to give out any personal information.

Diary date

CIBSE Technical Symposium
In association with De Montfort University
● **6-7 September, Leicester**
www.cibse.org/events

Top firms honoured

● **YEN awards winners confirmed**

Arup, Couch Perry & Wilkes and Crofton Design have been announced as the winners of the Employer of the Year Awards 2011.

Now in their third year, the awards – hosted by CIBSE Young Engineers Network and sponsored by Baxi Commercial Division and Heatrae Sadia – recognise a commitment to supporting and encouraging engineers of the future, and seek to reward those organisations that proactively champion young talent in the industry.

CIBSE president Andy Ford said: 'It is great to see such fine examples of professionalism in our industry and support for development of the capabilities of young engineers. This shows me that the best can move forward – even in recession – by creating an excitement around respect for each other as both people and engineers.'

Each of the winning companies showed particular commitment to championing newly qualified engineers, and in supporting them in employment and education.

For the second year in a row Arup won the award in the large company category, with Couch Perry & Wilkes winning the medium company category, and Crofton Design the small company trophy. Crofton was also crowned the overall award winner.

Barry Henson, from Crofton Design, said: 'It is fantastic for all our hard work to be recognised. We hope to continue the work to support our students and the engineers of the future.'

Crofton Design representatives with their prize

Standing proud... all the winners with Andy Ford, centre

The winners, who were announced at the July event at Milbank Tower, London, each received a trophy and £1,000 of CIBSE training vouchers.

CIBSE would like to acknowledge the hard work of all entrants, who have demonstrated they are willing to go the extra mile to support young engineers.

For more information:
www.cibse.org

Task group needs you!

The CIBSE Maintenance Task Group is currently updating *CIBSE Guide M: Maintenance Engineering and Management*, and is asking members for feedback on the existing guide.

Set up in the 1980s, the group provides a point of reference and expertise within CIBSE for all matters relating to the operation and maintenance of engineering services in buildings. It also helps to inform CIBSE publications, organise events to help disseminate knowledge, and promotes good practice.

The group is made up of representatives from leading industry organisations, including BSRIA, HVCA, Mitie FM, SPIE Matthew Hall, and Faithful and Gould among others, helping ensure everyone is working to the same principles.

If you would like to offer any feedback on *Guide M* you can do so through the CIBSE and BIFM LinkedIn sites, or email current group chairman Jo Harris at **jo.harris@bsria.co.uk** by 31 July.

Tied to benevolence

We currently have a supply of CIBSE ties available to buy at a cost of £9.50, with all proceeds going to the CIBSE Benevolent Fund.

The fund supports members, former members and their dependants who are in need, whether through sickness, bereavement or financial hardship. Last year, through the support of members, the fund was able to help more people than ever before.

Ties can be purchased at **www.cibse.org/bookshop** or from CIBSE HQ reception.

Carbon reduction policy update

More changes to simplify CRC proposed

The Department of Energy and Climate Change (DECC) has made further proposals to simplify the Carbon Reduction Commitment (CRC). Subject to further analysis and formal consultation, these modifications will be implemented from phase two onwards, with registration starting in April 2013.

The simplifications proposed include:

- Reducing the number of fuels in the scheme;
- Using fixed-price allowance sales instead of auctions;
- Simplifing rules and qualification processes;
- Reducing the overlap with other schemes; and
- Reducing the administrative burden of evidence and records.

Currently, businesses must report emissions from 29 different fuels. Since about 95% of emissions in the CRC come from electricity and gas, it is proposed to cut this to four, with kerosene and diesel for heating included. DECC argues that this will significantly reduce the burden without compromising the emissions coverage.

Sales of allowances will continue, on a retrospective basis, for the rest of phase one. In phase two, instead of an emissions cap and annual auctions, two fixed-price sales per year are proposed, giving price certainty to help investment decisions.

Andriano/Shutterstock.com

'Based on feedback from stakeholders and wider policy considerations, these changes are intended to simplify the scheme'

Any Climate Change Agreements or EU Emissions Trading Scheme sites will be automatically exempt from the CRC.

Qualification will be a one-step process. Instead of first registering all qualifying electricity meters, then determining the qualifying supply through those meters, participants will just calculate the supplied electricity through settled Mandatory Half Hourly Meters (HHMs) that are not exempt.

DECC will continue developing these proposals this year, with a view to conducting a formal consultation early next year, and the changes being implemented in phase two. Meanwhile it is important that those in the scheme continue to comply with the current rules.

For more information:
www.decc.gov.uk

20 years of funding research

CIBSE Research Fund was launched in 1991 by Lord Ezra and Jerome O'Hea to resource the development of publications and knowledge for members, their employers and the wider industry. Since then, under the management of the Publications and Research Committee, the fund has helped to transform CIBSE's publications portfolio.

In 1998 the decision was taken to revise the entire catalogue of CIBSE guides, updating them to reflect the current state of professional knowledge.

Despite some reservations about the target of completing this within five years, it was achieved and, since then, largely maintained.

The fund also provided support for a number of research projects that were supported by 50% government funding from the Department of Environment and its various successor bodies. The energy assessment tool, *TM22*; the design guide to photovoltaics, *TM25*; the ductwork cleaning guidance, *TM26*; and the 2001 update of *Guide B*, were all funded in this way, obtaining a high level of gearing for the fund and delivering significant benefits to CIBSE members.

Updates to the *Applications Manual for Natural Ventilation, AM10*, and guidance on sub metering, which became *TM39*, were supported by the Carbon Trust, with contributions from the fund. More recently the fund has enabled CIBSE to provide the benchmarks for Display Energy Certificates, *TM46*, and the recent comprehensive review of the first 18 months of DECs.

Most recently the fund has provided vital resources to underpin the development of CIBSE's online delivery of knowledge through the new 'Knowledge Portal' and the online learning modules delivered over the past two years.

The principal income to the research fund is an annual share of members' subscriptions, 8% of which is allocated to the fund. Over the years this has been supplemented by a variety of government grants and some generous donations. But, with ever tighter constraints on public funding, this continues to provide CIBSE with the resources to maintain and develop the professional knowledge that supports CIBSE members in their work.

Spread the word to students

CIBSE is looking to appoint university co-ordinators to act as a first point of contact for students and colleagues who are CIBSE members, and for those wishing to join as members.

Co-ordinators are not expected to answer queries about CIBSE, but will guide people considering a career in building services engineering, or who are interested in joining CIBSE, to our relevant staff.

Co-ordinators have a central role to play in liaising with CIBSE, engaging with our regions and membership activities.

We are also funding an introductory student event at universities to make students aware of career opportunities within the profession.

If you work at a university and would like to be a CIBSE university co-ordinator, please contact Marie Dignan, director of membership, via **mdignan@cibse.org**

Blazing a trail is not rocket science

The 2011 Annual Lecture, in part sponsored by CIBSE Patrons, will be held on Thursday 10 November 2011 at the Welcome Collection, 183 Euston Road, London NW1.

This year's lecture will be delivered by Chris Wise, engineering designer. Wise co-founded design-led engineering consultancy, Expedition, in 1999 after a successful career with Arup. Expedition has a 'trail-blazing' ethos written into its constitution.

He has worked with many of the world's leading architects, including Rogers, Foster and Renzo Piano. He is also the guiding hand on the structure of many projects, including: the revamped Barcelona Bullring; London Millennium Bridge; and Channel 4 HQ, London.

The event will start at 6.30pm, with registration and refreshments from 6pm. An evening reception will follow. There is no charge to attend, but booking is essential.

To book your place visit **www.cibse.org/annuallecture** or email **vwilliams@cibse.org**

CONFUSION FACTOR

Uncertainty over carbon emissions factors for the national grid is undermining consultants' ability to make the correct technology choices for buildings, argue **Phil Jones** and **David Shaw**

So, what's it to be: 0.591, 0.568, 0.543, or maybe even 0.517? Which of these emission-factor levels should we, as professionals, apply? These figures all seek to represent the carbon intensity of the electricity delivered by Britain's national grid (the amount of kilograms of CO_2 produced per kWh of electricity). All the factors quoted have been disseminated by government departments at one time or another to 'help' engineers calculate the CO_2 emissions arising from the energy used in and by buildings.

It's true that emissions factors have to take account of an ever-changing mix of energy sources being used to generate the UK's power. At present, nuclear accounts for around 20% of the total grid mix, but our ageing nuclear plant is being decommissioned, pushing up the fossil fuel share – which means the emissions factor is rising steadily.

Consulting engineers need accuracy in order to make the right choice of solution for each project in hand. Emissions figures are used to find technical solutions that replace grid-supplied electricity, in order to meet statutory carbon reduction targets in, for example, planning applications. So, if there are so many possible factors to choose from, how can engineers be sure of getting the right result?

It has to be tempting for a designer, who favours one particular technology over another, to use the emissions factor that makes the most persuasive case for their preferred solution. There is terrible confusion around this issue and it is vital that we get some clarity and commonality. Without this, there is potential for all sorts of unintended consequences. In worst-case scenarios, buildings will meet their statutory obligations but miss their carbon targets because of inappropriate system selection based on the wrong carbon factor.

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For example, if you select combined heat and power (CHP), you have to take into account the primary fuel you are using to drive the process. If you assume all the electricity produced on site by the CHP is displacing grid electricity from a coal-fired power station, then your figure will be highly persuasive. But it is less impressive compared with purely gas-fired power generation. The emissions factor can also materially change the size – and even the number – of the CHP engines that are specified: the higher the factor, the more carbon that can be saved using fewer or smaller units.

So we need to streamline the method for calculating the emissions factor, to help designers make more informed choices. However, the government will struggle to select just one figure. The collision of different influences on the mix of grid electricity means the picture is changing all the time.

Despite the difficulties of establishing a single emissions factor, we can probably learn from the energy markets and their use of 'spot' prices. Government departments need to work with some common 'agreed' factors. Then we could offer the industry an 'historic' figure based on last year's values; and a 'future' figure based on predictions from the energy markets. This would make it easier for consultants to explain their technology choices to clients. One government department should take responsibility and publish these agreed factors each year to minimise confusion.

> There is terrible confusion around this issue and it is vital that we get some clarity and commonality

In addition, some experts, such as Robert Cohen of Camco, have called for harmonisation of emissions factors. For example, given that most Display Energy Certificates are part of a Carbon Reduction Commitment footprint, it makes sense, and would save administrative cost, if both policies were to use identical factors. Using different factors for design calculations and greenhouse gas reporting (DECs, CRC and so on) only adds to the confusion, plays havoc with any 'as designed' versus 'actual' performance assessment, and is difficult to justify given the current huge uncertainties about the future grid mix.

It's true that, once smart meters have been rolled out, we may be able to take account of day and seasonal variations in grid factors, and use a 'marginal' value. But in the meantime, an annual average is the best available option. The lack of precision, although apparently small, makes all the difference to an engineer's calculations and can impact on statutory reporting. Getting the equation wrong undermines everything the industry is trying to achieve in reducing the carbon impact of buildings.

● **PHIL JONES** (above left) is chairman of the CIBSE Energy Peformance and CHP groups, and **DAVID SHAW** is business manager of Baxi-SenerTec UK

Your letters

We need to recruit more widely

The new CIBSE president, Andy Ford, says experienced building engineers and building services graduates must work together, with a mutual respect, to shape the future of the building services industry (*Journal*, July, page 26).

While I agree with these sentiments in part, the relatively small number of individuals entering building services degree courses is not sufficient to meet the demands of our industry. The secret to shaping this new integrated industry lies not just with building services graduates, but with highly talented graduates from a range of subjects.

I am keen to recruit building services graduates, but only those who can display the spark, intellect and capability that is essential to becoming a successful building services engineer. In fact, just 20% of all graduates we have hired over the last few years have been from building services degree courses. I would strongly encourage Andy Ford and my contemporaries within the industry to open their eyes to the talent and ability outside of the small pool of building services graduates, and widen the scope of their search to find the raw talent that exists, and which can easily be moulded into the next generation of building services engineers. This, I believe, is the best way to support and develop the future of our industry

Geoffrey Palmer

Why the exessive car park lighting?

An article in the May issue of the *Journal* concerned the effective ventilation of multi-storey car-parks. However, the night-time illustrations of the Manchester Interchange car park on pages 3 and 52 raise another crucial design issue with UK multi-storey car parks – the profligate wastage of energy through all-night, and in many cases 24-hour, burning of lighting. For a publication committed to sustainability and energy-saving, not to draw attention to this seems like an unfortunate oversight.

With new multi-storey car parks, the installation of lighting sensors and crime-prevention systems – such as zones of brightness within dimmed-down floors that could alert the police to the presence of potential wrong-doers – should be a 'no-brainer', with payback in just a few years.

Carl Gardner

CIBSE Journal welcomes article proposals from any reader, wherever you are – whether it be letters, longer opinion pieces, news stories, people or events listings, humorous items, or ideas for possible articles.

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MANUFACTURER'S VIEWPOINT

The Renewable Heat Incentive will provide a futher opportunity for heat pumps to show their value in making cost-effective energy savings, writes **Martin Fahey** of Mitsubishi Electric, sponsor of this column

The government is set to introduce a Renewable Heat Incentive (RHI). Although not all the details are known, the RHI will reward those using renewable technologies for their commercial and domestic heating needs.

But for it to be suitable, the right low carbon approach to heating commercial buildings has to offer a number of characteristics.

First, to operate on a daily basis, it needs to be straightforward. Previous experience shows how quickly a technology becomes obsolete if it causes too much inconvenience.

Second, the technology has to be scalable, meaning that it can be deployed in buildings of varying sizes, and offer both small and large-scale solutions. This also implies that the technology can be manufactured in large numbers, and is supported by a wide skills infrastructure that is either already in place, or is ready to be skilled up.

Of course, the technology has to be environmentally sound, compared with existing technologies, offering demonstrable energy use and emissions savings. However, it is also very important that the right solution for renewable commercial heating is also economical – it can be produced in numbers that deliver cost benefits for end-users and, where possible, will offer real cost benefits compared with conventional systems.

> Heat pump technology is ready now and is able to answer the need for low carbon commercial heating

Heat pump heating offers all of these characteristics, and as a result it is becoming an increasingly popular option in the commercial sector.

Already a proven technology, advances over the past decade, such as the introduction of inverter technology, have helped to make heat pumps even more energy and carbon efficient.

Two leading research bodies, BSRIA and BRE, have independently tested the efficiency of heat pumps. At point of use, for every 1 kW of electrical energy input into a heat pump, 3.2 kW of heat is produced. This means that for the same heat output, heat pumps use less primary energy than direct electric heating, gas or oil boilers.

Heat pumps can extract renewable energy from the ground, from a body of water such as a lake or river near the building, or from the air. They can deliver heat into a building in a variety of ways, including underfloor heating, radiators or via warmed air. This flexibility gives designers more choices about what delivery system will work best for their project.

With both air and ground source heat pumps recognised as renewable technologies, the choice of type will depend on the characteristics of a project. However, one thing is certain: the technology is ready now and is able to answer the need for low carbon commercial heating.

DEALING OUT IMPROVEMENTS

The government aims to promote upgrades to existing buildings through the Green Deal, which is being introduced in the new Energy Bill. **Hywel Davies** looks at the implications of the plan

If we really want to reduce carbon emissions from our existing buildings, they need to be a whole lot more energy efficient. The coalition government recognises this and has adopted a policy first envisaged under the previous government to drive the energy refurbishment market. The idea is simple: buildings can be refurbished to use less energy; and savings made on energy bills can pay for the energy efficiency measures over time.

Originally called 'pay as you save', the scheme is now the Green Deal, which is expected to come into effect in October 2012. It is being introduced via the Energy Bill currently going through parliament. The Bill is due to become law this autumn.

Initially intended for home energy efficiency improvements costing a few thousand pounds, the Green Deal incarnation of the policy is now open to domestic and non-domestic buildings; and, as long as the measures can be funded from reduced energy bills there is no limit on the costs. The money will come from Green Deal 'providers' who will help to deliver energy efficiency upgrades.

The fundamental tenet of the Green Deal is that measures installed are paid for through a charge on the electricity meter, which must not exceed the anticipated savings due to the measures – known as the 'golden rule'. The current proposal is for SAP and SBEM, the software used to calculate asset ratings for energy performance certificates, to be developed to calculate the anticipated savings, and to test whether any proposed measures will meet the rule.

Anyone who wants a Green Deal package to fund improvements will require an assessment by an independent accredited assessor, who will determine the current performance of the building and then assess the anticipated savings from the proposed measures.

