Published 2016

The Heat Report

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Are we getting warmer?

By Tim McManan-Smith, editor, the energyst

Almost half of UK final energy demand is heat. Most of it comes from natural gas. Gas is the cleanest of the fossil fuels, but that's still a lot of carbon. What are we going to do about it?

Readers of *The Energyst* surveyed for this report suggest we are going to install heat pumps, CHP and biomass technologies, with a little bit of solar thermal, heat recovery, more efficient boilers and more efficient controls also on the cards. Three quarters of respondents said they were assessing low carbon methods of heating.

It may be that those findings - based on the views of 81 people across industrial, commercial, public and private sectors - are slightly skewed, given that people who work with heat are more likely to fill out a survey on the subject.

In the wider world, gas is cheap. Purse strings are tight and energy costs relatively low. So the answer to 'what are we going to do to decarbonise heat' from many quarters may be 'not a lot'.

There is currently little incentive for companies to start paying serious attention to renewable heat unless it is a going to save them money and deliver reasonably quick payback. Respondents interviewed for this report said that many renewable heat technologies are simply not cost competitive.

Others said that heat subsidies in the main are unattractive for all but the largest biomass installations, many of which are, funnily enough, larger than they need to be. Meanwhile technology remains expensive and can be rendered inefficient through poor operation and maintenance.

All of which paints a disjointed picture - and it may be that the challenge in decarbonising heat is because it is a fragmented, small-scale market, local in nature. Unlike power, where large coal stations are rendered uneconomic by large wind farms and, for now, cheap gas, heat use is determined by local demand and conditions. It is about what people do with their thermostats.

Perhaps then, local strategies must be devised, which is what government is trying to do by putting aside some money for heat network acceleration.

Heat networks undoubtedly have merit. They are assets that infrastructure funds will find attractive, bringing in extra capital. But Decc's own figures predict that the £300m it has set aside to boost local authorities' chances of getting projects off the ground will at best result in lower carbon heat for the equivalent of 400,000 homes. That equates to 1.5% of the UK's 26.5 million households. Retrofitting heat networks will also be very challenging.

The truth is that decarbonising heat, while perhaps technically not that difficult, will be extremely expensive due to the disaggregated nature of the task. Additionally, while non-domestic sectors may be influenced by mandates, 82 percent of householders are used to using the vast gas network - laid at a time when large-scale infrastructure projects were not things to be feared - whenever they like.

Targets or not, cultural resistance to change should not be underestimated.

Until renewable heat technology becomes more cost competitive, or the available incentives reallocated to genuinely support the lowest cost solutions to decarbonisation, energy efficiency is likely to be our best bet. Also, a major drive on insulation and efficiency would mean a much lower peak than the 360GW currently needed if we were, eventually, to meet heat demand by switching from gas to renewable electricity.

Now that would be expensive.

What this report covers

We wanted to gauge views on heat. 81 readers across public and private sectors completed an online survey in early 2016. The findings, presented in this report, suggest significant appetite for a range of renewable heat technologies, particularly heat pumps, CHP and biomass, but a mixed response to the incentives available for them.

We then undertook qualitative interviews with five survey respondents, including an energy manager, a financier, a community power company boss, an academic and a consultant. These are also included in the report, alongside a view on decarbonising heat from Association for Decentralised Energy chief Tim Rotheray, and an outline of how the Energy-related Products Directive and Medium Combustion Plant Directive will affect end-users from The Industrial and Commercial Energy Association.

We thank all those who shared their views and hope you find the report useful.

The heat is on

With 2020 four years away, the energy secretary has admitted decarbonisation of heat is behind schedule. Money is tight, the energy market is in flux, oil and gas are cheap. Against that background, what are the problems and where are potential paths to progress?

As the first set of decarbonisation targets loom, potential Brexit aside, the heat is literally on. The drive to decarbonise the power sector means electricity looks set to deliver its share. The problem is that, apart from guaranteed contracts already negotiated by government and certain power companies, the billions of pounds which drove the renewables boom appear to have dried up. But heat is actually responsible for a far greater percentage of energy use and carbon emissions and is arguably much harder to decarbonise. So which policies, actions and incentives can deliver both progress and best bang for remaining buck?

WASTED HEAT

Tim Rotheray, head of the Association for Decentralised Energy, says waste heat must be better utilised and incentivised. He thinks subsidy rules around additionality should be relaxed so that projects can become economically viable by amalgamating all available support. Rotheray also believes local authorities must be given more resource to decarbonise heat, and users more say in decision-making. Heat "is by definition is local", he says. The only way to decarbonise it "is to design the policy framework so that it works for the user".

The European Commission plans to give heat a major push this year and will simultaneously review the Renewable Energy Directive, under which waste heat from non-renewable sources cannot receive subsidy.

Whether or not rules change, some may reasonably argue that subsidy is unsustainable. Others argue that without sufficiently attractive incentive, the money to decarbonise heat will remain wherever the returns are higher.

HEAT NETWORKS VERSUS HINKLEY

Heat networks are one such technology that divides opinion. Now a significant policy focus, with government pledging cash to support their development, they are seen as investible infrastructure than can deliver carbon reductions at scale. However, some think they are too disruptive, take too long and are too expensive.

Heat networks would require subsidy of 75p/kW hour to create the seven-year payback periods sought by investors, Wales & West Utilities director of asset management Chris Clarke recently told the Energy & Climate Change Committee.

Such subsidy would make even Hinkley C look cheap and the ADE's Rotheray labelled such conclusions "absurd", given heat networks, like Wales & West's gas distribution network, are multi-decade assets. Wales & West's investors have ample appetite for those type of assets, he points out.

Dr Tanja Groth, decentralised energy manager at The Carbon Trust, agreed. "Most of the unsubsidised

Small scale CHP, storage and hybrid systems

"Small scale CHP is currently only cost effective if all electricity can be used on site but this often creates restrictions on output if the heat and electrical loads do not coincide," says Sustain's Chris Jennings. "Being able to have small-scale electrical agreements with private clients over the network would help with the viability of these systems."

While energy storage is a "vital support" for many renewable heat technologies, it "will not succeed in the short term without support to reduce costs," says Jennings.

He believes hybrid gas/heat pump/solar systems "look appropriate for mid-term decarbonisation as system integration can be more flexible and risks are lower, but the technology is still currently not cost competitive."

Image: EDF Energy

schemes that we work on have payback periods of 10-15 years, and in some cases lower than this," she wrote in response.

Greater constraints, she said, include "the general lack of information and awareness about district heating and its potential advantages in terms of cost and carbon savings, lack of clarity around local authority planning policy power to support district heating development and constraints on access to low-interest capital financing."

HURDLE RATES

Government has recognised the challenges faced by cash-constrained local authorities and last year made £300 million available to help develop up to 200 heat networks.

That's a big help, according to district heating and cooling specialist Vital Energi. But the firm takes the view that rates of return are currently too low for many would-be investors.

"That funding has allowed local authorities to prepare detailed business cases to prove potential project viability," says Vital Energi business development manager, Brendan Clancy. "What we need now is the funding to take these projects to delivery, which sets a new challenge. We welcome being invited to bring private investment into the projects. But it is important that investment is attractive to the private sector (IRR greater than 8%). In some public sector projects recently, we have seen indicative returns as low as 4-8%, which are less attractive and likely to require additional funding support."

Infrastructure investors, on the other hand, find return rates acceptable.

NUMBERS GAME

"These projects will probably not attract traditional bank debt at the moment, but they do work for a longer-term infrastructure-type play," says Jenny Curtis, a director at specialist investor and fund manager Amber Infrastructure. "I don't think [the need for a seven year payback] is true at all."

Investment has to take a long view, says Curtis, "because heat networks are about a long term partnership with the sponsoring body and they require long term-asset management. So you need to be in it for 25 years, not only to make your money back but also to make sense of the asset."

Curtis thinks the real challenge is robust modelling and scoping. Numbers and data, even at a basic level, can be "pretty ropey", she says. But a district heating project that comes to potential backers with full, robust background data can go "a huge way" towards successful delivery.

Immediate heat challenges

Heat Network (Metering and Billing) regulations pose one of the most pressing challenges to anyone that supplies and charges for heating, cooling and hot water.

District heating and communal heat networks fall under the scope of the regulations, which are part of the EU Energy Efficiency Directive, and are intended to make users more energy conscious by making them more aware of consumption. It means heat suppliers, such as commercial landlords and local authorities, must install meters for each final customer unless they can prove it is not viable to do so.

That is no small undertaking and the job is made harder because precisely what constitutes technical and financial viability is under review, and will not be consulted upon until summer. It is therefore likely that the original meter installation deadline of 31 December 2016 will need to be pushed back, although some suppliers will have to install meters regardless of any changes.

MORE SUBSIDY OR LESS?

While some argue for higher, more targeted heat subsidy, Curtis says infrastructure investors do not base business cases on incentives.

"We are always very wary of subsidy schemes because they are very open to political risk," she says. "We haven't invested heavily in any of those subsidy-based projects. We would rather do the schemes that stack up on their own two feet or to be working with local authority covenants that we know will be there for the long term."

End-users can be equally wary.

James Tiernan, energy and environment manager at Unite Students, looks after 136 UK properties. He decided against applying for Eco funding for a heat network project not just due to hoops and hurdles, but because of the increased risk.

"If you predicate your business case on the funding, and you don't actually get it, it is just too high a risk. Plus you have to have bridging funds in the interim anyway because [that Eco funding] is retrospectively applied."

If projects manage to get support "it is then almost like a bonus," says Tiernan. "In which case you don't need it anyway because you have already had to write a viable business case. So it is almost irrelevant. The way we see it, something is cost effective and viable, or it is not. You have to build a business case that stands on its own two feet."

But others think that existing support schemes could make a big difference if properly directed.

...OR JUST BETTER ALLOCATION?

In the domestic market "most financial instruments don't work," says Andy Lewry, principal consultant at the Building Research Establishment's sustainable energy team. In both the domestic and non-domestic market, "insulation is a much bigger issue".

The problem with support in the non-domestic sector, says Lewry, is that while the Enhanced Capital Allowance (ECA) scheme is "a good idea, it doesn't support fabric measures."

He says a cynic may argue that is because insulation is not photogenic.

"ECAs don't support insulation because it is not plant and machinery. Why isn't there a mechanism for improving the fabric first? Because it is not sexy and it doesn't provide a photoshoot." Windows and roofs may not be sexy, says Lewry, "but surely there should be something alongside the ECA that provides incentive for building fabric?"

Adjusting schemes such as the RHI to prevent abuse would also ensure the available pot goes further, says Chris Jennings, strategic development manager at energy and carbon consultancy Sustain.