There is concern that, as currently proposed, the assessment will not take any account of the occupant's operational energy use. There is also some discussion about adopting a simpler approach for non-domestic buildings, whereby a specific package of measures, such as a lighting refurbishment, or renewal of a heating system, which can be shown to meet the golden rule, may be permitted without undertaking a full SBEM analysis. This would certainly reduce the costs of the assessment.

Assessors will already be energy assessors, but will require further competences to carry out Green Deal assessments. It is not yet clear how those competences will be assessed. Energy assessors can either obtain an NVQ, or be accredited on the basis of prior experience. The Department of Energy and Climate Change is currently consulting on the arrangements for Green Deal assessors, and it is not yet clear whether the prior-experience route will be open.

Since consulting engineers have professional qualifications, and have been assessing buildings, devising refurbishment schemes and advising clients on the costs and savings those schemes will deliver, it would be strange to require them to obtain a further NVQ to allow them to do this for the Green Deal. CIBSE is currently in discussion with DECC about these proposals.

> The fundamental tenet of the Green Deal is that measures installed are paid for through a charge on the electricity meter, which must not exceed the anticipated savings due to the measures

Once a package of measures has been tested against the golden rule, then an accredited installer must install the measures. Installers will have to be accredited, and will be required to work to a Publicly Available Specification, or PAS, which is being developed by BSI to provide a specification for the installation of energy efficiency improvements in existing buildings. This is due to be consulted on shortly, with a draft for consultation expected in August. Arrangements for the accreditation of the installers are also under development.

Transitional arrangements deadline soon

Time is running out to start work on projects under the 'transitional arrangements' for the Building Regulations and Approved Documents (ADs). These arrangements allow for the use of the 2006 editions of ADs L, F, and J. These provisions change on 1 October, so any scheme for which an Initial Notice was not served and the works commenced on site by 30 September will have to work to the 2010 regulations and ADs.

HYWEL DAVIES is technical director of CIBSE

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The development of Stratford in east London has delivered not only the Olympic Park but also a district heating system powered by two innovative energy centres. **Andy Pearson** gets an inside view

There is a year still to go until the start of the London Olympic and Paralympic Games, but already the legacy of the 2012 Games is evident for one housing development in east London. An energy centre, built to provide an efficient, low carbon heating and cooling system across the Olympic Park site for the Games and the long-term regeneration of the area, is already supplying a Genesis Housing scheme of five residential blocks, a care unit, business space and retail units situated adjacent to the site.

The district energy scheme provides low carbon heating and cooling from two

POW

The Kings Yard energy centre to the west of the Olympic Park will supply power to the national grid as well as heating and cooling to the Park's permanent and temporary Olympic venues and the Olympic Village. The three cylindrical tanks shown are chilled- and hot-water circuit buffer vessels

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VER BEHIND THE GLORY

A 20 MW boiler inside the energy centre at the Olympic Park, which has the capacity for five such boilers (see table below)

state-of-the-art energy centres, which incorporate combined cooling, heat and power (CCHP) systems and biomass boilers. The centres, known as the Kings Yard and Stratford City, and the associated network of heating and cooling mains have been designed, built and financed at a cost of £113m by utility provider Cofely, a division of GDF Suez, following competitive tender.

The Kings Yard energy centre, to the west of the Olympic Park, is the larger of the two schemes. It will supply power to the national grid, along with heating and cooling to the Park's permanent and temporary Olympic venues and the Olympic Village. The Stratford City energy centre will also supply electricity to the grid, but its heating and cooling energy will be supplied primarily to Westfield shopping centre and the associated commercial and office developments currently under construction at the entrance to the Park.

Developing the largest district energy scheme to be built in the UK, on time and with sufficient capacity for the Olympic

Current equipment installation and additional equipment planned for the post-Olympics legacy period, and capacities (MW)

	Equipment installed for Olympic mode		Additional equipment installation planned for legacy		Kings Yard		Stratford		Total capacity (KY & S)	
Description	Kings Yard (units)	Stratford (units)	Kings Yard (units)	Stratford (units)	Olympic	Olympic + Legacy	Olympic	Olympic + Legacy	Olympic	Olympic + Legacy
Gas engines (3.1MW each)	1	2	4	2	3.1 MW	15.5 MW	6.2 MW	12.4MW	9.3 MW	27.9 MW
Hot water boilers (20 MW)	2	2	3	1	40 MW	100 MW	40 MW	60 MW	80 MW	160 MW
Bio boilers (3.5 MW)	1		1		3.5 MW	7MW	0 MW	0 MW	3.5 MW	7 MW
Total heat					46.6 MW	122.5 MW	46.2 MW	72.4 MW	92.8 MW	194.9 MW
Absorption chillers (4 MW)	1	1			4 MW	4 MW	4 MW	4 MW	8 MW	8 MW
Electric chillers (7 MW)	2	5	1		14 MW	21 MW	35 MW	35 MW	49 MW	56 MW
Total cooling					18 MW	25 MW	39 MW	39 MW	57 MW	64 MW
Cooling towers	5	10								

Park and the adjacent retail park, was only part of the task. Equally importantly, when the Games are over the energy centres will continue to be developed and run by Cofely's specialist business unit, Cofely District Energy, for the next 40 years to provide the Park's legacy buildings and surrounding developments with low carbon heating and cooling. The challenge is that, whilst the energy demands of the Park's venues during the Games are known, the future energy demands of the site's legacy buildings are less well defined.

Modular design

The approach has been to design and build the energy centres in a modular format to enable plant to be added in the future, once the legacy loads are known. The utility had two years from the start of construction to build the two energy centres and the site-wide network of 16km heating and cooling pipework.

Both energy centres are housed in buildings designed by architect John McAslan & Partners. The centres are large, brown rectangular boxes, wrapped in a mesh of pre-rusted, perforated cladding panels with a 45m tower at one end housing the boiler flues. The rusty façade was not installed until the key items of plant had been positioned on the building's steel frame. To enable future plant to be installed, sections of the building's cladding have been designed to be easily removed.

Inside the giant Kings Yard energy centre, the modular approach to the scheme is immediately apparent. Adjacent to the two, huge 20 MW dual-fuel gas/oil fired boilers is the space for three additional boilers. All the pipework and flues are in place so that boilers can be added in the future with the minimum of disturbance, while the system remains live. Similarly, adjacent to the 3.3 MW gas-fired combined heat and power (CHP) engine, pipework connections are already in place in four empty bays for further units, if required.

In summer, when the demand for heating is less, heat recovered from the CHP units can be used to drive a 4 MW absorption chiller. Even if the absorption chiller is not running, cooling can still be provided by two, 7 MW ammonia-based chillers. Again, space has been allocated for an additional future chiller. The chillers reject heat through five roof-mounted cooling towers.

During the Games the main demand for cooling will come from the International Broadcast Centre and the Handball Arena. After the Games, the Handball Arena is set to become a community sports centre, but the big and, as yet, unanswered question is: what will happen to the Broadcast Centre, particularly in terms of utilising the installed cooling capacity?

To ensure cooling can be supplied efficiently, even under light load conditions, the chilled water circuit includes a giant cylindrical chilled water buffer vessel. The 750 cu m vessel increases the capacity of the chilled water system by 4.7 MWh, so that when loads are low the ammonia or absorption chillers can run uninterrupted, charging the vessel. A similar system operates on the hot water circuit, with the 27.5 MWh capacity buffer vessel intended to allow the uninterrupted operation of the CHP engine and the system's giant boilers. A third tank contains treated make-up water for the hot and chilled water system. The enormous tanks are situated outside the building, adjacent to its eastern façade.

The plant's current installed capacity is 46.6 MW heating, 18 MW cooling and up to 6.68 MW of electrical power, depending on loads. When all the plant is in place the energy centre will have the potential to generate up to 122.5 MW heating, 25 MW cooling and 10.02 MW of electrical power.

In contrast to Kings Yard, Stratford City energy centre has no spare cooling capacity and less future capacity for heat-generating plant because the energy centre was built primarily to meet the established cooling and heating loads of the new Westfield Shopping Centre and its associated office

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A view of part of the Olympic Park with the athletics stadium in the foreground. The Kings Yard energy centre can be seen by the waterway in the top left of the picture

Pipework Installation of the heating and cooling mains

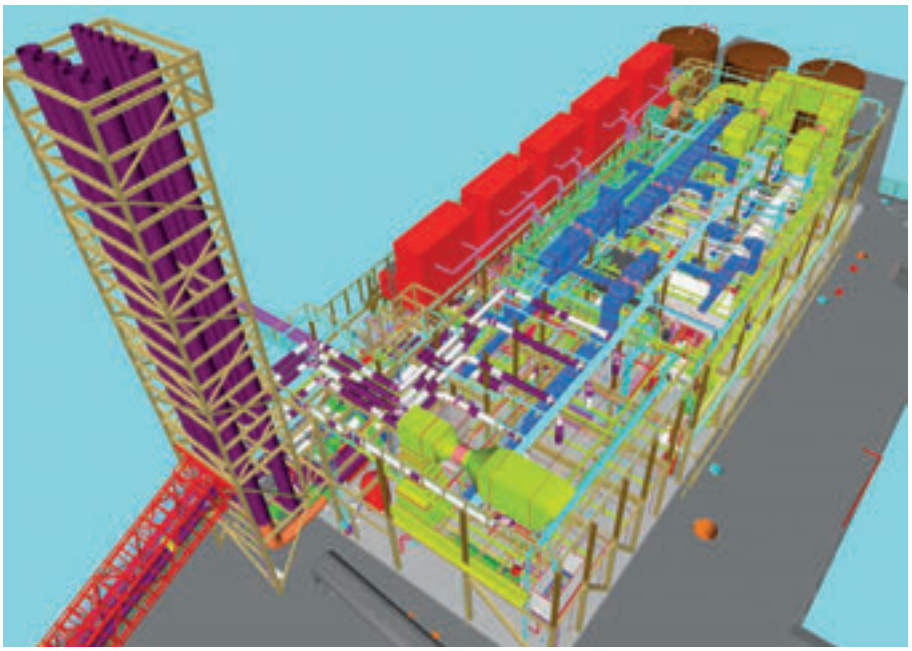
One thing was for certain: the 16km network of district heating and cooling pipework that link the two energy centres with the Olympic venues had to be in place for the Games. This achievement was only possible in the two years from commencement of construction to operation because the entire installation was modelled in 3D (see Design: 3D Modelling).

There was insufficient time to wait for the venues to be constructed, and for the site to be landscaped, before installing the heating and cooling mains. Instead the mains were installed in sections as areas became available. It was a challenging operation with mains passing beneath railway tracks and over bridges to reach all the Park's venues. Over time these sections were gradually joined as further sections of the site became available, until the network was completed.

The mains are constructed from pre-insulated carbon-steel pipes comprising 50mm of polyurethane insulation enclosed in a polyethylene protective outer sleeve. The pipes have a built-in leak detection system. The pipes were installed in 12m lengths, at diameters up to 400mm, and welded together. Once the leak alarm cables were joined, a muff was wrapped around the pipe joint and insulation injected into the void created by the muff.

The pipes are buried so that the top of the pipe is at least 1m below surface. By using buried pipework, network losses are low, with a temperature drop of around 1C per kilometre. The advantage with the site is that there were very few buried utilities to avoid. However, on the down side, because the site was still being reconfigured the ground was not always at the finished level. As a result, some pipes over 2m had to be installed above the ground on temporary supports until the final ground level was established.

Cofely



A 3D image showing, in purple, the gantry containing the biomass boiler flues which connect the existing building to the new Olympic Park energy centre. Roof-mounted cooling towers are shown in red, and the buffer tanks at the rear in brown

development. This energy centre features two 3.3 MW CHP engines; a 4 MW absorption chiller; five 7 MW ammonia chillers; and two 20 MW dual fuel gas/oil boilers. These give it a current output of 46.2 MW of heat and 39 MW of cooling and up to 3.34 MW of electrical power, depending on loads.

The Stratford City energy centre also has the capacity to add another 26.2 MW of heat with an additional boiler and two CHP engines. Some redundancy has been built into the centre's total capacity to enable the systems to run uninterrupted even while items of plant are off-line for maintenance.

Between them the two energy centres have the potential to supply a total of 194.9 MW of heating, 64 MW cooling and 30 MW electrical power.

Design 3D modelling

The project design team used 3D packages to develop the scheme and build the energy centres virtually, before construction commenced.

The design was developed using a variety of software packages including AutoCAD 2010, AutoCAD MEP and 3D CADduct. To assemble the energy centres, the steelwork layout was imported from the fabricator. However, the existing Edwardian building, housing the biomass boiler, was modelled using 2D drawings in AutoCAD before being imported into a design package. The scheme was drawn in AutoCAD with CADduct running alongside so that the designers could access the CADduct library of pipe fittings and other services. The larger elements of plant, such as the boilers, were modelled by the CAD team and imported into the design.

To render the model, Navisworks was used. The designers used the rendered model to view the design and check for any clashes visually or run clash-detection software. The model was also used to work out delivery routes for the installation of future legacy plant. Once the designers were happy with a scheme, it was published as a model along with dimensioned sections and plans. These are produced as PDF files and published on a Projectwise database so that the sub-contractors can access the current drawing.

Along with the energy centre, the pipework distribution network was modelled in 3D by importing ground-level data and converting this into a model of the site. The model has all 75 substations, to enable teams working on individual buildings to model the connection to the heating mains. This model has been uploaded to the Olympic Delivery Graphic Information System model of the site.

There is an agreement to achieve a reduction in carbon emissions of 20% in 2012 as a result of the CHP services, rising to 30% in 2013. When fully operational, the scheme has the potential to save up to 12,000 tonnes of CO_2 a year, compared with conventional energy supplies.

Linking up

While the energy centres have been designed to operate independently, two giant heating mains link the two buildings. This enables the heating plant to be run efficiently under low-load conditions. Currently the heat loads are supplied from Kings Yard; however, as more venues are completed and heat loads ramp up as the Games approach, more capacity will be progressively brought online until each centre is operating at design capacity.

Substations are strategically located around the network to enable heating and cooling to be supplied to the venues. These skid-mounted units were prefabricated at the Milton Keynes works and comprise one or two heat exchangers, depending on whether heating and/or cooling is being provided, with controls and pipes attached. A secondary circuit transfers heat from substation to the consumer. A total of 75 substations have been installed to serve both the permanent and temporary Olympic venues and legacy schemes.

The network operates as a variable-volume, constant-temperature circuit, with the volume varied by altering the speed of the circulating pumps. The system is set up to maintain a differential pressure at the index point, which is the point in pressure terms furthest from the energy centre; in reality this means there is sufficient pressure difference between the flow and return mains to push the heating or cooling water through the heat exchanger at this point.

In addition to the two McAslan-designed buildings, the Kings Yard scheme also incorporates a Grade II listed Edwardian building, which has been renovated. This is the Olympic Park's only retained building; it is situated adjacent to the energy centre and will house a 3.5 MW biomass boiler and woodchip store as well as provide the space for a future visitors' centre. The boiler is due to be operational by the end of 2011, and a wood-chip supplier is currently being sought that complies with the Olympic Delivery Authority's (ODA) sustainability criteria. There is space for a second biomass boiler to be added in the

> The cost of the new energy centres and district heating mains will be recovered through the long-term operation rights of the new infrastructure

future. A 16 km network of buried pipes deliver the district heating and cooling throughout the Olympic Park (see box).

The heating mains operate at temperatures of 95C flow 55C return, while the chilled water mains operate at 6C flow and 12C return.

Legacy schemes

A scheme of this scale does not come cheap. The cost of the new energy centres and district heating mains have been financed by Cofely, who will recover their investment through the long-term operation rights of the new infrastructure.

Currently, energy demand is starting to ramp up as preparations for the Games gather pace. The Games and the Paralympics will provide an eight-week demand peak. After the Games, demand will drop for a year or so while the temporary venues are removed, the remaining venues undergo their conversion into legacy buildings and the athlete's village is transformed into homes.

The first legacy scheme likely to be constructed after the Games will be a housing development, built on the site of the temporary basketball arena. Critically, the mix of development slated for this area has changed. Originally the plan was to develop a high-density housing scheme with 12,000 homes located mainly in high-rise apartment blocks.

However, the proposals have changed so that the scheme now has 5,000 fewer occupants and a higher proportion of lower-density family housing. The extent of district energy service required, and the subsequently high heat losses, mean that low-density housing is, traditionally, unviable from a district heating perspective. However, options are being examined to ensure that, when the scheme is connected, it will be in the most efficient way possible.

It would be ideal if new developments with a high heat load are attracted to the site after the Games. The energy centre scheme is heat led, which means the utility needs to sell heat to make the CHP and biomass boiler systems viable to operate, and to reduce the carbon intensity of the heat supplied. The ideal businesses to set up on the site would be hotels, leisure and healthcare facilities because they have high hot water loads. It helps, too, if the loads are clustered together to minimise the pipe network; it is also beneficial if the loads are from a diverse range of businesses to even out demand throughout the day.

The project has been helped in its mission to sell heat by the Olympic Park being declared 'an area of exclusivity'. This designation entitles the utility to be the sole provider of heating and cooling on the site; a 'price control formula' has been put in place to regulate the price at which heat can be sold to ensure it costs less to end-users than traditional means.

Originally the project business plan included the sale of 20% of the energy centres' heating capacity outside the Park's boundary. However, following changes to the legacy plans, this figure is likely to increase. The heat supplied to the Genesis Housing Group's scheme is the first scheme outside the Olympic Park boundary to benefit from the district energy network. **CJ**

Within the Olympic Park energy centre, huge circulating pumps are suspended above pipework rather than being floor mounted

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Greener horizons

A wide-scale 'passive' approach to urban planning and design across the globe can help to cut the carbon footprint of our towns and cities, writes **Becci Taylor**

Action is taken by regulators and designers to increase the energy efficiency of buildings, primarily through improving their envelopes and applying low-energy technologies. But are we missing a trick by ignoring the potential of applying passive design on an urban scale?

All urban structures can be relevant to such urban masterplanning. The courtyard, rooftop or car park can have an impact. The importance of urban-scale factors with an impact on energy consumption can be increased by their positive reinforcement of each other. For example, improving external thermal comfort can lead to reduced car use, which reduces anthropogenic heat production, which in turn improves external comfort.

Centralising heat rejection can reduce the ambient temperature, which will result in reduced cooling loads and heat rejection. Better external spaces encourage people to be outside and reduce the need for cooling in the first place – people use less energy in the park than an air conditioned flat. In a cooled office, each person eating lunch outside daily removes over 30 kWh per year of cooling load.

To achieve the above we need a design hierarchy that includes low carbon urban planning (see Figure 1). The following factors are key to making this a reality (see also Figure 2),

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Optimising shade and daylighting

Site layouts can be designed to minimise the effects of the sun and reduce cooling loads. In hot climates, narrow street canyons provide shade to both streets and buildings. However, this traditional vernacular is inappropriate for vehicular access and can lead to trapping of pollutants and poor air circulation.

Around tropical latitudes, streets oriented along a north-south axis are more shaded than east-west orientated streets. The translation to lower radiant and air temperatures will lead to lower energy consumption. Depending on latitude, height:width ratios of more than two will reduce solar heat gains to north-south streets, whereas east-west streets will require ratios closer to four.

In theory, sites can be laid out according to their latitude and climate, in order to allow shading of direct solar radiation to be achieved while daylight levels are realised. This provides the potential to reduce energy consumption due to reduced lighting and heat gains. The use of surrounding buildings and other obstructions to provide shading of low-angle sunlight can significantly reduce the additional shading (and obstruction to light) required at glazing units. Analytical methods can help to optimise these effects at an early stage.

Improving air movement

Air movement is most critical where pollutants are produced. Streets can be oriented along the prevailing wind directions to provide a constant low-speed aeration path. In a simple orthogonal plan this would mean streets that are perpendicular to the wind would have lower rates of ventilation. Alternatively, a higher overall average ventilation rate may be achieved in all the streets if they are aligned at 45 degrees to the prevailing wind direction.

To enhance the ventilation in streets perpendicular to the prevailing wind directions, wider streets or higher buildings on the downwind side of the street can be used to encourage downdraughts. Alternatively, wind-catching structures can draw wind into these streets. Coastal sites can often capitalise on sea breezes.

Wide streets will tend to increase air movement (and disperse pollutants), but

> We ought to think beyond the usual low-energy mantra of 'passive building design first, then efficient systems, then building integrated renewables'

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A view over Dubai , United Arab Emirates, which claims to be incorporating sustainable development into the city's rapid growth

will require shading for both pedestrians and buildings. Low ventilation rates in narrow streets are idea for cool shaded pedestrian routes, which may utilise other heat sinks to improve conditions further.

Natural ventilation

Reduced anthropogenic heat gain and quieter streets will improve the viability of natural ventilation of buildings to provide comfortable working and living environments. Resulting improvements in air quality can reduce urban heat island impacts even further than the direct heat emissions. The provision of more comfortable external environments for pedestrians will reinforce walking, cycling and use of public transport.

The potential for natural ventilation can be improved by the use of building geometry to provide high pressure differentials for cross flow ventilation. Differential building heights or wind catching structures can improve the wind environment available to ventilate buildings.

Materials

Material selection has a significant effect on the urban environment, influencing surface energy balances and visual fields. Heavy materials provide a dynamic element to the urban environment, acting as heat stores and leading to elevated night time temperatures.

In very hot climates this can have a detrimental impact on evening comfort (and may be of benefit in cooler climates). This thermal-storage effect is a contributor to the urban heat island. Lower surface temperatures reduce the radiant field, significantly improving comfort, as well as producing less convected heat. External comfort can be improved by the use of high-mass materials in the shade to reduce operative temperatures in hot conditions – for example, stone colonnades are a common device to produce cooler external routes.

High albedo (reflective) materials reduce the amount of solar radiation absorbed into both the surfaces and the buildings within them. These materials include white paint and plaster, light-coloured stone and shiny aluminium. Surfaces should also be diffusive, avoiding any specular or glossy finishes to prevent direct reflection and glare.

Vegetation

Planted surfaces tend to have significantly lower surface temperatures than hard surfaces. This reduces the radiant field and can cool air blowing over the surface. Vegetation can create a cooling effect not only within its own environment, but also upon its surrounding area. This can lead to a direct reduction of cooling load and greater use of the outdoors.

The cooling effect of vegetated surfaces is partly due to evapotranspiration from leaves, which occurs mainly at night. The upper part of a tree's leaf canopy loses heat to the sky by transpiration and the leaves cool the air around them. This can be very useful in cultures where external areas are largely used at night.

Solar radiation is mostly absorbed in the leaves of plants, so that the reflected radiation is low and leaves can intercept solar radiation without producing undesirable reflection. The use of ground planting adjacent to shaded areas or windows can reduce reflected radiation. Green roofs and walls provide a heat sink as well as reduced convective and radiative heat fluxes compared with concrete. This effect is pronounced in enclosed zones in hot, dry climates.

The benefits of vegetation should be achieved within appropriate water use.

Water

The use of water in external environments provides cooler surfaces, reducing the mean radiant field, and evaporation can provide cooler air temperatures. At most angles (less than 80 degrees from the normal), water has very low reflectivity,

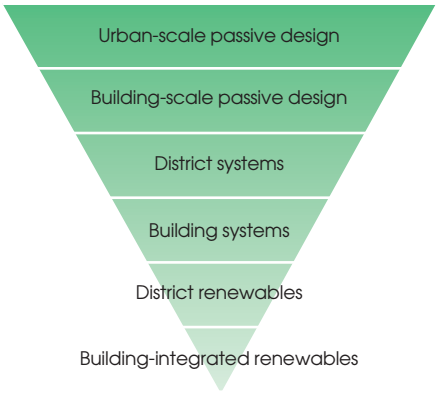

Figure 1: A revised hierarchy of low carbon design

and therefore tends to reflect little solar radiation towards occupied zones. This means that unshaded water absorbs a lot of solar radiation; but this does not necessarily produce a significant increase of water temperature due to the large thermal capacity of water and evaporation at its surface.

Cool spaces

Courtyards can be designed as well-shaded, sheltered places where localised air temperature reduction due to heat sinks can be contained and improved. The addition of vegetation or water features into such spaces can provide significant improvements to the environment. As a result of this, a building opening onto a courtyard is likely to have lower radiative and convective fluxes.

Transition spaces between air-conditioned buildings and the outside can protect entrances while providing pleasant climatic transitions for people. Large buffer spaces can replace vestibules to capture air conditioning leakage at entrances while using passive techniques to improve conditions, leading to zero-energy public areas. Retail circulation can occur outside of conditioned malls in passively improved areas to reduce the total conditioned area.

Centralised systems

Lower external temperatures can improve the efficiency of heat rejection. It is suggested that heat rejection may be centralised and carefully placed to reduce further anthropogenic heat input. Such planning of systems at an urban scale offers the potential to place heat-rejection devices in better ventilated environments and improve their efficiency, further reducing energy consumption. Centralisation provides improved scope for the use of new technologies such as solar-powered district systems.

Renewables

The potential for renewable energy production associated with buildings is limited by the availability of resource: urban form should ideally be devised to provide buildings with elements facing the sun. In sunny climates, the unshaded surface area available for solar water heaters should be guaranteed, and space for future solar plant reserved. The installation of renewables should be considered on a regional scale when masterplanning, to achieve the most economic solution. Building-integrated generation should be addressed in context of the site, but compared to centralised options when available.

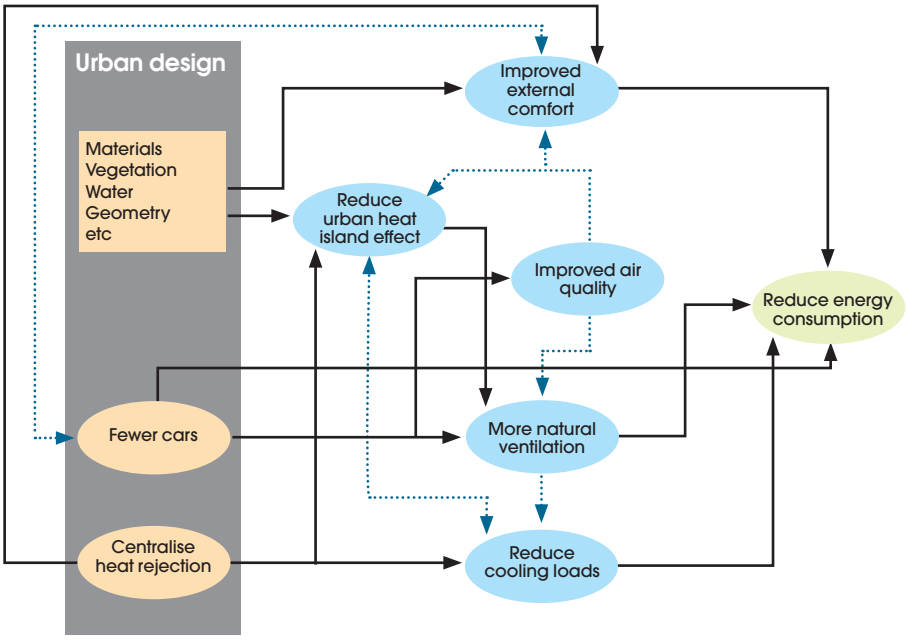

Figure 2: Positive feedback mechanisms in urban design for reduced energy consumption

Conclusions

The aim of microclimate design in climates with very hot seasons is to extend the usability of the external environment further from the cold season towards the hot season. In many locations this can produce outdoor spaces that are usable all year round. It is unlikely that passive measures will provide external comfort in extreme Middle Eastern summers, and this should not be a design aim for sustainable developments.

For the maximum impact on designs, and therefore the largest impact on energy use, it is necessary to consider the urban design principles discussed here at the earliest stage of a project through design workshops and outline studies. As designs progress, analysis may be carried out in order to support the implementation of energy-saving site-wide strategies.

We ought to think bigger about our designs, beyond the usual low-energy mantra of 'passive building design first, then efficient systems, then building integrated renewables'. We need more consideration of context and more sustainable masterplans. Encouraging designers to think on an urban scale is crucial: the impact of masterplanning will be enormous and very long term. **CJ**

● **BECCI TAYLOR** works for Arup

> The installation of renewables should be considered on a regional scale when masterplanning, to achieve the most economic solution

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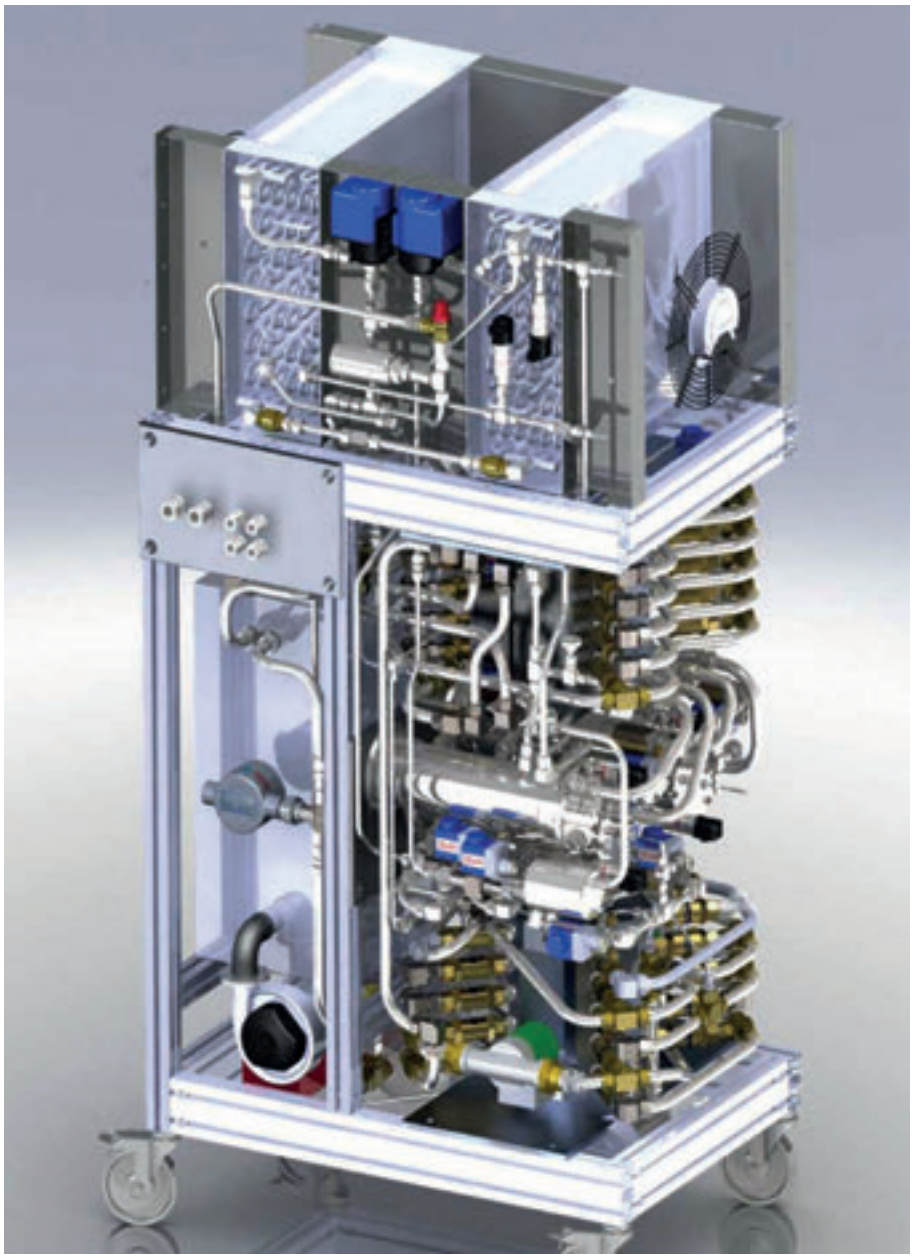
FIRED UP

Gas-fired heat pumps using adsorption have been developed only for commercial use – until now. A system that is small enough for domestic applications has been developed as a prototype. **Tim Dwyer** explains how the technology works



All images and illustrations Sorption Energy Ltd/University of Warwick

An artist's impression of the air source sorption heat pump concept developed by Warwick University

The development and application of sorption heat pumps have been part of the heating and refrigeration scene for many years, and in recent times several manufacturers have produced gas-fired heat pumps aimed principally at the commercial market. But such technologies have been too large to use in a domestic setting.

Now a research team led by Professor Bob Critoph of the University of Warwick's School of Engineering has taken a well-tried concept and developed it into an affordable air source sorption heat pump that is small enough to be used domestically and could replace a conventional gas-fired boiler. Modelling of the new concept, which is now at prototype stage, suggests that the heat pump could be produced at a realistic cost and reduce gas consumption by over one third, thus providing good payback on the investment.

The system evolved by Critoph uses ammonia as the working fluid, as it is able to work well below zero and, in compact equipment, has comparatively low flow pressure drops, so improving the effectiveness of the overall system. The sorbent itself is solid active carbon, although other solids (such as silica gel or zeolite) or liquid sorbents may have been used.