Biomass boilers, he says are often "inappropriately sized to maximise income from the RHI and not to be the most efficient installation."

Proper regulation of operation and maintenance of assets is also absent, he believes.

"Improving operations and maintenance may be the most cost effective measure per tonne of carbon reduction," says Jennings. "Better procurement practices to hold an operations and maintenance operator to efficiency performance targets would help."

Which technologies are readers investing in?

81 people completed the survey for this report across sectors spanning manufacturing, health, local government, central government, leisure and retail. Respondents also included consultants working across multiple sectors.

Around 50 respondents specified which technologies they were deploying or considering. Of those, 44% are assessing or deploying more than one type. A handful of others said they were assessing all options or that choices were dependent on client suitability.

By volume, survey data shows that they are most interested in heatpumps, with 19 respondents stating they are either considering deployment or are deploying the technology, most of which were air-source where specified. Combined heat and power was the next most popular technology, cited by 16 respondents, followed closely by biomass (15).

Respondents are also either deploying or investigating: waste heat recovery (4); condensing boilers (3); solar (3)*; solar thermal (3); heat networks (2); BMS/controls (2); energy from waste (2); infrared panels (1); geothermal heat (1); fuel cells; nanopartical technology (1).

*As responses to this question were open-ended it may be that solar actually refers to solar thermal, more commonly used than PV for heat.

HEATPUMPS, NANOTECH AND INFRARED

Others think policymakers move too slowly and risk paying over the odds for technological losers and that manufacturers should also step-up.

Former energy trader Toby Costin once ran the supply side of three of RWE's power stations but now runs Social Power Partnerships. He accepts the requirement for due diligence on technology support, but is frustrated at the time it takes to make decisions.

"Government has got to fast track technology quicker," says Costin. "It always seems to be a year or two behind what the commercial people are looking at. We need a way of speeding up that process."

Costin is trialing infrared heating panels within electrically-heated social housing schemes and believes they could make drastic efficiency gains. Along with nanotechnology insulation for walls and windows, he thinks such CE-marked technologies should be supported "because it will halve the amount of work that needs to be done".

"We need to be faster than we are," says Costin. "Not two year deliberations."

But government can't be expected to do everything and Costin says manufacturers must also do their bit. He questions why heat pumps in particular are so expensive, given "this is not a particular difficult technology".

SOLAR THERMAL AND HEAT STORAGE

While electricity storage appears to be making progress towards commercialisation, thermal storage

appears to have been left out in the cold. But it would not take much to prove commercial viability, according to Chris Sansom, associate professor of precision engineering at Cranfield University.

Sansom says solar thermal panels have been similarly overshadowed by their PV counterparts, "but there is enough energy falling on 6,7,8 square meters of roof panels to provide heat and hot water [for households] all year round," he says. "That is fact."

Storing solar heat is the challenge. Sansom is working on a solution that uses Epsom salts as a seasonal heat store (i.e. for four to six months). He is hoping to secure funding for a commercial demonstrator with a housebuilder to prove it works "at the three or four house level".

"We are not doing basic research any more. We are building this system to serve several houses. And once you build a demonstrator and show people that it works in reality, the commercial guys all come in."

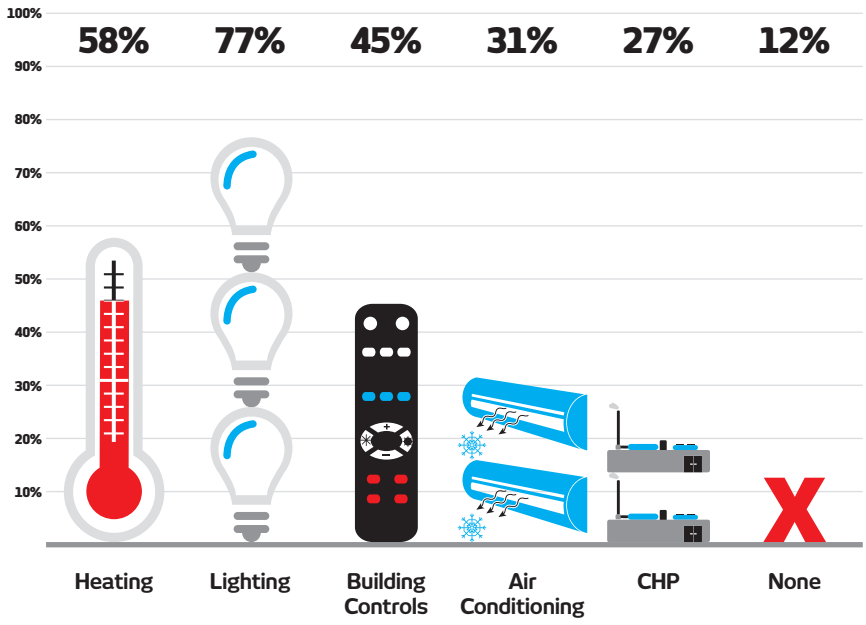
Sansom thinks a tightly directed fund from Decc or Innovate UK for applied research "with a company-led commercial plan at the end of it as part of the call" would cost no more than "a few hundred thousand pounds" or "low millions" to fund several projects.

"That is the stage we are at," he says. "It really isn't that far away."

Which low carbon technologies have you installed within your building?

Almost eight in ten respondents have installed energy efficient lighting systems, versus almost six in ten installing low carbon heat solutions. Greater lighting actions may be because lighting solutions are often lower cost, easier to retrofit and require less work in terms of business case. But both are positive statistics. Almost half of respondents have also upgraded building controls, possibly to more effectively use existing assets or as part of an upgrade to light or heat.

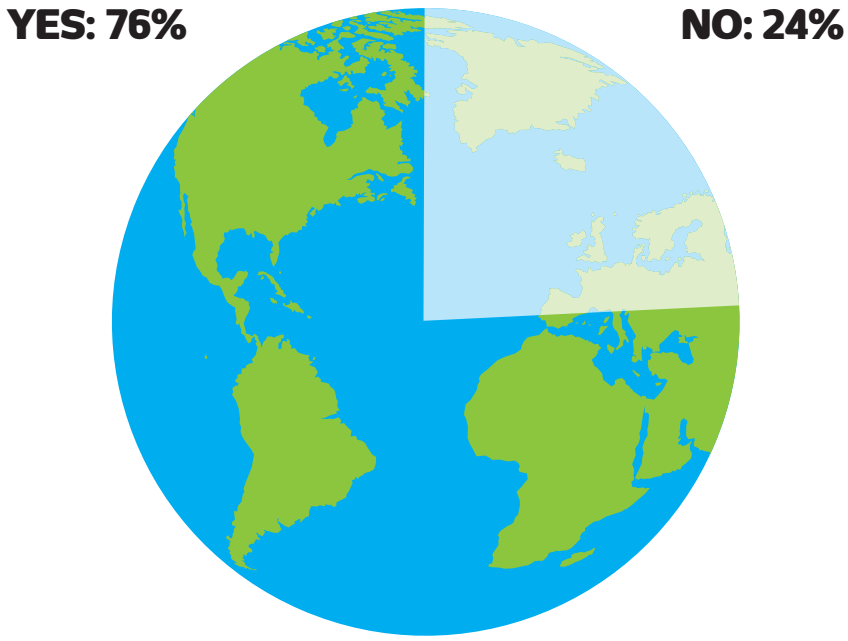
That more than 25% have installed CHP may reflect the number of respondents from local authorities, education and health sectors.



Is your organisation looking at low carbon methods of heating?

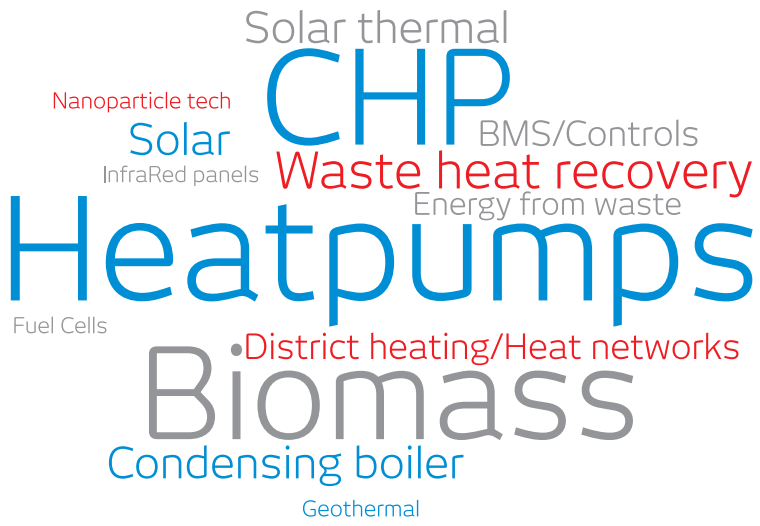
More than three quarters of respondents say they are assessing lower carbon heating solutions.

Of those respondents that stated which technologies they are considering or are already deploying, almost half were assessing or using at least two technology types. If the survey sample is representative, that suggests significant appetite to decarbonise heat. It may also suggest that concerns around the cost competitiveness of renewable heat are not shared by all market participants.



Please specify which methods you are / would consider deploying?

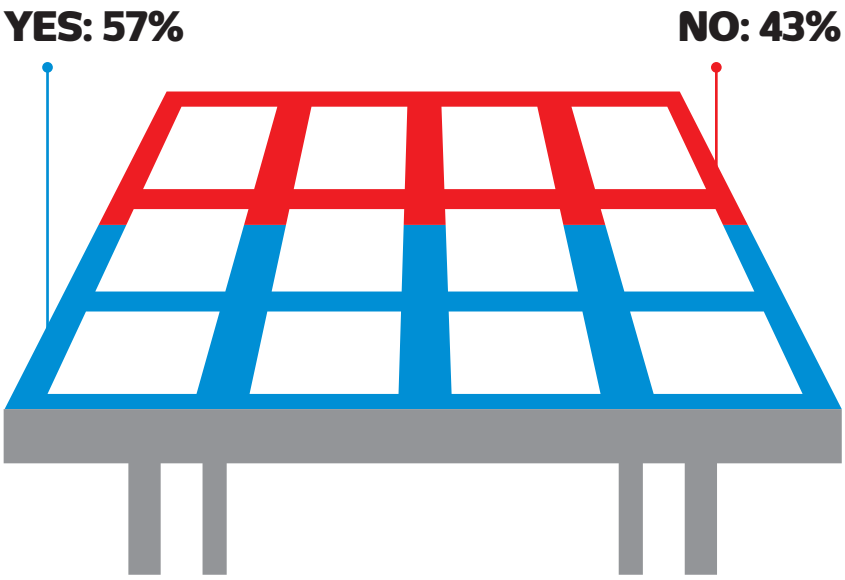
Many respondents stated that they are using or investigating multiple technologies. Heatpumps, CHP and biomass are the most popular technology choices. It is not clear whether respondents that stated solar (3) actually meant solar thermal (also 3), which is a relatively cheap but often overlooked technology, partially because a lack of seasonal thermal storage. Given their broad applications, it is perhaps surprising to see that few respondents are considering condensing boilers or controls. The breakdown of respondents citing specific technologies is as follows:



Heatpumps:	19	Waste heat recovery:	4	Solar thermal:	3	BMS/Controls:	2	InfraRed panels:	1
CHP:	16	Solar:	3	District heating /		Energy from waste:	2	Geothermal:	1
Biomass:	15	Condensing boiler:	3	Heat networks:	2	Fuel Cells:	1	Nanoparticle tech:	1

Is the Government's RHI (Renewable Heat Incentive) an effective tool for encouraging renewable sources of heating?