The basic principles of the resulting adsorption heat pump system are shown in Figure 1 – active carbon has an enormous surface area allowing the attachment of many molecules of the ammonia refrigerant.

This basic process is clearly not

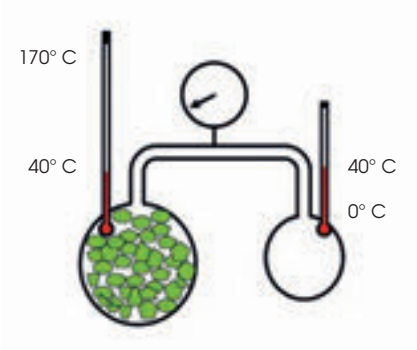
Figure 1: The adsorption process

Initial state

Ambient Temperature

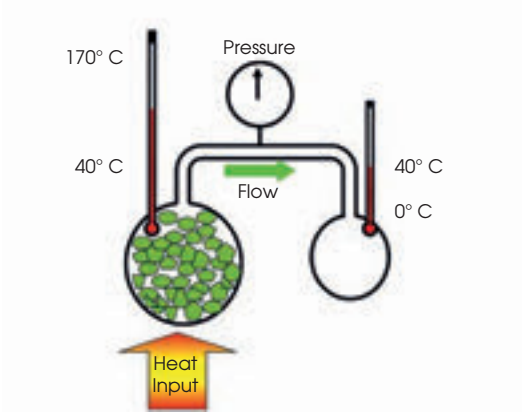
Low pressure

High concentration



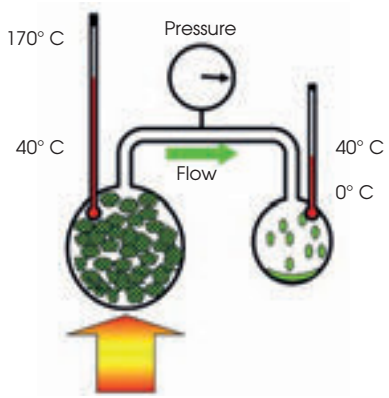
Process 1

Carbon bed is heated, ammonia is driven off and pressure increases until…



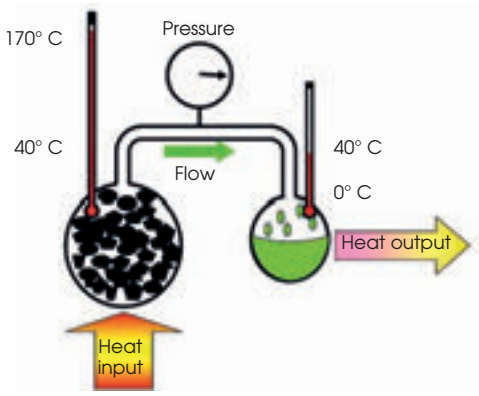
Process 2 starts

The saturation pressure is reached and ammonia condenses in the right hand vessel at ambient temperature.



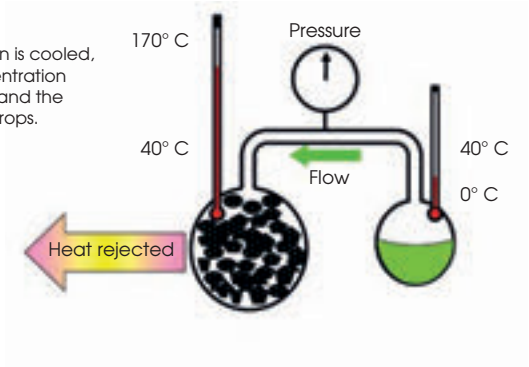
Process 2 continues

More ammonia is driven out from the carbon and condensed in the right hand vessel.



Process 3

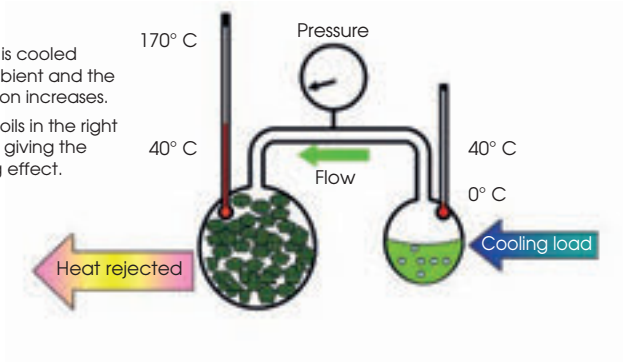
The carbon is cooled, the concentration increases and the pressure drops.



Process 4

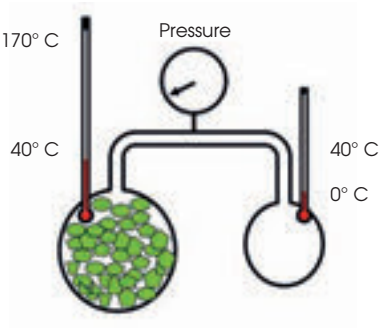
The carbon is cooled towards ambient and the concentration increases.

Ammonia boils in the right hand vessel giving the refrigerating effect.



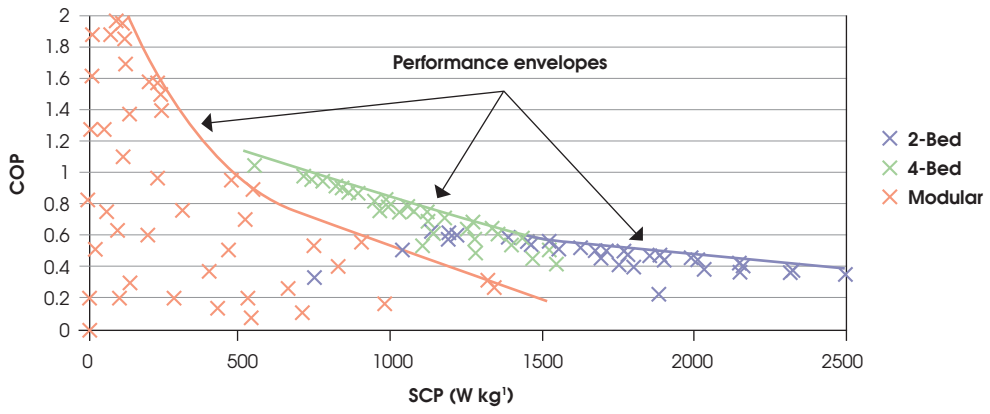
End of Process 4

The system is returned to the starting condition



continuous. The adsorbent (the active carbon) is heated to drive off the working fluid (ammonia) and then subsequently allowed to cool again to readsorb the ammonia. For commercial systems the adsorber is split into a number of 'beds' and arranged so that while one or more beds are adsorbing the ammonia, others are being heated ('desorbed' or 'regenerated') to drive off the ammonia so that the vapour is made available again for the cooling process. The adsorbent beds then switch their function (using changeover valves to redirect the ammonia refrigerant) so that those now saturated with ammonia can be

Figure 2: Comparative performance of absorbent bed systems under prescribed temperature conditions



regenerated whilst the previously heated beds may be cooled so that they adsorb ammonia vapour again.

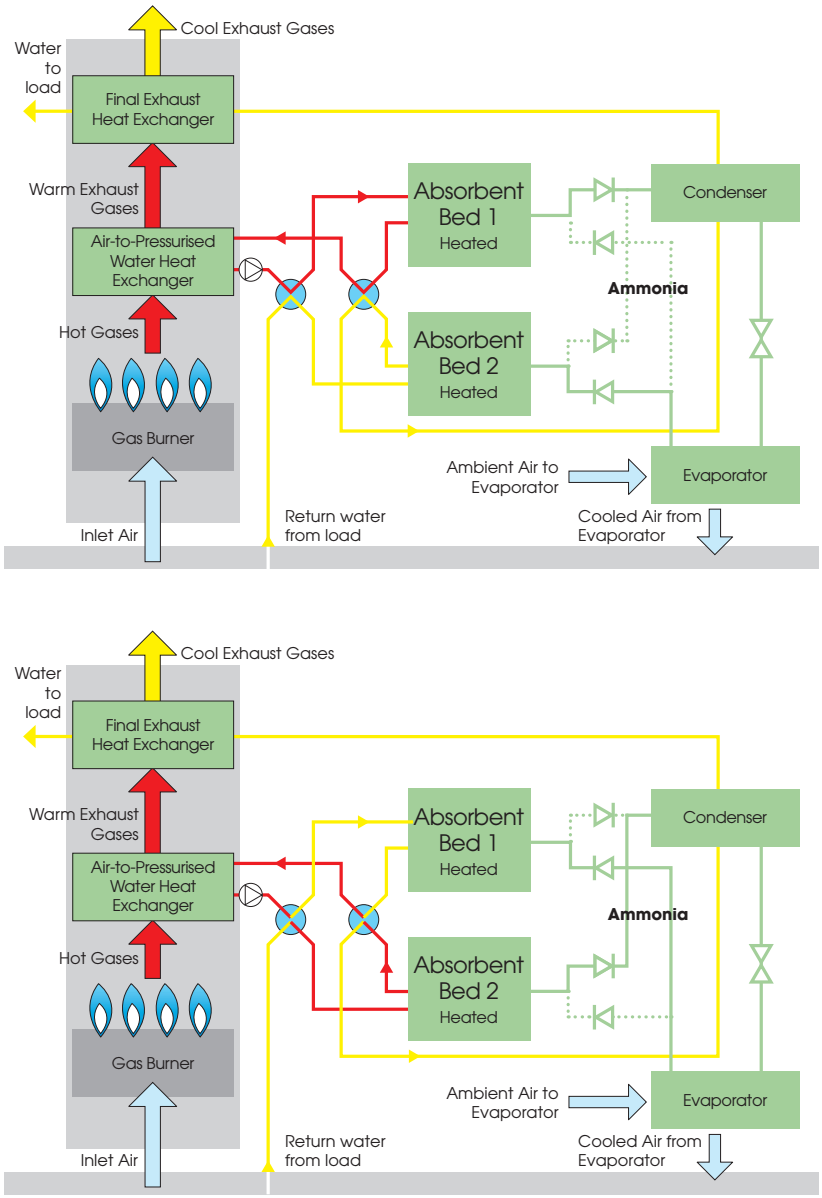
Critoph considered a large number of possible cycles, ranging from one known as Shelton's thermal wave that uses two beds with some simple heat recovery between the two; through variations proposed and developed by Critoph over the last 25 years (some that he has successfully applied to solar-powered vaccine refrigerators); and including isothermal beds with heat recovery as proposed by Meunier.

Using modelling developed by the Warwick team's Steven Metcalf, they compared the potential two- and four-bed systems as well as a modular system developed using the thermal wave principal to identify the best combination of coefficient of performance (COP) and specific cooling power (SCP in watts per unit mass of adsorbent) for a system used to provide cooling at a prescribed set of temperatures.

> The team has developed the prototype of an affordable air source sorption heat pump that is small enough to be used domestically

As shown in Figure 2, whilst the modular thermal wave can deliver very high cooling COPs, it has a correspondingly very low SCP, which would imply a very large and costly machine (per unit of cooling power). At the other extreme a simple two-bed system (that included heat recovery and mass recovery between beds) has much higher SCPs although lower COPs. If COP was not important, for example when the

Figure 3: Schematic representation of packaged unit showing the two modes of operation that allow continuous operation



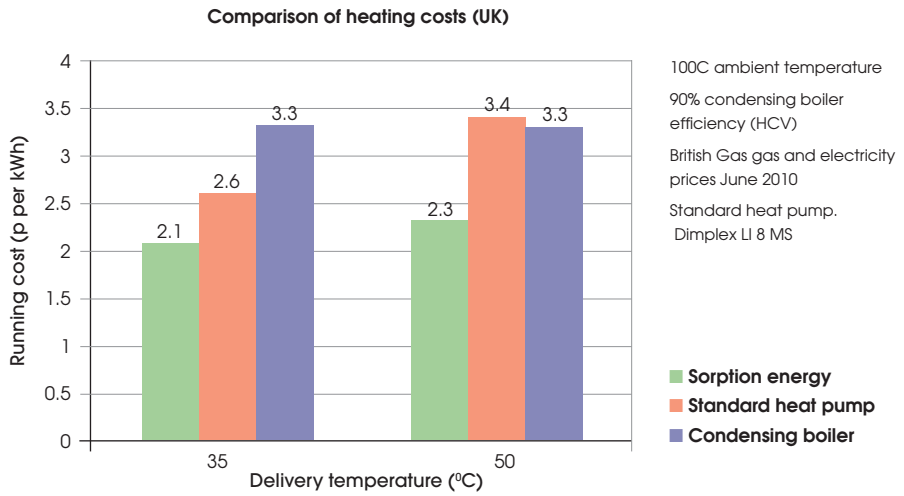
GLOSSARY
ABSORPTION OR ADSORPTION?

Both absorption and adsorption are used to produce refrigeration and to power heat pumps.

Liquid absorption systems use an absorbent (such as lithium bromide) to absorb (dissolve) another fluid (for example, water vapour) to produce a low partial pressure in a connected (cold) evaporator. The water is driven off the absorbent solution using heat after having been pumped into a higher pressure (hot) generator. Then, after cooling and condensing, it is passed back as a low pressure liquid to the evaporator. **(www.cibsejournal.com/cpd/2009-11)**

Adsorption systems use materials with large accessible surface areas (in simple terms a massive 'sponge') that will selectively attach, or bond, molecules of working fluid to it by chemical attraction. The huge surface area of cool active charcoal provides an excellent adsorber for organic materials that are subsequently released when the active carbon is heated. This drives the 'refrigeration' process.

Figure 1: Predicted comparative operating costs based on 2010 prices



energy supply is from waste heat, the two bed system may be the preferred selection.

In Figure 2, performance towards the top right of the graph indicates both high COP and a smaller amount of absorbent – an overall higher performance. The four-bed performance is superior to that of the thermal wave for COPs less than 1.2 (SCP about 450 W/kg) and gives way to the two bed system for COPs less than 0.6 (SCP about 1500 W/kg). Larger numbers of beds were not considered, since the mechanical complexity of valves and pumps were thought to be excessive.

Similar comparisons can be made for different operating conditions and heating rather than cooling, but the conclusion was reached that a four-bed cycle was most suitable for a domestic heat pump system. It still requires complex valves and extra pumps; but for the conditions suitable for domestic applications, the COP is about 25% higher than that of a two-bed design.

To make the system compact enough for use as a domestic appliance, the team designed a novel shell and micro-tube adsorber unit that has a low thermal mass and yet equivalent heat transfer to a more traditional flat configuration. The adsorber is the core of each of the four

Electric power Heat pump technology has sights on retrofit market

Electrically powered heat pumps can deliver excellent winter performance when supplying an under-floor heating system at 35C. Existing UK radiator heating systems (designed for 60C to 80C heating water) present a challenge where operating at this lower temperature can lead to a 50% drop in heating capacity.

Two main approaches appear to have reached commercial reality as an air-source heat pump capable of direct retrofit, namely the cascade cycle and the economised vapour injection cycle. Most major suppliers now have cascade or split units that typically utilise R410a in their lower stage (outdoor unit) and R134a in their higher stage (indoor unit). Performance of these units produces coefficients of performance (COPs) at more than 4.2 at European test standard (EN14511) and about 3 at higher temperatures. The University of Ulster's research has developed the economised vapour injection (EVI) cycle in conjunction with Emerson/Copeland Ltd. Initial laboratory results were promising and a unit was field trialled in a 105m2 semi-detached house giving a seasonal COP of 3.7.

However, a number of challenges arose over part-load operation in summer, using a single heat pump to meet the whole heat demand (marginally oversized for winter conditions) suffering failures due to very short cycling in hot-water-only mode; variable speed drives have been investigated to help overcome this.

Numerous companies, particularly in Asia, have developed EVI heat pumps for higher temperature delivery air source heat pumps. Other research by Ulster in cooperation with EA Technical Services is developing a combined compressor expander device to recover energy from the higher temperatures and pressures associated with heat pump retrofit applications.

A compact unit was developed to recover power from a turbine. The initial unit designed for R134a has a mass flow 0.0018 kg/s for a compressor electrical demand of 3 kW at 3000 revs/min. It is designed for a maximum operating compressor delivery pressure of 15.4 bar absolute, leading to a heat output of 15 kW and is based on the ability to link a hinging vane with a piston. This technology enables recovery of energy from low-grade heat and efficient expansion and compression of air or refrigerants. Compression and expansion ratios can be varied on demand over a wide range of speeds. Initial results were promising but deteriorated over time as internal refrigerant leakages and heat transfer between turbine and compressor negated expander gains. A new unit has been developed with improved design, limiting heat transfer and eliminating turbine/compressor refrigerant leakage – providing superior compression and expansion efficiency.