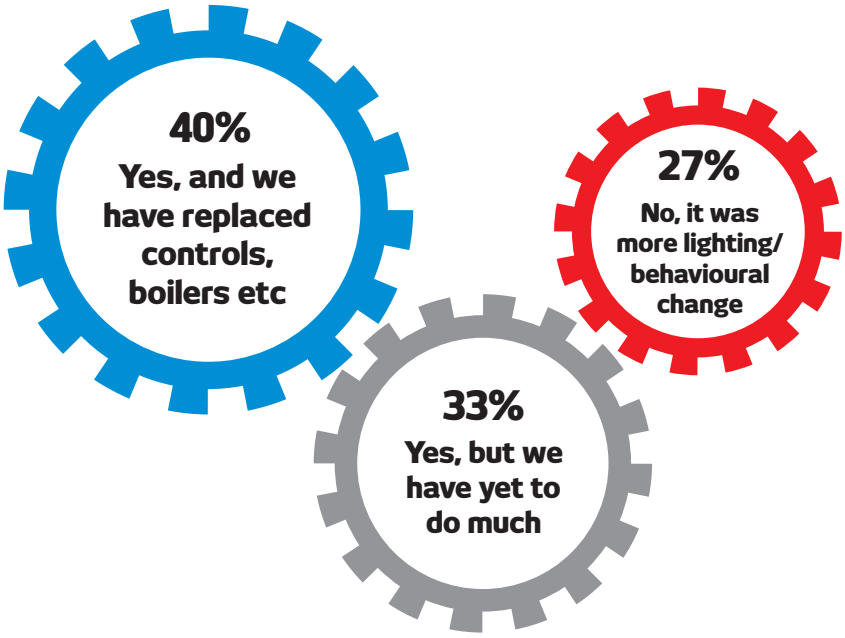
A slim majority think the RHI has been effective. However respondents interviewed by Energyst Media said that the incentive is too small and fiddly with many hurdles to clear, while investors tend to regard it as a political risk. Other respondents said the scheme was open to abuse, citing biomass boilers often being oversized to maximise RHI revenue, for example. The RHI budget was increased in the Autumn Statement. It may be that the government will look at better ways to allocate the available money.



When addressing the optimisation of buildings that your business owns, has heat been a focus of this?

Almost three quarters of respondents have made heat a focus when thinking about building optimisation. Most end-users recognise that reducing heat use or optimising set-up will usually have more impact on energy bills and carbon emissions than any other factor. However, a significant chunk have yet to take action.

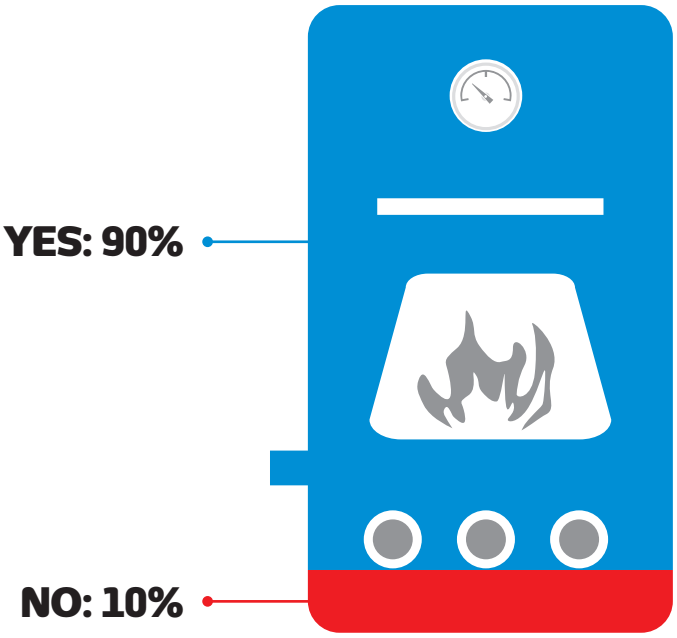
Around a quarter of respondents admitted they had focused more on lighting, which can often be a more straightforward project with shorter payback periods, or behavioural change, which can cost virtually nothing but yield significant results.



As a method to improve the carbon performance of buildings, are you aware that high efficiency condensing boilers can significantly reduce carbon emissions from your heating system?

It is unsurprising that the vast majority of respondents are aware that condensing boilers can reduce carbon emissions (various manufacturers claim reductions of between 30% and 90%).

It is more of a surprise that 10% of respondents do not equate higher fuel efficiency to reduced emissions.

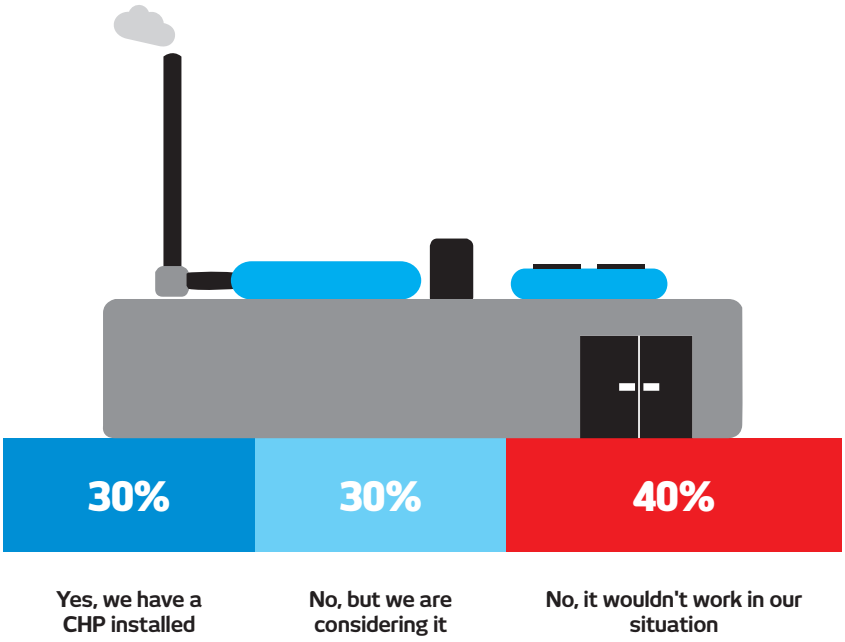


Is combined heat and power (CHP) something that you use?

Around 60% using or considering using CHP may suggest sample bias, given DUKES figures state there were 2,066 schemes operating in the UK in 2014 (plus 485 domestic CHP units registered with Ofgem for FiTs).

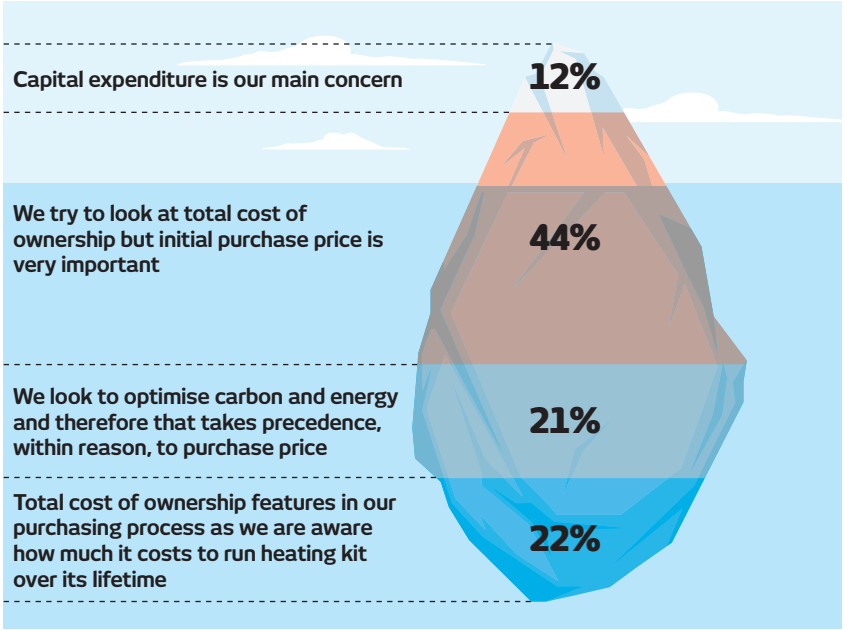
Two thirds of UK CHP schemes are fueled by natural gas, with 11% fueled by renewables. Of 1,488 schemes installed in the commercial sector, public sector and residential buildings, the largest proportion of the capacity is in the health sector (34 per cent), mainly hospitals. Leisure and hotels schemes are more numerous but represent only 20% of capacity.

CHP represents around 6% of UK electricity generation and in 2014 delivered 43,306 GWh of heat, saving 12.99 $MtCO_2$, according to DUKES.



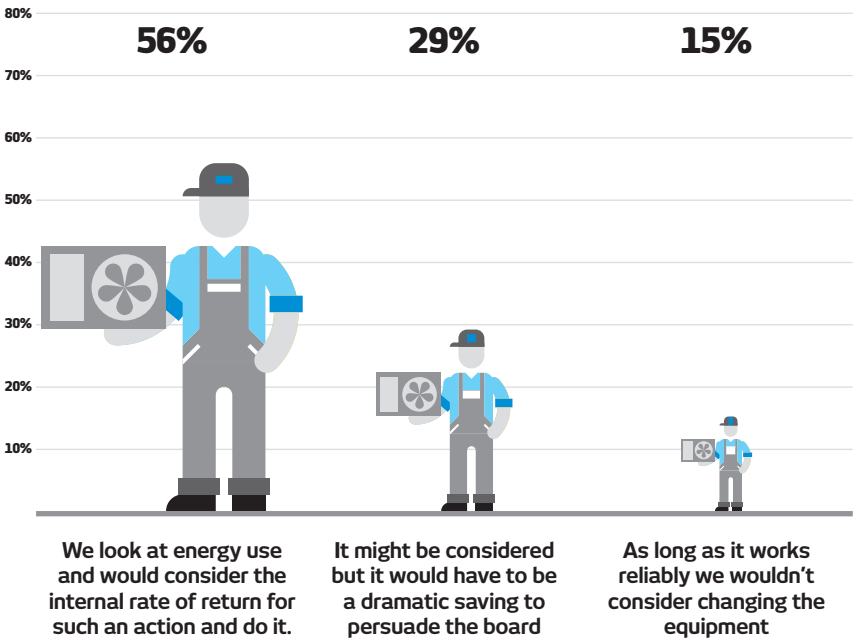
When purchasing heating equipment does your company take a longer term total cost of ownership view regarding energy use and maintenance or is it more on how much it costs to purchase?