Heat pump technology is evolving, making it increasingly possible to deliver higher temperatures at good coefficients of performance and reduced capital cost. If linked with demand-side management, benefits accrue for both home owners and electricity utilities that may encourage wide-scale deployment and delivery of economies of scale in manufacture.

By Professor Neil J Hewitt, director, Centre for Sustainable Technologies, University of Ulster

generators (the sections that generate the ammonia vapour) that form a sub-assembly consisting of the generators, ammonia check valves that connect to the evaporator and condenser, and the mass recovery solenoid valves.

The schematic for a two-bed package shows the operation that allows the active carbon beds to adsorb and desorb in sequence (see Figure 3). Although still in prototype, the whole system has been visually modelled to fit in a compact, externally mounted casing with gas, electricity and water connections being made from inside the residence. It is designed for a typical UK house that had been retrofitted with good insulation to the point that the heat pump needed to deliver 7 kW of heat.

The predicted operation of the systems would have roughly the same carbon emissions as traditional electrically driven vapour compression heat pumps at low (30C) output temperatures, but at higher temperatures (50C) it is expected that this new system would save around 14% carbon. Since the system is heat driven (with gas) the energy cost savings are likely to be more dramatic (see Figure 4).

The control mechanisms within the unit are relatively complex, but Critoph's team has a fully working prototype that is being tested to EU standards. This prototype has:

- A system using gas fuel;
- Four beds for higher efficiency; and
- Nominal heating power of 7 kW (continuous) for space heating and hot water.

The modelling predicts a seasonal space-heating COP of 1.4, using radiators – which suggests a 36% drop in fuel use compared with a 90% efficient condensing boiler. The team hopes that the prototype will lead to a production design that will reduce the component complexity. **CJ**

This work described above was undertaken as part of the CALEBRE (Consumer Appealing Low Energy Technology for Building Retrofit) programme funded by the UK's Engineering, Physics and Science research Council and EO.N Work; it was carried out by the University of Warwick and is the subject of further development by Sorption Energy Ltd. A presentation of the findings was made at a CIBSE seminar on heat pumps in May.

> It is hoped the prototype will lead to a production design that will reduce down the component complexity

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URBAN CHALLENGE

Heat pumps are seen as crucial to cutting carbon emissions from the built environment. But, writes **Roger Courtney**, this approach may not be practicable when it comes to heating urban environments

With the UK having set itself a target of an 80% cut in greenhouse gas (GHG) emissions by 2050, compared with 1990 levels, it is widely accepted that 'decarbonising' both the built environment and energy supplies is vital to achieving this reduction. The built environment is, of course, a significant contributor to carbon dioxide emissions.

But while CO_2 is the main component of GHG emissions, other gases (notably methane from agricultural processes) contribute to the total. In its Fourth Carbon Budget report (December 2010), the Committee on Climate Change (CCC), an independent advisory body established under the Climate Change Act 2008, noted that emissions from international shipping and aviation were not included in the 1990 baseline. The CCC expressed the view that these should be included when considering the 2050 target.

Taking this into account, and assessing that a reduction in emissions of gases other than CO_2 will be more difficult to reduce than the CO_2 contribution, the CCC concluded that achieving the 2050 target for GHGs will require a 90% reduction in CO_2 emissions compared with the 1990 baseline of around 600m tonnes (MT). This means that CO_2 emissions will need to be reduced to around 60MT by 2050.

UK CO_2 emissions in 2008 were some 490MT; Table 1 shows the approximate distribution across different forms of fossil fuel use. The scale of reduction required between now and 2050 is clearly very challenging.

The CCC has projected a rapid decline in the carbon intensity of electricity generation through the construction of nuclear and carbon-capture-and-storage plants, and from the growth of renewable sources. The potential for reductions in transport and industry will depend on developments in battery technology and biofuels (including the availability of the latter) but achievement of the 60MT target is likely to require reductions of around 80% from 2008 levels in emissions from transport and industry.

A possible distribution of 2050 emissions across the various sectors is shown in Table 2.

While these figures represent only one

The feasibility of using heat pumps in city centres needs to be established

view of the 2050 distribution, it is clear that achievement of the 2050 target requires the built environment to be effectively decarbonised by that date.

Put simply, this means that natural gas, oil and coal will need to be replaced as a source of low-temperature heat in the national building stock by 2050. This would exclude not only the direct combustion of gas in heating appliances, but also indirect use of gas in gas-fired communal heating and combined heat and power (CHP) schemes.

Energy supply to buildings in 2050

Demand for heat in the built environment will of course be reduced through a national programme to install energy efficiency measures in older buildings and through the growing proportion of more efficient or 'zero carbon' buildings in the national stock (and by climate change itself). But there will continue to be some demand, both for hot water and for space heating in many older buildings. Indeed, even 'zero carbon' buildings are expected (under current proposals) to require some heating energy.

The CCC sees a large role for heat pumps in the future supply of heat to buildings; its Renewable Energy Review (May 2011) estimates that heat pumps could meet 55% to 75% of domestic heat demand and 70% to 90% of non-domestic demand. Its projections of future electricity supply capacity take this expansion of heat pump capacity into account.

The CCC has also noted that widespread use of direct electric heating would require a very large and probably unrealistic increase in electrical supply capacity.

However, heat pumps require a suitable heat source, generally either the ground or the air. Thus there has to be a suitable relationship between the heat demand that needs to be supplied and the availability of heat from that source. In particular, if the density of buildings is high, it may not be feasible to draw enough heat from the ground or the air in the vicinity of the buildings to satisfy their heating needs.

The proposition that heat pumps have a major role to play is reasonable for rural communities and low-density developments, such as the leafier suburbs of our cities. But the feasibility of this approach in the

Table 1: Sources of CO_2 emissions across different forms of fossil fuel use in 2008

Sources	Million tonnes*
Electricity generation	150
Transport	125
Housing	80
Industrial processes	65
Non-domestic buildings	20
Other (eg, refineries)	50
Total	**490**

Source: Committee on Climate Change Fourth Carbon Budget report **www.theccc.org.uk**

Table 2: Possible distribution of CO_2 emissions in 2050

Sources	Million tonnes*
Electricity generation	10
Transport	25
Housing	0
Industrial processes	15
Non-domestic buildings	0
Other	10
Total	**60***

*This is the level that CO_2 emissions will need to fall to in 2050, according to the CCC report (see above)

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Heat pumps can have a significant role in leafy suburbs

> Achievement of the 2050 target requires the built environment to be effectively decarbonised by that date

central areas of towns and cities, which have high-density housing such as 19th century terraces, and extensive areas of non-domestic buildings, needs to be established.

Urban heat supply

If heat pumps serving individual buildings are not feasible in urban areas, other options will need to be considered. These include:

- Direct electric heating;
- Combustion of biogas;
- Communal heating schemes; and
- Currently unproven approaches such as distribution and combustion of hydrogen.

Each of these presents challenges. As noted above, direct electric heating would require a large increase in supply capacity. Scenarios such as the construction of a new mega-grid that would supply Europe with electric power generated from photovoltaic (PV) arrays in North Africa might provide such capacity, but these remain speculative.

Similarly, the sustainable level of energy production from biomass remains unproven. The Renewable Energy Review notes that there are limits to sustainable biomass and that it may be preferable to use biogas (and biomass generally) to reduce emissions from industry rather than from buildings. The CCC intends to publish an assessment of biomass later this year.

The economic viability of communal heating schemes depends on the 'heat density' of the areas served, which will be lower in the future because of energy efficiency measures in buildings and the rise in average winter temperatures as a result of climate change. Such schemes could draw heat from local biomass-fired boilers or CHP plants, where the larger scale of operation (as compared with boilers for individual buildings) would facilitate the installation of equipment to clean flue gases and maintain urban air quality.

Alternatively, these schemes could be supplied by large heat pumps which draw heat from under a local park or other open space. A third option is that they could be supplied with heat from grid power stations; past studies have shown that this could be a viable option even if the station were 50 to 100 km away.

Conclusions

While most attention is currently focused on measures that will reduce the demand for heat in the building stock, these will not remove the need for housing and other buildings to be supplied with heat. Decarbonisation of the built environment will therefore require a combination of demand-side and supply-side measures. Heat pumps supplied by decarbonised electricity will undoubtedly have a significant role to play nationally, but this may be limited in highly developed urban areas.

Land use, which is a key responsibility of local councils, could become an important factor in future energy supply. Communal heating plant based on biomass would need to be located conveniently to the area served, with due allowance for storage of fuel. Perhaps new open areas will need to be created, both for energy supply needs and to improve the local urban climate. If heat is to be imported from distant power stations, suitable supply corridors will need to be protected.

Energy supply may therefore become a matter for strategic planning at the city and town level, rather than the national level – almost a return to a previous era when municipalities invested in gas works and electricity generating plant.

Similarly, there are potential implications for the new power stations required over the next two decades. It will be important to establish whether these, like their predecessors, will be confined to supplying electricity, or should also supply heat.

A programme of studies is therefore needed to establish the relative technical and economic merits of the different options for heat supply to urban areas, against the background of the overall emissions targets to which the UK is committed. **CJ**

● **ROGER COURTNEY** is professorial research fellow, Manchester University, and visiting professor, School of Construction and Project Management, University College London

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ENVELOPING ISSUE

MASTERCLASS
Professor
Doug King

This month's article questions whether simple, steady-state heat loss calculations will continue to be of use in a world of high-performance buildings

The design of building envelopes presently falls into an unhappy void between the responsibilities of the architect and of the engineer. I believe that, as guardians of building carbon performance, building services engineers should be responsible for the performance of the building envelope. However, to the architect the envelope is the means of sculpting the form of the building and generating its outward appearance. We must therefore be prepared to collaborate more closely and develop a clear understanding of envelope thermal performance issues in order to be able to communicate these with our architectural colleagues.

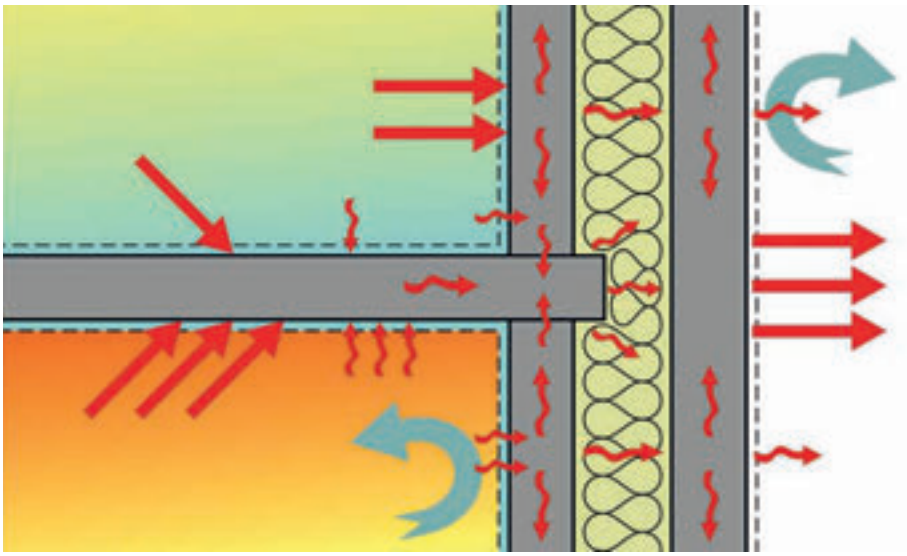
As we approach the limit of efficiency gains in equipment and systems, we need to achieve a step change in our understanding of building envelopes. The building physics that underlie thermal performance is well developed and we have sophisticated software to help us. Nevertheless, it is still essential for engineers to have a good understanding of the principles of heat transfer and storage, so that they can validate or challenge the veracity of the results generated from software.

When I started my career in building services, the building envelope was entirely the architect's responsibility and calculating heat losses was a simple business. Everybody assumed that construction was homogeneous and the Building Regulations had prescriptive standards for insulation. All the engineer had to do was choose the design temperatures and undertake steady state heat loss calculations using the U-values prescribed. This is far from the case in the present day.

Insulation standards have increased dramatically and it is simply not the case that you can go on adding insulation to a wall or roof and things will keep getting better. Adding insulation to traditional constructions changes the temperature gradient and thus introduces the risk of interstitial condensation. So, as we increase the insulation and air tightness of our buildings, we must also attend to the transit of moisture vapour through the construction, or provide means to exclude it.

From 1985 the Building Regulations required us to account for repetitive thermal bridging (construction elements that spanned the insulation thickness, such as framing in the walls of timber housing). This meant the steady-state calculation had to be expanded to include the linear conduction of thermal bridges represented by the psi-value.

As insulation requirements increased in subsequent revisions to the Building Regulations, it became necessary to insulate overstuds and rafters to reduce the conduction at thermal bridges, but this made calculations almost impossible without finite element analysis software to calculate the three-dimensional heat flows. The notional building used in Part L 2010 includes psi-values for all the common



The traditional U-value calculation models a simple, linear flow of energy from the internal air to the external air by conduction alone (accounting for the resistance of a stagnant air boundary layer). In fact, to represent the true picture, we ought to account for absorption and emission of energy by radiation, differential conduction into the internal face at high and low levels due to stratification, and for three dimensional flows within the construction

thermal bridging conditions but still falls short in some cases.

As we continue to increase insulation levels, thermal bridges assume increasing significance as a proportion of the overall heat loss. They can also create problems due to condensation at local cold spots. Yet, despite all this, thermal bridges do not appear to feature highly in the consideration of those designing external walls.

A study by the Joseph Rowntree Foundation on sustainable housing at Elm Tree Mews (*Journal*, December 2010, pages 7 and 23), found that the design calculations seriously underestimated the extent of thermal bridging, resulting in heat loss of 50% higher than expected. This appears to have been partly due to the assumptions included in the calculations not having been checked against the actual construction details.

It is essential that those taking responsibility for building performance calculations are fully involved in the design of the building envelope. There is a danger that any disconnection between those who detail the construction and those who understand the thermal performance could lead to serious consequences, possibly even failure of a structure due to condensation damage.

We may have accounted for non-homogeneous construction, but there are still more factors that we must consider in order to completely understand the steady-state heat loss. The calculations traditionally use a single temperature point to represent internal and external conditions, typically the air temperature. Yet in modern low-energy buildings it is not uncommon to find a mixture of radiant and air heating sources.

We often choose radiant heating systems for their ability to transfer energy to surrounding surfaces, without significant effect on the air temperature. Radiant heating therefore could create greater heat loss, due to the increased absorption at the internal surface, than would be indicated by simple conduction of heat from the air. The CIBSE heat loss calculations now include a heat source factor to account for the differential heat loss by fabric and ventilation conduction due to the balance of radiant and air heating.

Similarly we should also account for heat loss or gain by radiation from the external surface of the building. In an urban situation the heat loss from the roof to a cold night sky may be much more significant than heat loss from the walls which are surrounded by other buildings also radiating heat. Conversely the absorption of solar energy during the day may in fact be greater than the notional heat loss.

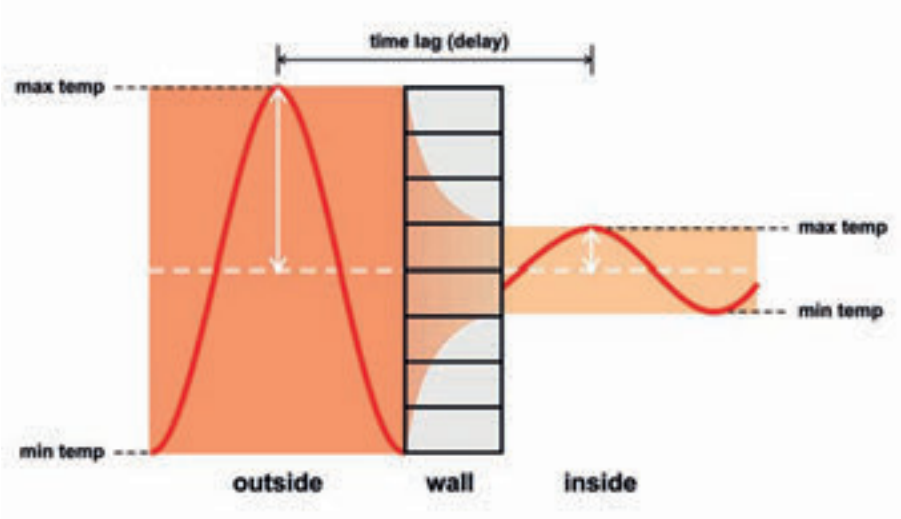
There is no simple way of analysing the radiant contribution to building heat loss but nevertheless it should still be considered when making choices about the materials used in building envelopes. In particular this might start to inform choices about the use of materials with high emissivity or those which are highly transparent to radiation such as glass curtain walls.

For the complete picture we should also consider the dynamic thermal response of a building, not just the steady-state condition. A proportion of the heat flowing through the envelope, in either direction, will heat up the construction materials. It is only when the temperature of the material has been raised that onward transmission takes place. This introduces both attenuation and a time delay, fundamentally changing the envelope's response to diurnal variations in temperatures and solar radiation. The attenuation is known as 'decrement' and the time lag as the 'decrement delay'.

Decrement is used when calculating summertime cooling loads but, as we continue to drive for improved

Doug King

This display of corks in a restaurant window indicates the problems that can be created by simply adding more insulation to an envelope construction without considering the vapour permeability. The corks act as an insulant, changing the temperature gradient, but they do not inhibit the passage of water vapour. Condensation occurs outside the insulation where the temperature drops below the dewpoint



Diurnal variations in external temperature are attenuated by building envelopes to the extent that they contain thermal mass to partially absorb the energy flow. This results in a dynamic insulation property known as decrement

performance, we will also need to account for it in the heating condition. Consider a traditional brick wall with insulated cavity. The decrement factor from exterior to interior is 0.26, with a decrement delay of about 10 hours. The decrement factor is applied to the steady state U-value heat transfer. Thus the heat absorbed at the exterior during the day is only transmitted to the interior at a fraction of the intensity during the night. Conversely, during the daytime, the interior experiences passive cooling as a result of the heat loss from the previous night. Consider now that the construction is symmetrical inside to outside as it is outside to inside. The same decrement factor and delay must therefore also apply to heat flowing outwards in the winter. So, we must now consider the insulation of conventional masonry construction as being dynamic over the diurnal cycle. The same applies, to a greater or lesser extent, to any form of envelope construction, and this must surely be an essential part of our understanding of building envelopes. The building envelope is the primary means of creating a comfortable and stable internal environment yet, outside academia, it is one of the least rigorously analysed aspects of the building services design. As we move forward we will need a concerted effort to refine our understanding of building envelope performance and to ensure that building services engineers are in a position to lead on this fundamental aspect of carbon performance. **CJ**

DOUG KING is principal of consulting engineers King Shaw Associates and visiting professor of building physics at Bath University.

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Airflow pressure drop in HVAC ductwork

Fans consume a great deal of energy, and so their efficiency is crucial to preventing waste. The airflow through ducted systems is key to maintaining maximum efficiency. This CPD takes a detailed look at flow and pressure requirements for such systems

It is somewhat odd that despite the universal adoption of fans in industrial, commercial (and increasingly domestic) systems, the underlying concepts that determine the size, selection and efficiency are still uncertain to many. It is thought that fans consume more than 20% of the electricity in buildings, and so are excellent candidates for optimisation when seeking opportunities to reduce the carbon footprint and the operating cost in the built environment.

This CPD will consider the flow and pressure requirements to allow air flow through ducted systems. A future CPD will apply this to consider the pressure profile through the whole system and the appropriate selection of fans.

The 'total' story

When examining the air flow through a duct, it is convenient to consider the pressures in the flowing air in terms of duct static, velocity and total pressure. The development of these concepts comes from a standard relationship, the Bernoulli Equation, which applies the conservation of energy to incompressible flowing fluids. The equation (for a 'frictionless' system) is:

Potential Energy + Pressure Energy + Kinetic Energy = Constant (or Total Energy)

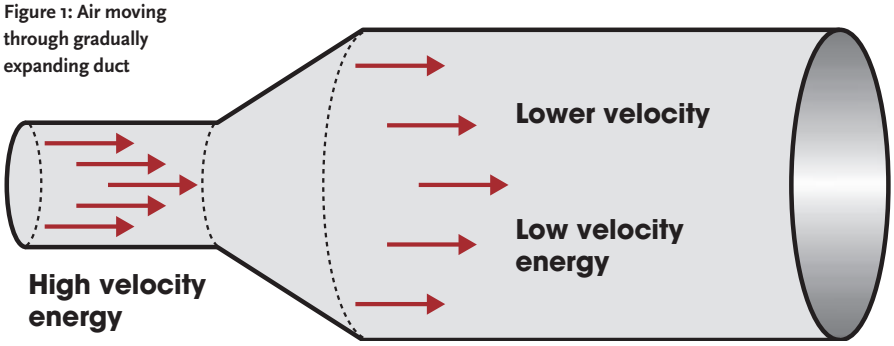
The potential energy relates to the elevation of the fluid (for example, its height above a datum such as ground floor level – think of the energy required to carry a barrel of water up several flights of stairs); pressure energy is due to the force of the fluid all around it (air at the bottom of a cold lift shaft will have a pressure energy related to the force imposed by the weight of the column of air above it); and kinetic energy relates to the movement of the fluid (to the square of the fluid velocity).

As the sum of the three is constant in a closed system such as a duct or pipe (ignoring friction and assuming incompressible fluids) it means that if one of the values changes, then one or both of the others must compensate to keep the sum of the three constant.

So, for example if a round duct very gradually expands (as in Figure 1) the velocity goes down as the area of the duct increases. The potential energy stays the same (as the centreline of the duct is still at the same elevation) and hence the pressure energy must increase to compensate, for the loss in velocity energy.

Air is, of course, compressible but, at the pressures experienced in HVAC ductwork, it is assumed that the air will not compress and, if the temperature does not vary, the density of the air (kg/cu m) will remain

Figure 1: Air moving through gradually expanding duct



constant as it flows throughout the duct. This reasonable assumption also allows the use of water (in this article) to more readily illustrate the pressures involved in fluid flow. Drawing (a) in Figure 2 shows a round pipe carrying water with a section of clear tube attached at right angles ('normally') to the side of the pipe.

Looking at drawing (a) with the water flowing smoothly through the straight pipe, the height, z, of the column of fluid gives what is known as the 'static head' of the water at that point – the vertical pipe is a simple 'manometer'. This reflects the static energy in the water, since the movement of the water is in line with the direction of the pipe and so the velocity of the water will not impose a pressure at the entry to this manometer tube.

If, as an example, the height of the water in the manometer, z, was 0.20m, then this would be the value of the static head and the static pressure (relative to the air around the pipe) at that point can be determined from pressure = ρ g z (Pa), where ρ is the density of the water, (nominally 1000kg/m^3) and g is the acceleration due to gravity, 9.81 m/s^2.

So, in this particular case the (relative) static pressure = ρ g z = 1000 x 9.81 x 0.20 = 1962Pa.

This static pressure happens to be positive relative to the air outside the pipe (the atmospheric pressure), and so any leaks in the pipe would push water out into the air. If, however, this were a length of pipe being used to draw water from a reservoir below into a pump (in suction) the relative static pressure would be negative; and if this simple manometer tube were still attached to the pipe, it would suck air into the system. If a tube is added to the inside of the original pipe facing the direction of the flow, known as a 'Pitot tube' (as shown in drawing (b) in Fig 2), then the height of the water in this manometer would be greater as this will now additionally reflect the velocity energy of the flowing water (that is always positive) as well as the static head. The manometer column height, z, will give the sum of the static head + velocity head. Used in conjunction with an adjacent static head reading (as in drawing (a) in Fig 2) the velocity head may be determined by subtracting the static head from the combined total head (static head + velocity head); and this assumes that the potential head is the same for both measurements, and so cancels itself out.

And these can readily be converted into static and velocity pressures, as before, using pressure = ρ g z. The manometer cannot reflect the 'potential pressure' – in a level piece of pipework, potential pressure will not alter but as the pipe rises the potential pressure will also rise and there will be an equivalent drop in the static pressure.

For the flow of air in ductwork in low-rise buildings the changes in potential pressure are almost always neglected, as these are relatively small (due to the low density of the air). So practically, when considering the pressure of ducted air systems, the potential pressure is assumed to be constant; duct velocity pressure (p_v) + duct static pressure (p_s) = duct total pressure (p_t).

If the average velocity, c, of the air (m/s) is known, the value of velocity pressure (p_v) can be calculated from 0.5 ρ c^2 (and frequently this is shortened to 0.6 c^2 by applying a 'standard' density of air of 1.2 kg/m^3). This value is based on air flow, with the speed c being measured normally to the direction of the air's travel (ie in line with the duct) – in most 'real' applications the velocity of the air will alter across a duct due to the friction at the side of the duct, to obstructions and changes in direction. Pressure (p_v) + duct static pressure (p_s) = duct total pressure (p_t), where the term 'duct static pressure' will be taken to mean 'duct static pressure relative to the surrounding air'.

> In another CPD article to be published in the future the knowledge discussed here will be further applied to consider pressure profiles and fan requirements

If the average velocity, c, of the air (m/s) is known, the value of velocity pressure (p_v) can be calculated from 0.5 ρ c^2 (frequently this is shortened to 0.6 c^2 by applying a 'standard' density of air of 1.2 kg/m^3).

In a theoretical world, if the duct was frictionless, then at two points in a duct (for example, points A and B in Figure 3) Bernoulli's Equation would mean that the total pressure at A would equal the total pressure at B, ie, $p_tA = p_tB$. But, of course in real ducts there is friction and so $p_tA = (p_tB$ + frictional losses).

Resistance to change

As the air enters the ductwork system – in Figure 3 through a simple louvred entry – the air will be accelerated from the still air outside the louvre to a velocity determined by the volume flowrate, q_v (m^3/s) of the air, and the area, A (m^2) of the duct. In this case as c = q_v/A = 0.6/0.1 = 6m/s. Before the air enters the duct it has a velocity pressure, p_v, of virtually zero and once in the duct p_v = 0.6x6^2 = 21.60Pa. This gain in velocity pressure will need to be matched by a drop in static pressure.

As the air flows through the louvre it will have to overcome some resistance and hence suffer an additional pressure loss. This can be calculated using the zeta factor, ζ, for the fitting (obtainable from section 4.11 of CIBSE Guide C 2007 or from manufacturers' data).

The resulting drop in static pressure is given by $\Delta p_s = \zeta \times p_v$, and the value of p_v is normally taken as that downstream of a fitting (but this may vary and should be clearly indicated in the tables in Guide C and elsewhere). The ζ for this particular

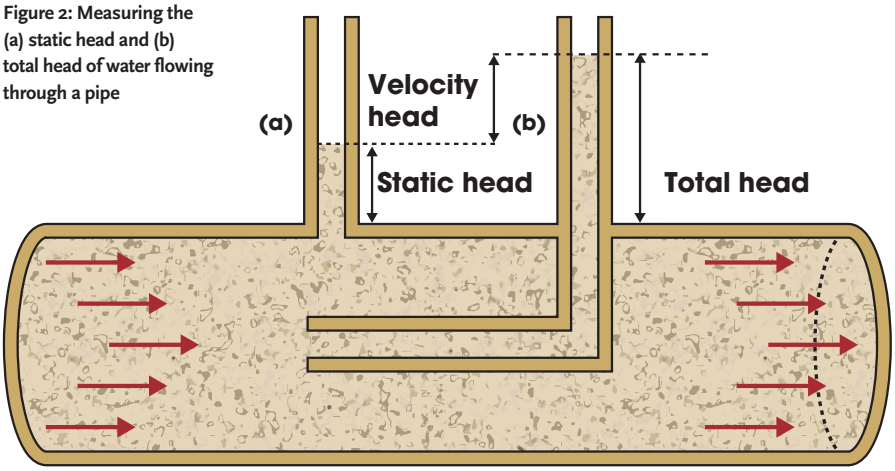


Figure 2: Measuring the (a) static head and (b) total head of water flowing through a pipe

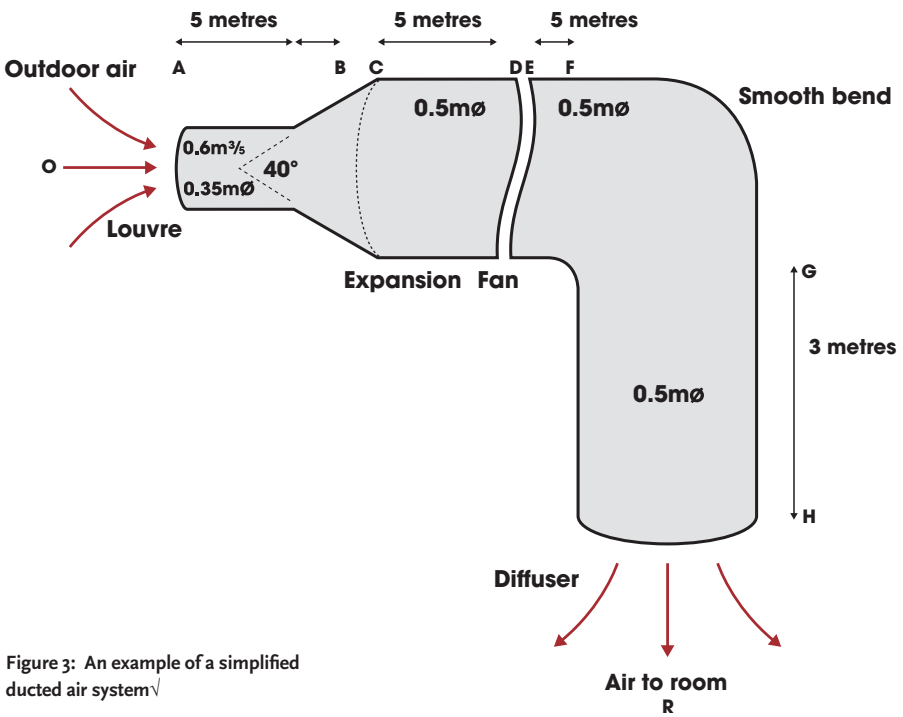


Figure 3: An example of a simplified ducted air system√

louvre (taken from the table in Guide C) is 3.0, so the static pressure loss as the air flows through the louvre due to friction, Δp_s = 3.0 x 21.60 = 64.80Pa.

Although expressed as a drop in static pressure, this loss will be a direct reduction in total pressure and, increasingly, many people relate the pressure drop in ducted air systems directly in terms of total pressure. This is useful for clarity when selecting fans, but the use of the static pressure can provide a clearer interpretation of the pressure inside the duct that is available to drive air out through supply terminals (such as diffusers and VAV boxes).

And so combining the louvre pressure loss with that required to match the gain in velocity pressure, the static pressure at a point just after point A would be -21.60-64.80 = -85.40Pa

Straight but still resistant

As the air flows through a straight duct (between points B and C) the friction of the air against the side walls of the duct (as well as between the air molecules themselves) will cause the air to lose energy (to heat and a little in producing sound).

The drop in energy manifests itself as a pressure drop. Between B and C the air will be travelling at constant velocity, so its velocity pressure will remain constant. The drop in pressure will be quite small (in a low velocity ductwork system) – typically around 1 Pa per metre run of straight ductwork.

In this particular circular steel ductwork system the value is 1.3Pa/m (and this may be checked by using figure 4.3 in Guide C). The length of that duct is 5m, and so the pressure drop is 5 x 1.3 = 6.50Pa.

Static regain

The next section is an expansion – in a real application the duct may change shape to pass around an obstacle, to join a device (such as a fan) or, indeed, the expansion may be there to alter the pressure characteristics in the duct.

Again, looking at Guide C (Table 4.55) the ζ factor for this expansion can be determined as ζ = 0.20 (where $Area_C/Area_B$ = 0.20/0.10 = 3 and the angle of the 'cone' is 40°). In this case (for the expansion) the pressure loss is calculated using the entering air velocity pressure, ie 21.60Pa. So the pressure loss is 0.20 x 21.60 = 4.32Pa.

However, an interesting change takes place at the same time. As the air passes through the expansion, the velocity will drop to 0.6/0.2 = 3.00m/s giving $p_v = 0.6x3.00^2$ =5.40Pa. Hence the velocity pressure has dropped by 21.60-5.40 = 16.20Pa. The loss in velocity pressure will be balanced by a gain in static pressure. So remembering that the pressure drop due to friction/turbulence will be 4.32Pa, the overall change in static pressure will be -4.32 + 16.20 = +11.88Pa, ie, an increase in static pressure – this is known as 'static regain'.

For the time being the fan will be ignored (to be considered in a future article) so between C and F will be the straight 0.50 m diameter duct of 10 metres length. Again looking at duct sizing diagrams (in Guide C or elsewhere) this gives a pressure drop of 0.21Pa/m duct. So the pressure drop for this straight section is 10 x 0.21 = 2.10Pa.