Only a small minority (12%) of respondents cite upfront cost as their key purchasing criterion, although almost half (44%) admit that it is a major factor. Around a fifth (21%) put carbon and energy savings ahead of initial purchase price with a similar number of respondents factoring in total cost of ownership into their decision. These figures, given the overlap in terms of answers, simply underline that buying decisions are largely based on multiple factors.



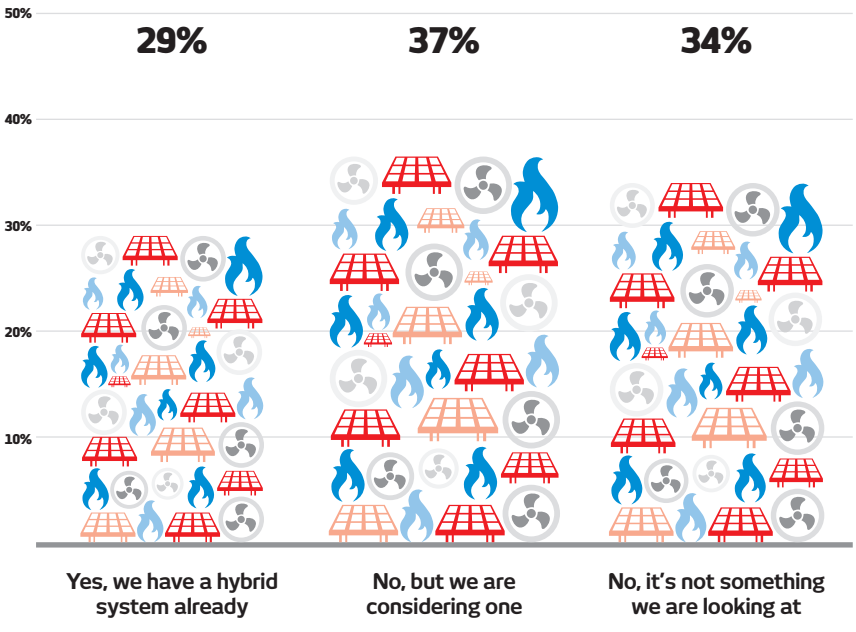
Would you replace old heating technology because of its energy use and the improvement of later generation models or technologies?

'If it ain't broke, don't fix it' remains a maxim for only a minority. More than half of respondents say they would buy replacement heating plant if it met internal rates of return. However, a significant minority admit that savings would have to be a dramatic to get the board's approval.



Do you have a blend of technology for your heating requirements? (such as gas boilers, heat pumps and solar thermal)

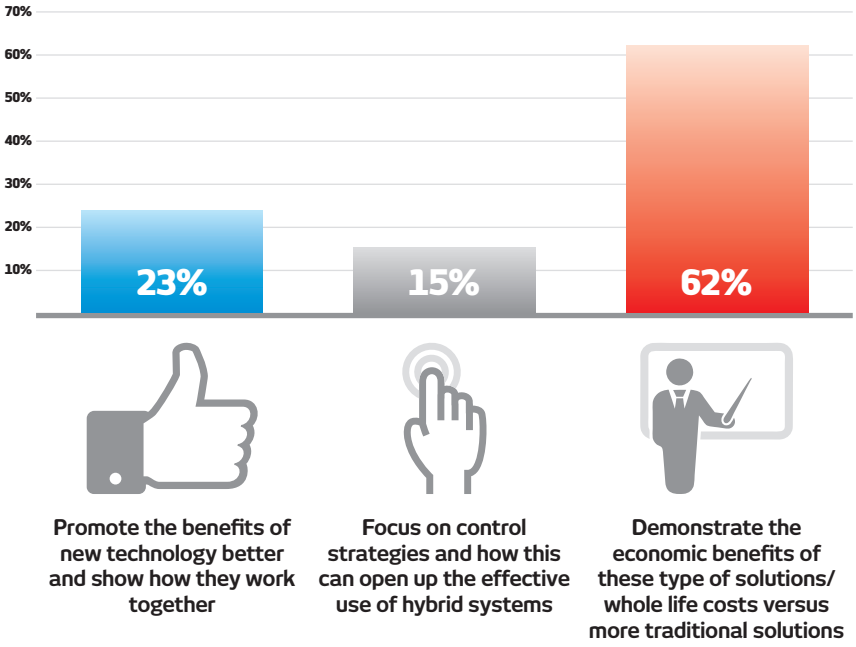
Responses are roughly evenly split with almost a third of firms suggesting they either have a hybrid system (29%) or are considering one (37%). Roughly a third would not consider one. Qualitative interviews with respondents managing multiple properties suggest that a hybrid approach is necessary because different buildings have different requirements and infrastructure. Others suggested hybrid systems were a good medium term approach to decarbonisation, due to more flexible system integration and lower risks, but stated that some technologies were not yet cost competitive.



Multi-technology heat solutions can offer an efficient option, what is the best method of encouraging this?

Cost, either upfront or whole life, is king. If suppliers can prove that their hybrid solutions are the most efficient option, there should, in theory, be no more need for sales pitches. That said, almost a quarter of respondents suggest a need for better marketing from technology providers.

Only a minority (15%) think providers should focus on control strategies as a way to promote greater uptake of hybrid systems.

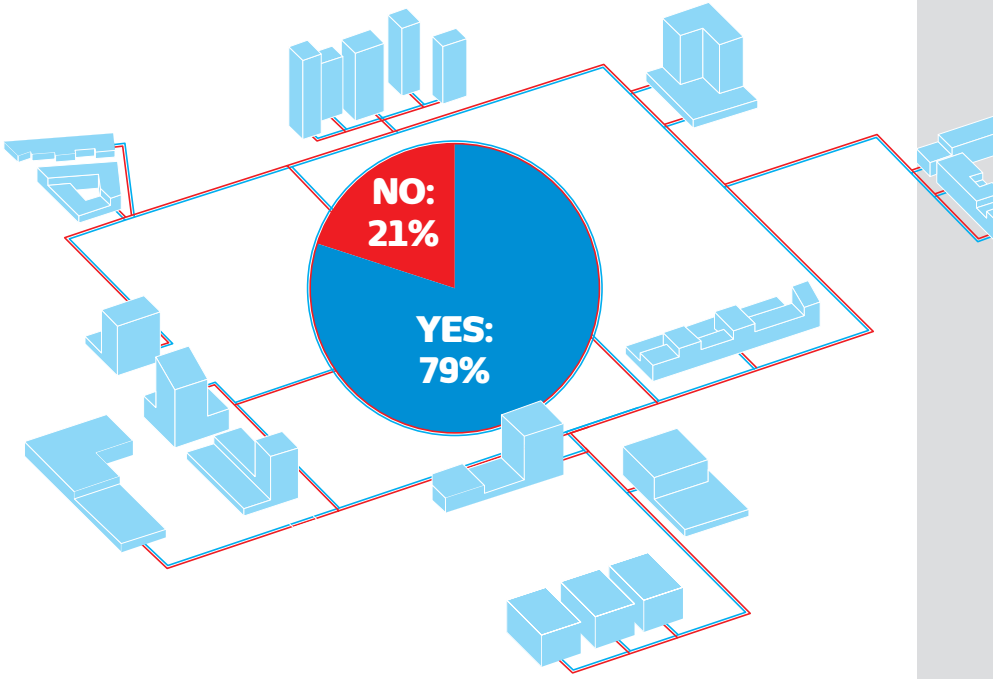


Do you regard heat networks as a future solution to decarbonisation in the UK?

Around 80% of respondents see heat networks as a decarbonisation solution. While financiers appear attracted to infrastructure asset classes, other interviewees working with local authorities and housing associations expressed frustration at the speed of decision-making with regards to heat networks, as well as doubts around public acceptance.

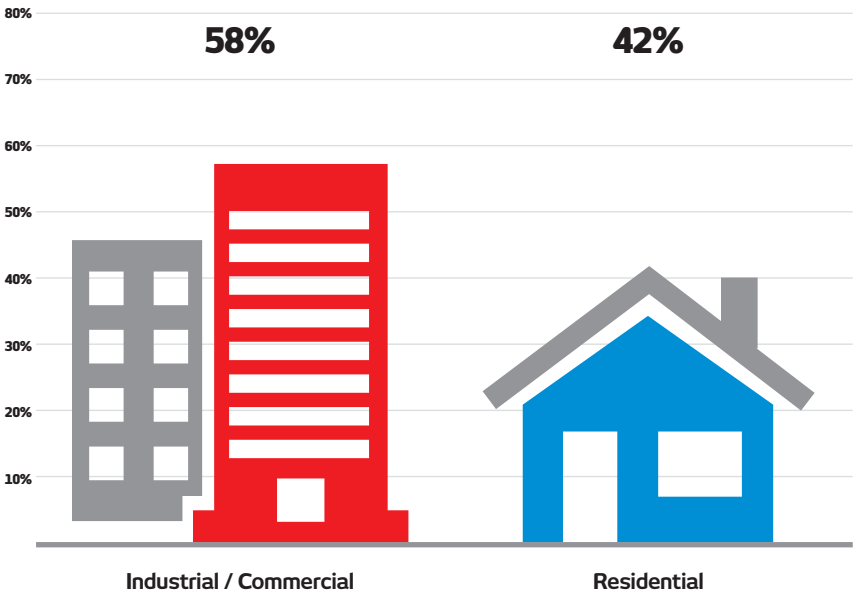
Decc says there are 2,000 networks, delivering around 2% of UK heat. However, one interviewee said those figures overlook the estimated 100,000 small-scale heat networks within commercial and domestic buildings.

While often associated with CHP, in 2014 just 88 CHP schemes served district heating and cooling, according to DUKES figures.



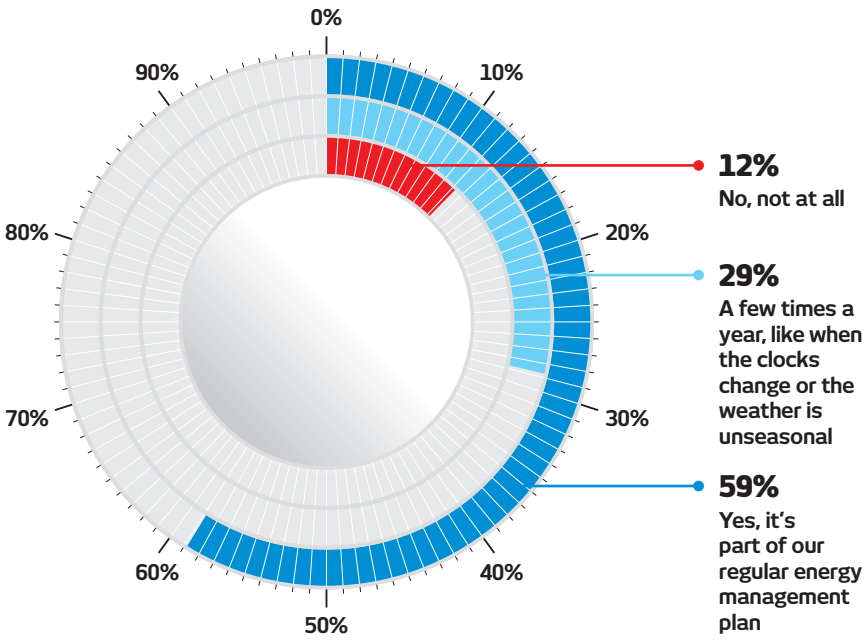
Where do you foresee heat networks best utilised?

A slight majority (58%) think heat networks would best serve businesses, versus 42% favouring domestic networks. There is probably no right answer. Having a guaranteed offtaker of heat, or anchor customer, is vital and if the asset life is at least 30 years, then the offtaker must be equally confident of its future. Decc has allocated £300m to help develop more heat networks, with local authorities and developers looking at mixed commercial and residential schemes that could go some way to decarbonising UK heat. Retrofitting heat networks to existing dwellings in urban areas however, may be challenging.



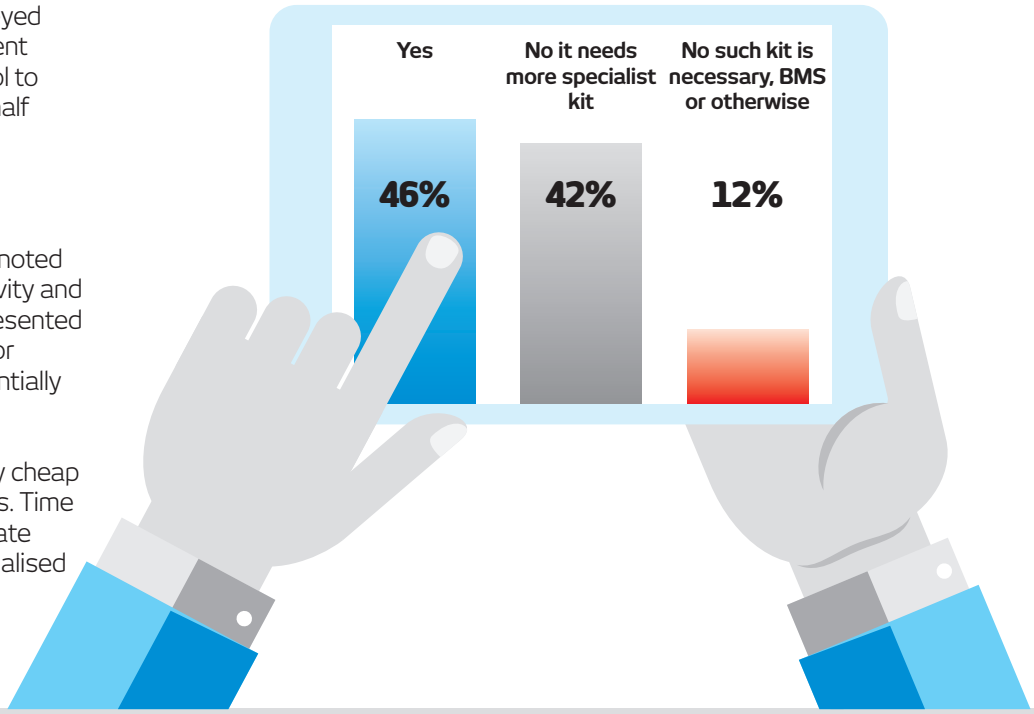
Do you look at heating controls regularly to optimise your heating system?

Most of those surveyed regularly optimise their system, suggesting proactive management and an ability to accurately match loads with demand. However, a significant minority do so only a few times a year. That may be because some wet heating systems are often optimised and left to run within set parameters to ensure system efficiency, and may not be suited to regular tweaking for fear of losing pounds to gain pennies.



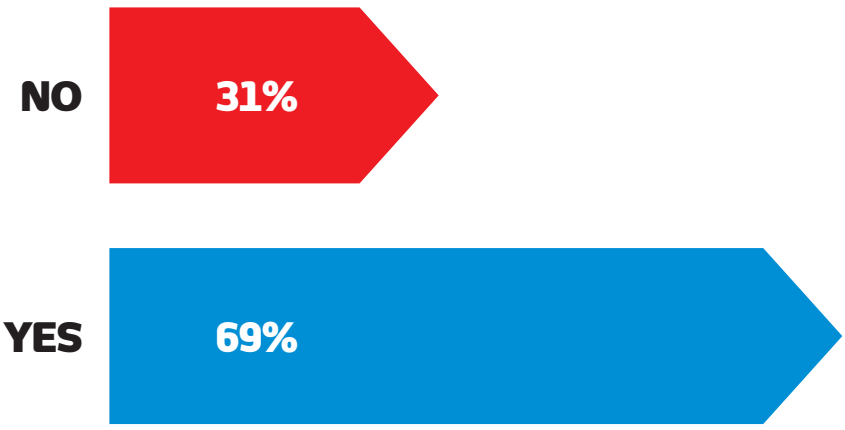
Do you consider the Building Management System (BMS) a sufficient tool for optimising your heating?

Around half of those surveyed think a building management system is an adequate tool to optimise heating, around half think more specialist kit is needed. That suggests an sizeable opportunity to go beyond the BMS.
Respondents interviewed noted that the surge of connectivity and the internet of things represented a significant opportunity for system optimisation, potentially at lower cost, as more manufacturers develop sophisticated yet relatively cheap connected control systems. Time of use tariffs may also create opportunity for more specialised control systems.



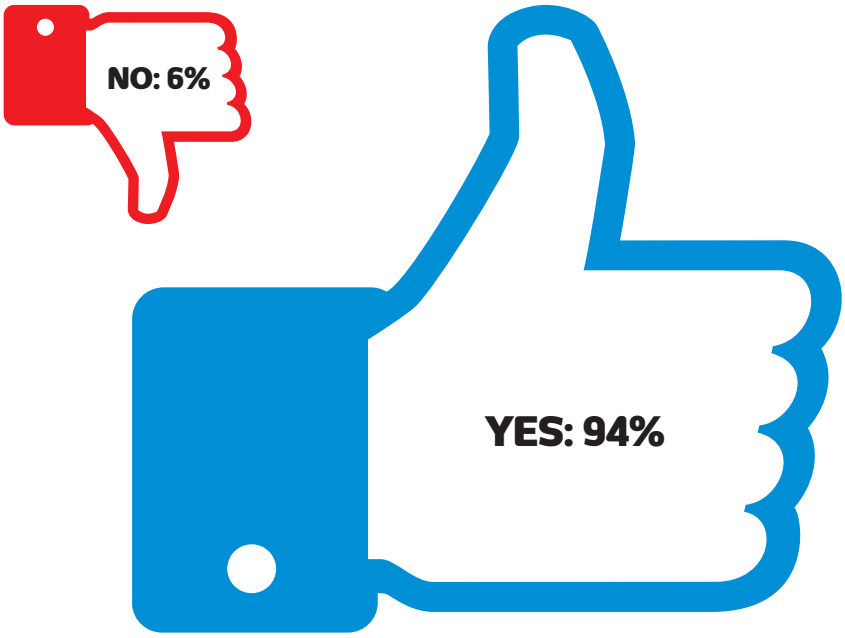
Are you aware of the Energy related products (ErP) Directive regarding heating products?

Roughly two-thirds of respondents were aware of the ErP Directive, which replaced the previous EU directive around product efficiency in 2009 and came into force last year. It essentially means that manufacturers can no longer sell equipment with poor levels of efficiency. But it will have impacts on boiler designs and biomass boiler emissions, which will affect costs (see p24). That a third of respondents are unaware of the Directive seems quite high.



Do you support the aims of the ErP Directive to continually force manufacturers to improve their design for energy efficiency and stop selling older, inefficient models?

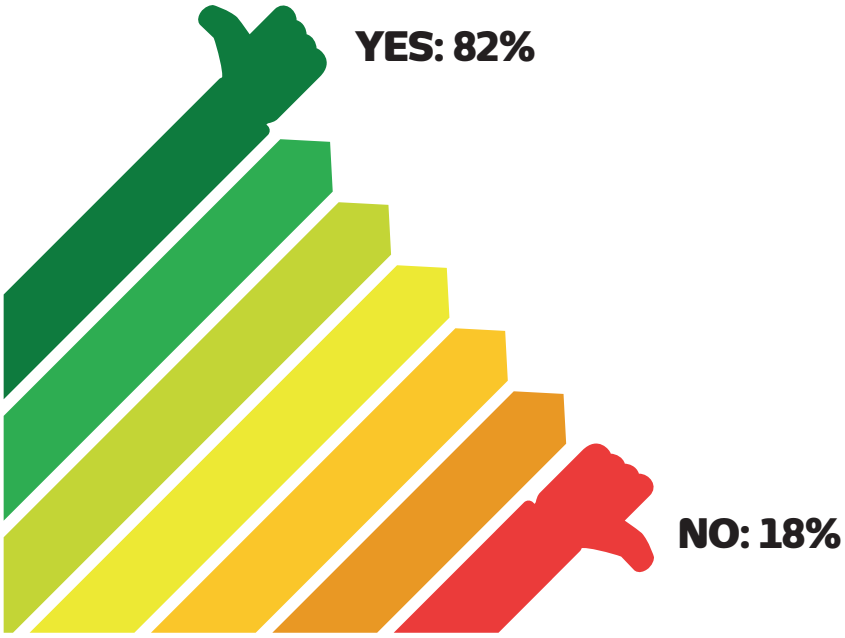
While a third of respondents are unaware of the ErP Directive, almost all (94%) of those surveyed think mandating continuous improvement of product efficiency is a positive step. It would be interesting to hear the views of the 6% that believe that is not a good idea. It is possibly that they have concerns around increasing product costs for diminishing efficiency returns.