Final bend and away

The following bend is treated in just the same way as with any other duct fitting. Determine the value of ζ from tables and, if there is a change in duct area, determine the change in velocity pressure.

To determine the correct data in Guide C needs the Reynolds number, Re, for the air flow in the fitting. This is fairly straightforward as Re = ρ c d / η where d is the diameter of the duct (m) and η is the dynamic viscosity of the air (kg/ms). At around 20C the dynamic viscosity of air is approximately $18x10^{-6}$ kg/ms. So in this case, with the air velocity remaining at 3m/s, Re = 1.2 x 3 x 0.5/(18×10^{-6}) = 1×10^5.

Using this value the ζ value can be read from the Guide C tables for a smooth 90° bend as ζ = 0.290 and hence the pressure loss calculated as 0.290 x 5.4Pa = 1.57Pa, and since there is no change in average velocity the velocity pressure remains at 5.40Pa. The pressure drop for the following straight section (G to H) is simply 3 x 0.21 = 0.63Pa (as per previous straight section).

Finally the air is supplied into the room. If this were just a plain opening at the end of the duct the static pressure at this point immediately before the air leaves the duct would be practically zero (ie, the same as the room or atmospheric pressure) and the duct total pressure would simply be due to the duct velocity pressure. This would effectively mean that there would be one velocity pressure loss as the air left the duct and passed into the room.

However, there would more normally be a diffuser or grille at the end of the duct (and frequently some flexible duct and/or a reducer) that will additionally incur a pressure drop related to its ζ factor (or a pressure drop taken from manufacturers' data). It is important not to forget the final velocity pressure, as it can be significant (although in this case it would only be 5.4Pa).

In a CPD article in the near future, this knowledge will be further applied to consider the system pressure profiles and fan requirements.

Module 31

August 2011

1. Overall, how much electrical energy is it thought that fans consume in buildings?

- ☐ A 10%
- ☐ B 15%
- ☐ C 20%
- ☐ D 25%
- ☐ E 30%

2. In a horizontal pipe if the water static pressure is 500Pa and the total pressure (ignoring potential pressure) is 5,000Pa, what is the approximate velocity of the water?

- ☐ A 1m/s
- ☐ B 2m/s
- ☐ C 3m/s
- ☐ D 4m/s
- ☐ E 5m/s

3. If a duct has air passing through it with an average velocity of 4m/s, and it then transforms through a very smooth (frictionless) expansion so that the velocity is 3m/s, what is the value of static regain?

- ☐ A 3.2Pa
- ☐ B 4.2Pa
- ☐ C 5.2Pa
- ☐ D 6.2Pa
- ☐ E 7.2Pa

4. If a bend in a duct has a ζ of 0.5 and the velocity is 2m/s, what is the most likely air pressure drop through the bend

- ☐ A 1.2Pa
- ☐ B 1.8Pa
- ☐ C 2.4Pa
- ☐ D 3.6Pa
- ☐ E 4.8Pa

5. What would be the approximate Reynolds number for air at 20C with a velocity of 2m/s flowing down a 400mm diameter duct?

- ☐ A 23,000
- ☐ B 33,000
- ☐ C 43,000
- ☐ D 53,000
- ☐ E 63,000

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To tackle restrictive long absorption distances in the air handling unit, HygroMatik has introduced VortexSteam. Insufficient absorption can result in contamination risks while long ducts can take up too much space. VortexSteam addresses this issue by significantly shortening the absorption distance while maintaining optimum hygiene and performance. This is achieved by placing the VortexSteam module in front of a steam manifold, which spins the air, mixing air and steam to shorten the absorption distance by up to 5%.

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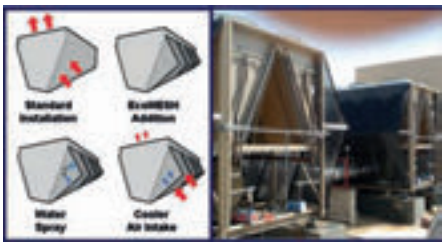


BACnet natural ventilation control from TITAN Products now available

The CCM-204-NV provides energy-efficient control in buildings by monitoring the natural ventilation on demand and improving the environmental conditions through the control of temperature and CO_2 levels. The CCM-204-NV can control two separate zones and, when used in conjunction with TITAN Products' temperature sensors, CO_2 sensors, rain detectors and window controllers, the CCM-204-NV can create an extremely flexible multi-zone natural ventilation system. This advanced application-specific controller with automatic seasonal adjustment will increase ventilation as CO_2 and temperature levels increase.

● **For more information call 0161 406 6480 or visit www.titanproducts.com**

KNX provides lighting control solution for the City

When financial services firm UBS took space in Broadgate West in the City of London, the company found that the 'Lightrak' KNX lighting control system from KNX UK member Electrak was already installed as part of the building's Cat A fit-out. Lightrak KNX is designed to provide seamless interoperability with any KNX building control modules. These can be added to the system on a simple 'plug and play' basis. Any trained integrator can then integrate them by plugging in a laptop anywhere on the system.

● **For more information call 0845 869 5908 or visit www.knxuk.org**

Watts Industries keeps cottages' water hot with Microflex

Seven recently completed luxury holiday cottages in the grounds of a 12th century Cistercian priory in North Yorkshire have a 21st century pre-insulated flexible plumbing solution from Watts Industries to ensure that hot water for guests is immediately available and piping hot at all times. Lightweight Microflex PE-Xa multi-core pipes in HD-PE outer jackets were chosen for their energy efficiency and easy-to-lay flexibility, and installed at Syningthwaite Priory, near Wetherby, in an underground ring circuit connecting the cottages to a central plant room.

● **For more information call 01386 446997 or visit www.microflexuk.co.uk**

Panasonic helps speed up heat pump specification

Panasonic has launched its new Aquarea Designer software for contractors taking advantage of today's strong interest in heat pump installation. The package will allow HVAC designers, installers and distributors to identify the correct heat pump for a particular application from Panasonic's Aquarea range, to calculate the savings compared to other heat sources and very quickly calculate CO_2 emissions. Marc Diaz of Panasonic said: 'We have designed this new software to be simple and of real benefit to busy engineers.'

● **For more information visit www.panasonicProClub.com**

CP provides control for new education centre of excellence

CP Electronics has installed controls at the newly refurbished Worcester Royal Infirmary building, which now forms part of the University of Worcester. The brief was to provide accurate and easy adjustment of light levels, something vital for today's places of learning.

Various products from CP were used to control illumination levels in corridors, lecture areas, corridors and WCs. These include the passive infrared detector EBDSPIR-PRM, which can be set for absence or presence detection, switching the load on or off after a preset time.

● **For more information call 0333 9000671 or email enquiry@cpelectronics.co.uk**

Telephone: 020 7880 6206 **Email:** darren.hale@redactive.co.uk

Polypipe launches Silvavent low energy fan range

Polypipe Ventilation, manufacturer of market leading energy-saving domestic and light commercial ventilation systems, has launched the first new addition to the Silavent range following its acquisition of the brand last year: a new range of low Watt centrifugal bathroom extract fans.

The new competitively priced Silavent low Watt fans use an incredible 70% less power than conventional fans, dramatically reducing operating costs and helping to reduce overall building energy consumption, an issue which remains high on the political agenda. In fact, changes to Part L of the Building Regulations require the Specific Fan Power (SFP) to be no higher than 0.5 Watts per litre per second (W/l/s); Polypipe's range of low Watt fans outperform this minimum standard.

The new range incorporates units suitable for most domestic applications, including decentralised Mechanical Extract Ventilation (dMEV) versions. These include the Curzon 100mm and Mayfair plug-in specification fan, which also features a twin speed dMEV option.

● **For more information call 08443 715523 or email vent.info@polypipe.com**

New free CableCalc level P – twin and earth calculations

To celebrate 20 years of CableCalc, Castline Systems has released a new, free version of its popular CableCalc program, which will calculate single phase radial and ring circuits wired in twin and earth cable. It even includes free technical support by email. CableCalc level P is a fully working, unlimited use version and provides far more than just simple volt drop calculations. CableCalc level P can be downloaded from **www.castlinesystems.com** free of charge.

● **For more information call 01293 871751 or visit www.castlinesystems.com**

New source of renewable information for architecture

The country's architects have access to a new information source on renewable technology with the installation of a permanent exhibition stand at the Building Centre in London's Store Street from Mitsubishi Electric, which focuses on sustainability in the built environment. The company, which has long pioneered energy efficiency, is using the space to highlight the potential that heat pumps offer in reducing the energy load required to heat, cool and ventilate both commercial and residential properties, and is also focusing on the energy producing potential of photovoltaic panels.

● **For more information visit www.buildingcentre.co.uk**

Global partners attend Hydropath conference

A three-day conference held in Nottingham saw distributor partners from 23 countries come together to celebrate Hydropath Holdings success worldwide. Hydropath's non-chemical limescale prevention technology has been used in product applications as diverse as Chilean copper mines and cement factories in Iran. Hydropath started in 1992, after Dr. Danny Stefanini devised his theory on crystallisation and developed the first prototype model in treating limescale. British Gas became one of the first customers; since then,Hydropath has developed 12 different ranges.

● **For more information about Hydropath visit www.hydropath.com**

Aquatech Pressmain launches range of cold water booster sets

The design of the Aquamatic 'AMV' 2020 plus series utilises the latest technology and manufacturing methods. Appreciating the current climate, Aquatech Pressmain has decided to pass this saving on to their clients. The company's managing director, Mark Taylor, said: 'I am delighted with this new product; it brings together the wealth and experience of our engineers for the benefit of our world wide users.' With energy-efficient variable speed pumps,constant pressure is maintained and the 2020Plus microprocessor gives protection from hydraulic shock.

● **For more information email Jim Rusbridge at jcr@aquatechpressmain.co.uk or call 01206 215121**

TA Hydronics provides unique solution to Uniqa Tower

TA Hydronics has lent its technological expertise and specialist range of balancing valves for use in the construction of a new HVAC system at Uniqa Tower in Vienna, Austria. It was important to ensure the installation of a heating and cooling system that would be able to maintain the comfort levels required. The building is 75 metres tall, so TA Hydronics needed to deliver a solution tailored to the project itself, considering its sheer scale and the need to effectively heat and cool all areas of the building.

● **For more information visit www.tahydronics.co.uk**

Telephone: 020 7880 6206 **Email:** darren.hale@redactive.co.uk

King's Cross first for solar test technology

Handheld PV electrical test instrumentation has been used for the first time as part of the installation of one of the UK's largest solar panel systems. Cumbria-based Sundog Energy, one of the UK's leading providers of solar photovoltaic (PV) systems, became the first installer to use the new Seaward Solar Installation PV100 tester as part of its contract with Network Rail to provide a huge solar PV system on the roof of King's Cross Station in London.

Fore more information call 0191 586 3511 or visit www.seawardsolar.com

Kinetic Engineers northern expansion

Kinetic Engineers continue to grow in their north east and Yorkshire design offices, providing building services and environmental consultancy to a wide range of clients, and on high-profile projects including the extension to Gateshead College's Skills Academy for Construction, which will house a renewable technology training centre. Kinetic's services now include traditional building services consultancy, BIM, thermal modelling, BREEAM assessments and BREEAM AP, renewables and low and zero carbon feasibility studies, SBEM and EPC calculations, condition surveys, and cost consultancy.

For more information call 0191 491 3709 or visit www.kineticengineers.co.uk

SE Controls TV

SE Controls, one of the UK's leading providers in natural ventilation and smoke control solutions, has launched 'SE Controls TV'. The service is an on-demand video facility, offered via the SE Controls website, which gives the viewer various choices of channels covering products, services and vital advice on specifying window automation systems. Covering such topics as product demonstrations and case studies, viewers can understand the benefits of adaptive natural ventilation and how these systems can be added effectively to new and existing buildings.

For more information call 01543 443060 or visit www.secontrols.com

Landmark sustainable office development showcases Velfac low energy glazing

A new HQ for conservation charity, the Woodland Trust, employs VELFAC glazing to actively contribute to energy efficiency across the building, resulting in a development that has achieved a BREEAM Excellent rating. Designed by architects Feilden Clegg Bradley Studios, the building's external facades feature three-storey high VELFAC glazing, interspersed with timber cladding, evoking the spacing and verticality of woodland. The glazing delivers maximum daylight to the open plan interior office space, with solar gain minimised by the use of solar controlled glass.

For more information call Kevan Woolf on 01223 897165

HeatCalc's heat-loss calculations

Castline Systems HeatCalc produces heat loss calculations for the design of heating systems, using the methods described in *CIBSE Guide A3: Thermal Properties of Building Structures*. HeatCalc performs calculations based on continuous heating, with U values supplied for outside walls, windows, floors and ceilings. With support for up to eight-sided rooms, it will design and evaluate energy loss for an entire property or building, with information output into useful graphs and reports.

For more information call 01293 871751 or visit www.castlinesystems.com

Vaillant celebrates installation of its one millionth ecoTEC boiler

Following the installation of its millionth ecoTEC high-efficiency condensing boiler in the UK, Vaillant has awarded both the householder and the installer of the boiler £1,000 of holiday vouchers each. Barry Stevens, who had the Vaillant fitted in his property, and installer Adrian Rigden, were presented with their prize vouchers by Vaillant's Ian Johnson at Barry's home in Ramsgate. The boiler – an ecoTEC plus 831 high efficiency combination boiler – was also awarded 'Best Buy' by the leading *Which?* consumer publication in 2010.

For more information visit www.vaillant.co.uk

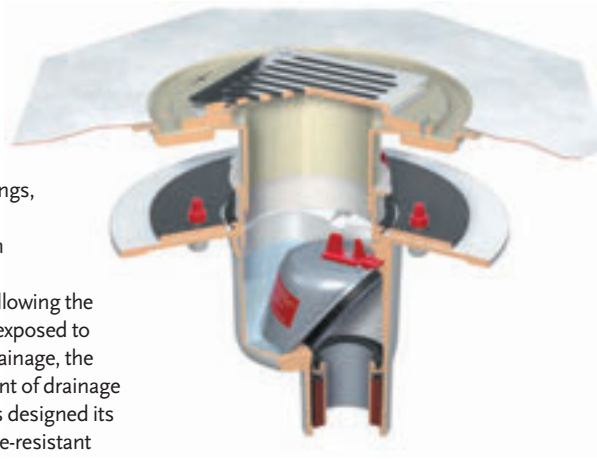
Glow-worm's Clearly Heat Pumps – clearly a better solution

Glow-worm are introducing a range of advanced air to water heat pump systems, designed for quick and straightforward installation, that offer high performance central heating and domestic hot water for a wide range of domestic properties. Utilising next-generation system technology, the new 7, 12 and 14kW systems join the popular Clearly Heat Pumps 5kW model to create the brand new Clearly Heat Pumps range. Glow-worm's Clearly Heat Pumps range offers not just a single unit, but a fully integrated heating system – straightforward to install, and easy to use.

For more information call 01773 596096 or visit www.glow-worm.co.uk

Telephone: 020 7880 6206 **Email:** darren.hale@redactive.co.uk

Fire protection drainage from ACO Building Drainage designed to protect occupants



With so many new build and refurbishment projects catering for multi-occupancy dwellings, the integrity of compartmentation required to prevent fire propagation can be compromised by drainage penetrations in separating floors, allowing the passage of flame and smoke from exposed to unexposed areas. ACO Building Drainage, the leading specialist in the development of drainage systems and building products, has designed its Selecta floor gulley range to offer fire-resistant properties that provide added protection for building occupants against fire.

Designed and manufactured to BS EN 1253, the cast iron Selecta floor gulley is suitable for solid and suspended concrete floors, and incorporates an intumescent fire cartridge that both reduces smoke transfer to other building floor levels and prevents oxygen paths that feed fire. The fire protection cartridge has been tested in accordance with BS EN 1366, ensuring performance in even in the most severe fire situations.

● **For more information visit www.acobuildingdrainage.co.uk or call 01462 816666**

Thermal energy storage

Phase Change Materials (PCM) store and release thermal energy during the process of melting and freezing, and the latest range of PCM solutions between -100°C and +885 °C offer new application opportunities. For example, using free cooling circuits overnight, +15°C containers can be charged without any mechanical refrigeration. This stored free energy later serves the chilled ceiling circuit to absorb sensible building loads during daytime. Using free nighttime cool energy is not only environmentally-friendly, but also offers lower initial installation cost, with significantly reduced system running cost.

● **For more information call 01733 245511 or visit www.pcmproducts.net**

New controller for intelligent fan range – i3Fan

Fläkt Woods has redesigned the controller unit for its intelligent control system, offering customers automated ventilation on demand, with an easy-to-use interface. It features improved connection and expansion options. The i3Fan intelligent controller optimises fan energy usage by adjusting power consumption to match system demands. The user interface has embedded software that is easier to use and understand. The hardware has been redesigned, enabling the users to combine it with other remote speed controllers and frequency invertors within Fläkt Woods' e3 range.

● **For more information call 01206 222555 or email info.uk@flaktwoods.com**

Static Systems completes fire alarm contract

Static Systems Group has completed the installation of a key fire alarm system contract as part of the redevelopment of Bracknell and Wokingham College. Static Systems' Series 900 fire alarm systems have proved their effectiveness and suitability in healthcare, prison and commercial sectors, and now the Bracknell and Wokingham College contract adds to a growing number of installations in educational establishments. The Series 900 system has been installed at the impressive new £36m college building, occupying eight floors, with a capacity for 1,500 students.

● **For more information call 01902 895551 or visit www.staticsystems.co.uk**

Prysmian supplies Westfield's Vue Cinema at Stratford

In all, 14,000 metres of Prysmian's FP200 Gold® is being installed within the Vue Cinema at Stratford's Westfield Shopping centre to power the fire alarm and multi-zoned voice alarm systems. Electrical contractor Solid State has been working on the project since April this year, as Mark Suffolk, contracts manager explains: 'FP200 Gold® from Prysmian was specified for this project due to the product's all-round quality and the fact it can be stripped with ease, enabling the installation process to be quick and efficient.'

● **For more information call 023 8029 5029 or email cables.marketing.uk@prysmian.com**

New BIM and CPD Services from Zehnder

Zehnder, a leading European manufacturer of indoor climate solutions, is enhancing its range of support services for Consulting Engineers. With a growing demand for BIM in building design, Zehnder is leading the way in the provision of parametric BIM objects for its product range. Designed as fully parametric Revit families, the Zehnder BIM objects are available to download free. In addition, a CIBSE-approved CPD seminar is now available on the use of Radiant Heating and Cooling Panels in building projects.

● **For more information visit www.zehnder.co.uk/bim**

Belmarsh sets new standards

Belmarsh is a Category A men's prison in London that first opened in 1991. Since then it has suffered from increasing overcrowding problems. The decision was therefore made to provide a new Category B facility at Belmarsh under a £415m PFI contract. Consulting Engineers Hulley & Kirkwood worked with selected key partners, including Grundfos Pumps, in order to deliver the highest BREEAM standards possible. The outcome is that the main houseblock has achieved a worldwide first rating of 'outstanding' for such a building, with the other nine achieving a rating of 'excellent'.

● **For more information call 01525 850000 or email uk-sales@grundfos.com**

PRODUCTS & SERVICES

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Classroom ventilation units

Aircraft Air Handling's 260mm-high classroom ventilation units are silenced to nr25. The plate recuperator is 60% efficient, with an air volume 0-500 litres. Heating: LPHW/ELECTRIC. Cooling: CW/DX. Larger air volumes and bespoke units are available.

● **For more information visit www.aircraftairhandling.com**

DRU-Style heaters keeping Mojo warm in Twickenham

Verve Properties is a property development company specialising in restoring and converting former brownfield sites and derelict buildings throughout London. One recent development is Crane Mews, a collection of former industrial buildings totalling 17,000 square feet next to the River Crane in the affluent suburb of Twickenham. Verve has selected DRU Style balanced flue gas wall heaters to heat the buildings. They provide an attractive and efficient alternative to radiators and only consume gas when required. They can also be turned off when the property is not in use.

● **For more information call 0161 793 8700 or visit www.drufire.co.uk**

MHS Boilers at Urban Splash development

Residents at the new Lakeshore development at Imperial Park, Bristol, will benefit from sustainable heating and hot water, thanks to 270 Nexus Bitherm wall-mounted units from MHS Boilers. As part of a major renovation and joint partnership between Urban Splash and the Homes and Communities Agency, the Grade II listed building consists of studio, one- and two-bedroom apartments. The original building dates back to 1974 and was formerly the Imperial Tobacco headquarters. The futuristic design was clad in Cor-ten steel, designed to give the building an 800-year life span.

● **For more information visit www.mhsboilers.com**

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BAR666/PA

Senior Electrical Engineer

£45-50k +benefits, Surrey

Our award winning client offers a fantastic career progression opportunity for a tenacious and motivated engineer. The ideal candidate will have been responsible for leading design teams on a range of projects, managing a revenue stream of over £25,000 per month, completing tender packages, preparation of budget cost reports, along with attending design and client meetings. The ideal candidate will also have completed a relevant engineering degree and be a chartered engineer.

BAR634/JA

Mission Critical Design Engineers

£Competitive +benefits, Surrey & London

We are recruiting at a variety of levels for a leading consultancy operating within the data centre sector of the building services industry. This global practice deliver technical projects in financial services, education, and communications, including data centres, command and control centres, trading floors, and disaster recovery sites. Candidates should have led the design of M&E services for tier 3+ data centres, or similarly high technology, high resilience environments, including infrastructure, LV, MV, and HV power distribution experience.

BAR658/JA

Design Manager (Electrical)

£400 per day or £70k +benefits, London

Our client provides turnkey mechanical and electrical project solutions in the design and construction of tunnels. They have a requirement for a Design Manager to oversee and manage the production of M&E services from concept to handover on a station relating to one of Europe's largest railway projects. Essentially, you will be responsible for checking the design process against the master program, and implementing rectification, this will involve interfacing with the Architects, Structural, and EDF HV Engineers. Applicants must have previous experience working to Network Rail & LUL standards.

BAR665/PA

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You will be a chartered engineer with substantial experience of mechanical, electrical and public health services in complex buildings. Communication and teamwork with a multitude of colleagues and stakeholders will be central to your role, as will managing budgets, workload planning and securing resources.

The closing date for this post is 14 August 2011. Please apply through www.jobs.soton.ac.uk or please telephone 023 8059 2750 for an application form.

Please quote vacancy reference number 021511TD on all correspondence.

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www.jobs.soton.ac.uk

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As part of our commitment to integrated design, we are expanding the engineering team within Foster + Partners. The team works on some of the most exciting and challenging projects in the world, developing them from first concepts to completion.

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(LAME0711/1)

We are seeking candidates with the following core skills and experience:

- Chartered Engineer
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- An understanding of all aspects of the role of an engineer in particular relevant and current legislation
- Proven skills in all aspects of negotiation and communication
- Proven experience in the financial aspects of running a design project on time and on budget.

Electrical Engineers

(LEE0711/1)

We are seeking candidates with the following core skills and experience:

- Nearing Chartership or a recently Chartered Engineer
- Creative ability to think beyond the conventional
- Proven interest in sustainable building and systems design
- Experience in the design of a broad range of electrical building services and site-wide infrastructure
- Ability to formulate designs and to present them for discussion
- Strong communication skills, both verbal and visual
- Sound knowledge of industry-standard design software packages
- Understanding of how the discipline interfaces with the whole design team
- Good interpersonal skills and ability to work well in a team
- Desirable: experience of international projects, low energy and renewable technologies, vertical transportation and HevaComp.

Environmental Water & Public Health Engineers

(LEW/PH07/11/1)

We are seeking candidates with the following core skills and experience:

- Nearing Chartership or a recently Chartered Engineer
- Creative ability to think beyond the conventional
- Proven interest in sustainable building and systems design
- Experience in the design of a broad range of public health building services and site-wide infrastructure
- Ability to formulate and present designs for discussion
- Strong verbal and visual communication skills
- Sound knowledge of industry-standard software packages
- Understanding of how the discipline interfaces with the whole design team
- Good interpersonal skills and ability to work well in a team
- Desirable: experience of international projects, HevaComp and Microdrainage.

More information about Foster + Partners and the job descriptions can be found at: www.fosterandpartners.com

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Playing a key role in the preparation of mechanical specifications, drawings and tender documents for large scale refurbishment projects, a facilities management background would also be an advantage. So, if you're ready to develop your skills, as well as one of the UK's largest healthcare providers, apply via www.bupa.com alternatively contact Kath Clarke, Tel: 0113 3816370, Email: kath.clarke@bupa.com

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- Confidence in making technical judgements

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The Role

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The Person

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Duties will include the project costing, costing variations, cost control, risk management, contract administration, monthly reviews, notices as required, monthly applications, invoicing, managing subcontractors and their accounts, final accounts and claim preparation, project cost control, commercial reporting and sub-contractor account management.

Candidates should have previous experience in M&E projects with a sound knowledge of instrumentation and controls works. There will be travel required between sites and working knowledge of NEC 3 forms of contract and their associated documents is vital.

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Please contact Darren Warmington for further information on this role on tel. 01483 768600 or email: darrenw@bsvconsultants.co.uk

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Intermediate Electrical Design Engineers | London | £NEG! | ref: 1293
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Electrical Engineer | Hampshire | to £45K+ | ref: 2050
We are looking for an experienced engineer to join our blue chip client. You will have a proven track record in design and have the ability to mentor junior engineers. Great career opportunity!

Lighting Design Engineer | London | to £32LTD | ref: 1519
Our client, a busy M&E Consultancy, is looking for a Senior Lighting Design Engineer who is able to lead projects and work unsupervised. Ideal candidates will have good Commercial Office refurbishment experience.

Mechanical Associate Director | London | to £60K+ | ref: 4424
We are looking for an experienced Mechanical Associate to join an established M&E Consultancy. You will have excellent client facing attributes and be well versed in office refurbishment and fit out projects. Excellent opportunity!

Principal Electrical Design Engineer | Surrey | to £50K+ | ref: 5387
An established Consultancy, our client is looking for a Principal Electrical Engineer who is able to lead a team and projects. Suitable candidates will be well qualified and have a broad project background, including health care and education.

For more information or a confidential discussion please contact Mark Butter

t: 02392 603030

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Cornwall Council is one of the largest unitary authorities in the country and was recently shortlisted by LGC for the Most Improved Council.

Property Services is responsible for managing a diverse range of over 6,000 assets with a value in excess of £2bn. The Service has recently restructured in order to deliver its strategic priorities and has an exciting opportunity to join an ambitious and successful team.

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CORNWALL COUNCIL

Electrical Services Strategy Officer

£34,629 - £41,616

We are looking for a Chartered Electrical Engineer to join a new multi-disciplinary Strategic Planning and Standards (SPS) team. In supporting the SPS Manager, you will provide expert advice and guidance on electrical standards, compliance, specification, and design and maintenance services for the property portfolio of Cornwall Council.

Working with team members in Construction, Mechanical Engineering and Fabric Maintenance, you will play a key role in developing comprehensive corporate solutions that provide accommodation needs throughout the whole building lifecycle. This new role will specialise in developing and implementing electrical services design and maintenance strategies that will be delivered through capital and maintenance programmes of work undertaken through framework consultants.

To meet this challenge we expect you to be a Chartered Engineer, with significant experience in electrical building services engineering. You will have a high level of IT literacy, excellent communication, team-working and presentation skills. You should be fully conversant with standards and practices, as well as having in-depth knowledge of low energy design and carbon reduction techniques

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Events & Training

NATIONAL EVENTS AND CONFERENCES

CIBSE Technical Symposium
06-07 September, Leicester
Two-day event showcasing research and technical developments. The symposium will include papers that are relevant for the full range of technical areas of interest to CIBSE members
www.cibse.org/events

Energy Event
13-14 September, NEC Birmingham
Leading business exhibition and conference, focusing on energy procurement, management and efficiency. Free to attend
www.theenergyevent.com

HBF Planning Conference
22 September, Milton Keynes
What will the draft National Planning Policy mean for your existing plans and land holdings? Your current land options and planning strategies? Early booking discount applies until 15 July
www.house-builder.co.uk

Energy Solutions 2011
11-12 October, London
Energy Solutions, an energy management and procurement event, will bring together energy management and procurement professionals from across the UK
www. energysolutions expo.co.uk

Professional Lighting Design Convention 2011
19-22 October Madrid, Spain
PLDC is a three-day conference offering around 65 papers from internationally renowned speakers and young professionals. The conference is accompanied by a manufacturers' exhibition, offering industry partners a platform to present their companies to delegates and broaden their business contacts
www.pld-c.com

SOCIETY OF LIGHT AND LIGHTING

LEDs – a CRI for help
11 October 2011
Details to be confirmed
www.sll.org.uk

CIBSE GROUPS AND REGIONS

Chlorine Dioxide as a Method of Disinfection within Water Systems and Suitable Generation Systems
6 September, London
Details TBC
steve.vaughan@aecom.com

Pinholing in Copper Domestic Water Systems
15 September, Bristol
A Society of Public Health Engineers event
www.cibse.org/events

Society of Façade Engineering technical meeting
21 September, London
Film on glass, and film in glass
www.cibse.org/sfe

Under-floor Heating
21 September, Manchester
Society of Public Health Engineers event
www.cibse.org/events

Symposium on lift and escalator technologies
29 September 2011, Northampton
www.cibseliftsgroup.org/events

High-rise draining design
04 October 2011, London
Details TBC
steve.vaughan@aecom.com

Society of Facade Engineering – Evening Technical Meeting
18 October 2011, London
6pm for 6.30pm start. Jonathan Lowy will be speaking on 'The use of zinc in building facades and roofs'
sfe@cibse.org

Liz McAulay


Karren Brady

Powering up for Energy Event

13-14 September

The Energy Event is the industry's leading business exhibition and conference focusing solely on energy procurement, management and efficiency. It is aimed at all professionals who want to get a grip on their company's energy use, comply with legislation and procure energy more intelligently.

The event features 50 seminars alongside an exhibition of 150 leading suppliers and industry representatives. High profile speakers include Charles Hendry, Minister of State for the Department of Energy and Climate Change; Lord Digby Jones, former Minister of State, managing director of RWE npower; and businesswoman Karren Brady.

The event will also feature case studies from M&S, BT, Travis Perkins, Environment Agency, the Carbon Trust, and the Olympic Delivery Authority.

CIBSE will be on stand 2956 – so don't forget to come and say hello.

To register for your free place and for more information, visit **www.theenergyevent.com/CIBSE**

Society of Facade Engineering – factory visit
15 November 2011, London
Details TBC'
sfe@cibse.org

CPD TRAINING

Visit **www.cibsetraining.co.uk,** call 020 8772 3660 or email **eventbookings@cibse.org**

ELECTRICAL SERVICES

Electrical Services Explained (three days)
27–29 September 2011, Birmingham

ENERGY EFFICIENCY AND SUSTAINABILITY

Low Carbon Buildings and Energy Infrastructure for Local Authorities
14 September 2011, London

Part L Building Regulations
29 September 2011, London

Part L Building Regulations
04 October 2011, Manchester

Low zero carbon energy technologies
04 October 2011, London

Introduction to Building Services
04 October 2011, London

Introduction to Energy Efficiency
04 October 2011, Manchester

FACILITIES MANAGEMENT

Preparing FM and maintenance contract
28 September 2011, London

MECHANICAL SERVICES

Design of Ductwork Systems
20 September 2011, London

Mechanical Services Explained
21–23 September 2011, Belfast

Mechanical Service Explained
28-30 September 2011, Birmingham

PUBLIC HEALTH AND WATER

Sanitary and rainwater design using BS EN 12056:2000
15 September 2011, London

Send your event details to
cbailey@cibsejournal.com

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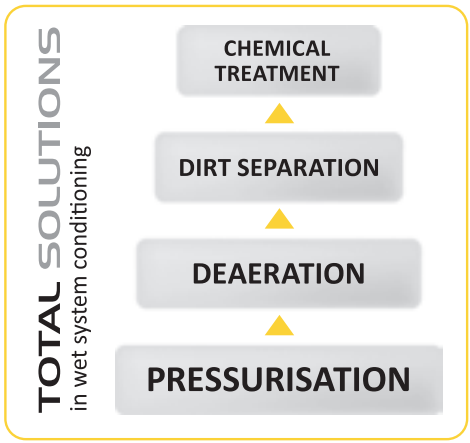

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Panel Mount Pressure or Velocity Transducers with remote alarms, analogue and digital interfaces. Traceable calibration certificates supplied as standard.

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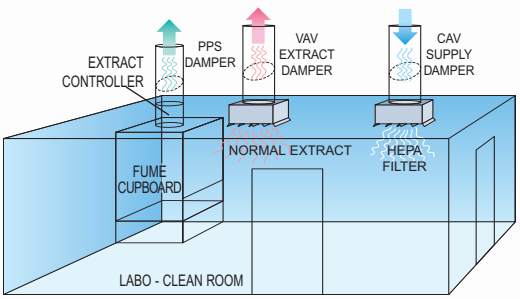

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