Would an ErP efficiency rating alter your purchase decision?

82% say an ErP rating would alter their purchase decision, which makes sense, given efficiency affects running costs, rate of return and carbon emissions. That statistic should give further encouragement to manufacturers allocating significant resource to product efficiency.

Although two in ten state that it would not affect decision making, it may be that they are the same two in ten that place carbon and energy optimisation ahead of purchase price, and therefore only ever specify A-grade kit. Or it could be those for whom capex is king and for whom energy efficiency is less important.



How to decarbonise heat at lowest cost

Scrap additionality rules, incentivise waste heat and give power to local actors to decarbonise heat at lowest cost, says Association for Decentralised Energy chief Tim Rotheray

Rotheray is relieved government finally recognises the "impossibility" of electrifying heat. Covering winter peaks without significant increases in energy efficiency would require 360GW, six times the UK's current capacity. Bills would skyrocket.

"It seems obvious now, but if you went into government three or four years ago, the rhetoric would be 'just electrify heat'." Recognition that is folly, says Rotheray, is the first step to decarbonising heat at lowest cost.

The second step, he says, is harnessing waste heat. That requires reinterpretation of the Renewable Energy Directive.

WASTE HEAT, WASTE MONEY

"Unlike power, it is very difficult to get low or no carbon heat," says Rotheray. "Under the Renewable Energy Directive, lots of low carbon and low cost ways of reducing emissions do not qualify [for subsidy]."

He thinks that creates perverse incentives.

"It means heat pumps are classified as renewable, even if they are powered by a grid with lots of coal in it."

Unless the grid is predominantly renewably powered, "[those fossil-powered heat pumps] are not a low carbon option. Certainly, in that situation, they are not lowest cost".

Rotheray believes waste heat should be supported, rather than ideologically ignored. Focusing on renewables, he says, serves only to create technology bias and unnecessary cost.

"The fact that we focus on renewables means that you prop up particular technologies rather than asking 'what is the cheapest way to decarbonise?'" he says. "You end up with skewed policy. But in all of this, cost to consumer is king."

The current UK government may be more immediately cost-focused. "But it still has obligations under the Renewable Energy Directive," says Rotheray, "That is a problem."

So what's the solution?

Rotheray reiterates that heat recovery should qualify as renewable, explaining why.

"Take a cooling system which is dumping out heat. Placing an air source heat pump next to that cooling duct would be more efficient than taking normal air from the environment. You would get a higher system efficiency and lower carbon result and, importantly, it would be lower cost for the user." Because that is not permitted under the Renewable Energy Directive, "the least efficient solution is the renewable one".

Those rules have "a massive perverse impact on heat", says Rotheray. He believes amending them would dramatically cut decarbonisation costs, "which must be the overarching principle".

While EU law appears sacrosanct, Rotheray thinks responsibility for allowing waste heat to qualify as renewable may in theory lie with UK government. Regrettably, "the UK has a tendency to be rather conservative in the way it interprets EU law".

Despite banging the drum for waste heat, Rotheray says he is not asking for subsidy, merely for the way pots are allocated to be revisited. He accepts that the UK government is right to rein in the "subsidy experiments which have led to a lot of perverse outcomes we must avoid in the future". But he says support reallocation would bear fruit

Brussels may be coming round to that view. In February the Commission committed to review the Renewable Energy Directive and touted big plans for heat and energy efficiency. It said waste heat from industry across the bloc "could heat all of the residential and tertiary buildings in Europe". So it may be that the tide is turning.

Rotheray also thinks devolvement of decision-making is key.

POWER TO LOCAL PEOPLE

"Heat is by definition local and it is controlled by the end user," he says. "They are best placed to know what solutions will work for them. The last thing you want to have is some kind of central diktat."

That means redesigning policy to devolve decisions to end users, he says, and by allowing people to appraise the most suitable options without bias.

AXE ADDITIONALITY

Tighter purse strings necessitate a regrouping of available incentives, says Rotheray. He believes additionality rules should be axed. That is, doing away with prohibiting projects from claiming more than one support mechanism to maximise outputs from available pots.

"[Additionality rules are] the biggest killer of action at local level," he says.

"People commission all these studies around removing barriers to investment. But the way we have removed barriers to investment in large electricity and decentralised generation is through incentives."

Further in-depth study, says Rotheray, is pointless.

"Barriers were removed by making the returns more attractive than they were. Additionality kills that."

Heat networks: Scope for improvement

Green infrastructure funds like the look of heat networks, says Amber Infrastructure's Jenny Curtis. But poor data, planning and leadership can undermine otherwise viable projects

Amber Infrastructure manages a listed infrastructure fund as well as unlisted funds on behalf of government entities in energy efficiency, green energy and regeneration - including the mayor's London Energy Efficiency Fund. It has appetite for green projects that would not ordinarily attract standard market investors.

Within heat, Amber primarily invests in CHP and district heating, taking particular interest in projects that can be moved "from their current field, where they require a grant or potentially a local authority guarantee, into a standard investment", says Amber Green director Jenny Curtis.

She says the difference between success and failure is all in the detail – which the public sector and its consultants must ensure is up to scratch.

"They need to be properly scoped. We see a lot of slightly unrealistic feasibility studies in terms of the real, underpinning financial economics. They need to be schemes that are driven as much by the carbon credentials as they by the cold hard numbers around demand and capex costs."

While it may be desirable to oversize networks and scope-in potential future offtakers, "that can cause you real issues up front in terms of getting a project that is deliverable," Curtis warns.

But a project with all the necessary background data can go "a huge way" towards securing funds, she says.

Jenny Curtis, director at Amber Infrastructure's Green unit

"The more data you have, the more you can derisk it. We are not asking for everything to be sewn up, but you need to know which risks you are being asked to take on."

Such as?

"Right down to basic things like how many units are there will be and when they will be built; what is in the terms of existing leases about provision of heat. That kind of thing makes a big difference and is the kind of work the public sector must undertake upfront to get these schemes together."

Low carbon heating schemes should not necessarily be led by low carbon experts, but by experienced project managers, says Curtis.

"You need someone to take the lead. I don't think that is the carbon people. It should be the people with commercial expertise." That may be the finance director, it may be the head of housing. "But you need a strong sponsor who understands that a large district heating scheme has the same core principles as building a new housing estate, school or civic centre," Curtis says.

Provided strong project managers are in charge, hired help will fill in the gaps, she adds, but local authorities should resist going it alone with free advice from, for example, government bodies. You get what you pay for, Curtis suggests.

"It is important to work with appropriate external consultants and technical advisers so that you go out with something as robust as possible," she says. "The modelling for these schemes is often pretty poor. There aren't that many functioning financial models for district heating. We have our own... but the numbers that we see coming in from other people are often pretty ropey."

But by putting the right people in charge, drilling down on detail and data, and by taking a realistic view on scope and scale, soundly developed heat projects will find backers, says Curtis.

"There is definitely a buzz around it. People are realising that heat is the major thing in terms of carbon," she says. "These things always move more slowly that you would hope. But we have a healthy pipeline and I see the market picking up."

Is the RHI any good to investors?

"We are always very wary of subsidy schemes because they are very open to political risk," says Curtis. "We haven't invested heavily in any subsidy-based projects. We would rather do the schemes that stack up on their own two feet or be working with local authority covenants that we know will be there for the long term."

Not all investors want seven year paybacks

While Wales and West Utilities recently told MPs that heat networks would require a 75p/kW subsidy to attract seven year investors, Curtis thinks not.

"I don't think that is true at all. You just have to get the right type of investor. These projects are probably not going to attract traditional bank debt at the moment, but they do work for a longer-term infrastructure style play. They are a long-term partnership and they require long-term asset management. So you need to be in it for 25 years, not only to make your money back but also to make sense of the asset. We very much like those characteristics."

100,000 reasons to think small

Decc says there are 2,000 heat networks in the UK. But actually, says Chris Jennings, strategic development manager, Sustain, there are 100,000 small ones that could be decarbonised with the right energy efficiency policies in place

It's "great" government has started to focus on heat, says Jennings. The downside is it "appears mostly interested in infrastructure projects – large scale heat networks across city districts."

That approach ignores the opportunity to "decarbonise an estimated 100,000 existing small-scale heat networks within commercial and residential buildings".

"We know the government has not clocked this, evidenced by a void in policy and their rollout of the heat network metering and billing regulations 2014 which were completely under-planned and under-resourced for the huge scale of the task," Jennings continues.

He says Decc should stop referring only to the 2,000 large-scale district heat networks on its radar.

"Energy efficiency policy should include the huge opportunity with building-level communal heat networks – carrot and stick to ensure owners and operators invest in proper low-carbon design and operation of their networks," he says, underlining that correct operation is just as important as design.

PROCURING EFFICIENCY

Energy efficiency should be "at the heart of the market's procurement" when heat systems inevitably come to the end of their life, he says.

"Too often procurement is conducted via open request to

contractors to design, supply and install replacement systems without first carrying out an options appraisal of new technology, an appraisal of the current system's performance, or even an evaluation of the building's actual heat requirements," Jennings continues.

"Hence simple like-for-like swaps happen where new boilers of the same size and controls are installed, missing the opportunity to reduce life cycle costs and decarbonise."

INCENTIVE ISSUES

Technologies such as CHP, solar thermal or heat pumps can require significant investment in heat distribution and emitters to make the system suitable. But Jennings says there is little incentive to invest.

"Payback periods are very long, even with income from schemes such as RHI, because they do not allow for the system upgrade costs. The most popular low carbon technology for retrofit to existing systems are biomass boilers where system upgrade is not required and so RHI payments cover the boiler cost. Research by Decc shows many of these are inappropriately sized to maximise income from RHI and not to be the most efficient installation."

Jennings says the non-domestic RHI provides insufficient incentive for heat pumps.

"Heat pumps need more costly distribution systems and there is no allowance for that in the RHI." There is also little thought given to distribution system efficiency "apart from incentives such as ECAs for additional thickness pipe insulation".

Jennings believes "more could be done" to incentivise upgrades of existing systems and higher quality new systems "where we have seen 50% losses from the distribution system between the boiler and the heat loads."

Meanwhile, the current support mechanisms do not support storage.

Both heat and electrical storage are "vital supporting technology" but currently expensive, he says, but storage "will not succeed in the short to mid-term without support to lower costs". Jennings thinks an RHI or FIT type subsidy may be necessary.

TECHNOLOGY COSTS?

But Jennings thinks driving down costs is not solely down to government. "Manufacturers could do their bit too," he says.

"For example why are heat pumps so expensive relative to a gas boiler? With an increasing spark gap (the price difference between gas and electricity) the operating cost of heat pumps relative to gas is a challenge without being propped up by subsidy and this can be compounded by high capital cost."

If you could create one policy, how would it look?

According to Jennings: "Some policy that recognises the opportunity of decarbonising the vast number of small-scale heat networks (single building or very localised district heating) to drive both better design and better O&M. Ideally a unified approach by Decc and DCLG to pull together planning, Building Regs, the Energy Efficiency Directive, the Energy Performance of Buildings Directive, domestic energy efficiency policy (er, where is it?), small-scale heat network policy, metering, the Energy Company Obligation, subsidy (FIT, RHI plus any other such as energy storage). Don't forget about the huge opportunity of aggregated savings from addressing the nation's often woefully inadequate legacy communal networks."

A universal approach to technology

Moving away from direct electric heat across an estate spanning 136 buildings in 26 cities is no mean feat. But Unite's James Tiernan relishes the opportunity to test as many technologies as possible

Tiernan, energy & environment manager at Unite Students, looks after the energy needs of 46,000 students across the UK. The estate spans 136 buildings in 26 cities, from Aberdeen down to Plymouth. Buildings vary significantly in design, age, construction type and approach to building services. Unite's new build pipeline also encompasses a range of strategies.

"It's quite a complex mix," admits Tiernan. But it means he can assess pretty much every technology in a bid to boost efficiency and reduce carbon emissions.

DIRECT ELECTRIC

Despite the variables, there is one near universal theme.

"The biggest chunk in our existing estate for heating and hot water is direct electric. Which obviously poses quite a few challenges from an energy and carbon point of view," says Tiernan.

"So the focus has been twofold: What is the best way of generating heat, whether space heating or hot water; and what is the best way of controlling it, specific to our requirements."

UNKNOWN KNOWNS

The tricky part is that those requirements are unpredictable.

"There isn't really a usage pattern. Students don't have one. It really is quite difficult to predict when demand is going to be there for heating and hot water," says Tiernan

"That's also true at a micro and macro level: Within the day, but also from day-to-day, week-to-week, month-to-month."

The third week in March, for example, is not always Reading Week and Easter. Also, students from one discipline might spend more time in lectures while others spend more time in halls. The only certainty, says Tiernan, is the summer holidays.

"Even then there are still hot water requirements for cleaning. Many of our buildings maintain water hygiene via temperature control, so you have to keep the cylinders above a certain temperature, otherwise they have to be reconditioned and purged. That is just not possible in the timescales that we have to turn the rooms around."

Ultimately Tiernan wants to move the estate away from direct electric heating. But that may take years and such narrow windows of opportunity make improving existing assets enough of a challenge. Hence making controls a priority.

He hopes those controls will also allow the company to participate in demand-side services and Triad management, and has begun discussions with aggregators.

DEMAND-SIDE RESPONSE

"Electric immersion heaters are a prime candidate for demand-side management (DSM) both in terms of switching off and turning on," says Tiernan. "In the long term I am keen to replace them with something far more efficient than direct electric. But if in the short term we can achieve some real benefits through changing the controller relatively easily, we are keen to do so."

What complicates the picture, compared to other sectors, says Tiernan, is that instead of having buildings with several large point loads, Unite Students has the opposite.

"Our buildings have many, many distributed small loads. That makes it difficult to cost effectively manage them - and that applies to DSM as much as anything else. So if we go down the DSM route, we must have cost effective controls."

He is upbeat that can be achieved given the explosion of connectivity and the burgeoning internet of things. Unite is working with suppliers to keep costs down.

"The moment you get above £100 per controller, with 46,000 rooms it starts to get very expensive. The business case then starts to look a bit less favourable. But as technology develops there will be more that we can look at doing."

INFRARED AND HEAT PUMPS

Tiernan says "next level" trials with direct electric sites aim to gauge whether existing basic panel heaters might be improved upon.

"We are trialing forced air convectors, infrared panel heaters, oil filled radiators and other technology to work out what is the best way of getting the heat into the room, and then controlling it," he says.

"We also have various pilots and trials running at the moment looking at the best retrofit approach as well. So where we have got distributed direct electric hot water throughout the building, we are looking at a pilot to see if we can retrofit those with centralised air source heat pumps."

That trial is taking place at a site that uses a gas boiler because it will provide back-up during the install. Tiernan says the need to provide continuous user comfort with no margin for error throws up another project skew.

"It is not like a hotel where you can take rooms offline for a week – even though there are time pressures there and I appreciate that – our rooms are occupied all year round apart from a small window in the summer. Our students are very much seen as customers. A central pillar of our service is providing a safe, secure, comfortable place to live. So we are trying to balance customer comfort versus energy savings."

DISTRICT HEATING

Beyond that, Unite has even bigger plans, aiming to connect to a heat network in Aberdeen, although Tiernan admits he has yet to write the business case. Retrofitting a wet heating system to a currently all-electric building is no mean feat, and he acknowledges that business case "will have to be quite compelling".

But he thinks the project looks viable because it will connect to an existing network, removing the cost of a central plant. And as Tiernan looks to move away from direct electric via wet-system retrofits, the project may well "kill two birds with one stone".

"It will prove the concept of district heating retrofit, but it will also prove the concept for wet heating retrofit, so we can then look whether we use CHP, condensing boilers, heat pumps or whatever, " he says. "It becomes almost academic."

FINANCE

Tiernan says Unite tends to use its own capital to fund projects, steering clear of external finance. Sometimes those projects are significant.

"We are halfway through a £21million LED lighting and controls upgrade, which was fully funded with internal capital. We don't have any EPC-type arrangements and I am not actively looking at any.

Energy performance contracts may work in certain environments, he says, "but with our estate and structures they don't work so well and can perhaps be a bit constraining."

Unite, he says, has to put customer comfort first.

"Anything that could potentially jeopardise that is too high a risk. The risk is that someone is incentivised by the savings they achieve, not necessarily the customer satisfaction that results."

SUBSIDIES

Equally, subsidies are not high on the agenda. Tiernan suggests that in the main they are too complex and create unnecessary risk.

"There was an Eco stream specifically for retrofit connections for district heating. Initially, we thought that looked brilliant." But scratching the surface proved otherwise.

"There are so many hoops to jump through along the way. Because it is retrospectively applied, the risk is that if you predicate your business case on the funding, and you don't actually get it, it is just too high a risk. Plus you have to have bridging funds in the interim anyway."

If projects actually manage to get support "it is almost like a bonus," says Tiernan. "In which case you don't need it anyway because you have already had to write a viable business case. So it is almost irrelevant.

"The way I see it, something is cost effective and viable, or it is not. So we have to build a business case that stands on its own two feet."

CERTAINTY?

That's not to say any guaranteed incentive would not be factored into projects, says Tiernan. But he questions whether certainty actually exists within energy policy, with one of the most recent u-turns proving his point,

"Historically we have looked at the carbon benefits that would be delivered and therefore the CRC savings that would be realised. That acted as an incentive within the business case because it was relatively certain. But, nothing is really certain and a few years from now we are going to lose that element of the business case due to the CRC's demise."

While admitting it is hardly an original thought, Tiernan says the only policy he can think of to decarbonise heat more quickly is certainty.

"Chopping and changing doesn't help anyone in any area of life. So if you are planning any major investment you have to make sure it can stand on its own two feet if the carpet is pulled out from under them."

A surprise outcome

Tiernan says that while he was "almost ideologically opposed" to using electricity for heating, running the numbers from this year's carbon calculations challenged his assumptions.

"The sites where we have direct electric heating and direct electric hot water actually performed pretty well from a carbon point of view compared to sites where we have gas," he says. "That is down to the fact it is much easier to control the electric sites and therefore you are not wasting heat in empty rooms."

"I found it interesting that my initial view [of direct electric] proved to be not necessarily the full picture."

Think smaller, faster to decarbonise heat

Social Power Partnerships CEO Toby Costin thinks that the focus on large infrastructure projects sets a glacial pace for decarbonisation of heat.

He believes that the focus on heat networks from central and local authorities overshadows swifter gains from technology that is much more simple to deliver.

"There seems to be a lot of energy around district heating but it is early stages. Once we hit the planners, we will hit problems. It's hard enough getting DNOs to agree connections," he says. "Putting in district heating will be very difficult."

Costin is working on a district heating scheme with Bridgend Council. It has a "fairly large budget" from Decc. But heat networks in general are not purely about money.

"I can't see residents putting up with that kind of disruption. You can see there is huge will from local authorities, housing associations hospitals and schools... and yet no one has told planning. They will say it is too difficult and I just don't see how you get around that."

Others may disagree but Costin thinks that the fact local authorities are "spending a lot of money" launching retail energy companies yet failing to tackle fuel poverty suggests a failure to join the dots.

He believes that the time it takes to deliver big projects also risks sinking costs into technology that will be overtaken.

"These things take five years. But in five years time we will have new technology and everyone will say, 'why did we agree to that?'"

He draws a parallel with the decision to plough on with new nuclear.

"Nobody thinks Hinkley C is a good idea and by the time it gets built, wind plus storage or solar plus thermal store will probably cost £20 - £30 per megawatt hour. And we will be sponsoring a system that costs £95MWh. That doesn't make sense."

Government, councils and housing associations, Costin believes, should focus on cheap new technology that can be easily financed.

Infrared heat panels are one such technology. Costin thinks they are perhaps the cheapest retrofit technology, particularly suited to all-electric heat systems as commonly found in tower blocks, often home to the fuel poor. Combining them with solar PV and battery storage can, he believes, create a very efficient solution that, should metering issues be resolved, also enables schemes to take part in grid services.

Another new technology he believes should be promoted is nanotech coatings for windows and walls, which claim to reduce heat loss by up to 40%, reducing demand.

"I think that government has to fast track technology much more quickly. [Some nanotech solutions] are already CE marked, so the European Union has approved it. Speak to Italian ministers, tens of thousands of homes in Italy use that technology. See what they have done and get it into the Eco budget because it will halve the amount of work that needs to be done. We need to be faster, not two year deliberations."

To set the pace, Costin says government must "get the right people in the room. Commercial people who are looking at what is happening next".

A remarkably good looking infrared heat panel

When is an incentive not an incentive?

Costin thinks there were two key flaws in the RHI.

"At the beginning you had to individually apply on a one-on-one-on-one basis. When you are dealing with a housing association and had to put in [dwellings] individually it was ludicrously administrative - and it didn't get a whole lot better thereafter," Costin explains.

The second flaw was the rate of return.

"It was structured so that if you bought [kit] for yourself and invested in your home, it kind of covered your interest payments but it didn't make it investible in the same way as solar or wind did.

"If you go up to Mayfair and talk with money men... [it's all about percentages]. It is too low to incentivise the people who would drive these projects forward."

A dose of salts for thermal storage

Chris Sansom, associate professor, Precision Engineering Institute at Cranfield University, specialises in solar thermal power and storage. He believes that solar thermal allied with storage is a relatively cheap opportunity, but one that has been overlooked

Decarbonising heat is "difficult in the short term, but there are technologies and approaches that government could incentivise to speed up that change", says Sansom.

He has "no doubt" heat could be decarbonised within "five to ten years if we decided as a nation that is what we wanted to do". Technically, he says, "it is not that difficult".

Waste heat is the "obvious place to start", he says, citing the number of large power stations adjacent to towns and cities. While there is an efficiency tradeoff between electricity and heat for combined heat and power, Sansom thinks it would be worth it. He thinks heat storage is also overlooked.

"Somebody once told me it is much easier to store heat than electricity," says Sansom. "I have built my career on that statement. It is very easy to store heat."

While average immersion heaters can store hot water for six to eight hours, Sansom is working on seasonal heat storage. He thinks that every house in the UK could store enough energy from the sun to service heat and hot water requirements all year round.

"Enough energy falls on my roof in Northampton, right in the middle of the country, so that 6,7,8 square meters of solar thermal panels will

heat my home and provide hot water all year round," says Sansom. "That is fact, I've worked it out."

"Of course, it all comes in the summer and I want all my heat in the winter."

SEASONAL SEASONING

But Samson believes the answer to solar thermal storage is not far away. He thinks it could shift the balance of power between solar PV and its poorer thermal relation.

The solution? Magnesium Sulphate Heptahydrate, otherwise known as Epsom salts, universally used to treat indigestion.

"If you heat it, dry off the water, keep it somewhere dry, go back a few months later and add some water to it, it will get up to about 80 degrees C," says Sansom.

Whereas hot water stores around 150MJ/m^3, he says the Epsom salts store around 2000MJ/m^3. His students are building seasonal storage units "about the size of a small shed... something you would put in your garden or loft." And that is with standard, off-the-shelf solar thermal panels. More advanced panels he says, "will reduce the footprint further".

But is it simply theoretical technology? Sansom says not. He is working with a property developer to trial the technology "at the three or four house level" and is writing proposals for Innovate UK and European funding. But he thinks a small amount of extra government help "could be a game changer, much as I hate to use the term."

"We are not doing basic research any more. We are building this system to serve several houses. And once you build a demonstrator and show people that it works in reality, the commercial guys all come in."

Sansom thinks a tightly-directed fund from Decc or Innovate UK for applied research "right up to a demonstrator with a company-led commercial plan as part of the call" would cost no more than "a few hundred thousand pounds" or "low millions" to fund several projects.

"That is the stage we are at," he says. "It really isn't that far away."

Pluck low hanging fruit to decarbonise quickly

"Low hanging fruit should certainly include waste heat from industrial processes and power stations," says Sansom. "There is no reason why [for example] Rugely – a massive power station – should not be heating the town. And there are a lot of towns with big power stations next to them. It really is easy to get that heat into their homes."

He also thinks excluding waste heat from renewable subsidies is a mistake. "That's an odd one. I don't really understand it."

The other low rider is solar thermal.

"It has been the poor relation behind solar PV. But if you want heat, the heat is there. No reason not to do that, but we lack the economy of scale, the cost curve that solar PV has experienced, where everything halved in price every year. There isn't the demand for solar thermal panels. Yet."

The impact of heating regulation

Whilst regulations relating to product performance predominantly impact manufacturers they can also have implications for building owners and energy managers. Ross Anderson of ICOM illustrates this with reference to ErP regulations and the Medium Combustion Plant Directive

Anyone involved in managing energy in a commercial or industrial facility will be aware of the significant contribution that heating makes to energy consumption and carbon emissions – as well as the organisation's overheads.

Consequently, regulations and directives that influence the design and specification of commercial and industrial heating plant will inevitably have implications for energy management in such buildings. As a result, it is as well to keep up to speed with developments in these areas.

In response to changing regulations and standards, manufacturers are engaged in an evolutionary process of product design to ensure compliance and also exploit new technologies. In the main, these efforts are directed at improving energy efficiency and reducing emissions as these deliver both financial and environmental benefits. The result of this is that products have continued to improve and this is clearly a benefit to all concerned.

When it comes to the development of EU regulations and directives, however, there is also a significant political element. This means that what is technically achievable or desirable does not always come to fruition as it is overruled by politics.

This is evidenced by the ErP (Energy-related Products) Directive, under which sit the Ecodesign requirements for energy-related products.

The purpose of these regulations is to ensure that products continue to improve and that manufacturers are required to comply with a standardised set of performance standards. Ecodesign has a number of sections, known as 'Lots', each of which has a fairly broad scope.

Until September 2015 much of the attention from the heating industry was on Lots 1 & 2. Lot 1 covers the Ecodesign requirements for space heaters and combination heaters, which refers to boilers up to 400 kW operating on gas and oil fuels. Lot 2 relates to water heaters and storage tanks up to 400kW input or 2000 litres capacity. These Lots came into force last September.

Lot 1 provides an example of how such regulations can affect both boiler manufacturers and their customers. This is because it requires that manufacturers of boilers with capacities between 70kW and 400kW to include information in the technical fiche. However, they do not need to comply with the more onerous labelling aspects of the regulations that apply to many other product - including boilers below 70kW.

Currently, this means that the majority of commercial and industrial boilers will not need to comply with the Ecolabelling regulations, so users of such boilers will not need to concern themselves with this.

However, it's interesting to note that the improved thermal performance of buildings, combined with the growing use and integration of renewables, is leading to a general reduction in the size of boilers required for commercial applications. Looking to the future, this may well result in more sub-70kW boilers being used in these applications – though by then the regulations will probably have changed again!

LOTS OF UNCERTAINTY

As is often the case with such regulations, there are areas of uncertainty within these Lots. For example, when new boiler shells and burners up to 400kW are supplied separately, as it is still unclear whether these fall within the scope of Lot 1. In relation to upgrades, it has been confirmed that identical replacements items will be available up to the 26th September 2018.

Ross Anderson, Director, ICOM

Another area of uncertainty is the status of the regulations for gas and oil boilers between 400kW and 1MW, and solid fuel boilers between 500kW and 1MW (the latter being covered under Lot 15).

This is because larger boilers (1MW to 50MW) have to comply with the Medium Combustion Plant (MCP) Directive – so there is a large gap between the 400kW gas and oil boilers covered by Lot 1 and the 1 MW boilers covered by the MCP Directive.

There is a similarly large gap between the solid fuel boilers up to 500 kW covered by Lot 15 and the MCP Directive. In fact, the original draft document for Lot 15 had a scope up to 1,000kW but this was reduced to 500kW in a subsequent draft, to fall in line with the current standard – EN303.

ErP Lot 15 has particularly serious implications for biomass and other solid fuel boilers, as the Ecodesign requirements set limits for emissions as well as efficiency. Under Lot 15, emissions levels are at

such a low level that current designs will find it very difficult to comply. For example, to ensure that biomass boilers meet particulate matter (PM) levels the most effective solution will be to add filters in the flue outlet on the boiler. These will require more plant room space and will add to overall costs.

MEDIUM COMBUSTION PLANT DIRECTIVE

Many readers of *The Energyst* will also be affected by the MCP Directive, which will come into force for new equipment on the 1st January 2018 and be implemented through the Environmental Permitting (England and Wales) Regulations.

The MCP Directive covers all plant with a net thermal input between 1MW and 50MW that combusts any fuel (gas, oil, biomass etc.). As a result it applies to a wide range of equipment types, including boilers, CHP, diesel generators and incinerators.

While new equipment is affected from January 2018, for existing equipment above 5MW the deadline is 2025 and for equipment below 5MW it's 2030. It has passed through the European Parliament and was submitted to the European Council of Members in December 2015. The details of how it will be implemented will be laid down by the Department for Environment, Food & Rural Affairs (Defra) in the UK.

It is estimated that 90% of the affected plant will fall into the 1MW to 5MW range. Of these, around 80% of these items will be boilers, the remainder being made up of engines and gas turbines.

The requirements of the MCP Directive are currently focused solely on emissions of sulphur dioxide, NOx and particulates, referred to as Emission Limit Values (ELVs). While most modern gas and oil combustion equipment will be able to meet the Directive's ELV requirements, biomass boilers may require abatement and there will be implications for existing plant beyond 2025.

There are a number of factors to be aware of in understanding the scope of the Directive.

For example, in the past this plant has not been subject to monitoring but the MCP Directive will introduce a registration scheme that will include testing schedules. It is anticipated that this will build into a Europe-wide register/database as the Directive is rolled out across all EC members.

At the moment the details of the registration procedure have not been fully determined. We know that building owners will have to register their plant within four months of a certain date, and that date is likely to be the time of handover, but this is still subject to confirmation.

The testing schedules will vary for different sizes of plant. Plant from 1MW to 20MW will need to be monitored every three years by measuring emissions and submitting them to the relevant body (which body is yet to be determined). For plant between 20MW and 50MW, testing will be an annual requirement.

An important point is how the size of the plant is defined. For example, each item (e.g. boiler) is classified as an item of plant – so the MCP Directive does not apply to cascades of smaller boilers that add up to over 1MW. However,

when several items of plant over 1MW share a common flue these will be aggregated. So, for instance, six existing 1MW boilers sharing a common flue would be classified as 'over 5MW' and would therefore fall within the remit of the Directive in 2025 rather than 2030.

Any plant that fails the emissions test will need to undergo some form of rectification or, if this is not practical, it will need to be replaced. There will be penalties for the owners of any plant that does not comply, though what those penalties might be is also unclear at this stage.

EXCEPTIONS

There are also some exceptions, including items of plant that are run for less than 500 hours per annum – such as many standby diesel generators. The Directive also makes allowance for exceptional circumstances by allowing this run-time to be averaged over a three year period. This means that if a major situation led to extended use of standby generators in one year the plant would remain exempt if the total use of that year and the following two years did not exceed 1,500 hours.

When the details of the MCP Directive were first mooted it would have been difficult for many existing plant designs to comply. However, subsequent discussions between various groups, including ICOM, have led to less onerous requirements so that most modern gas and oil fired products will comply relatively easily. In the case of particulates from biomass boilers, however, it is unlikely that many of the standard cyclone filters currently in use will enable compliance, so more efficient filtration methods will need to be introduced.

IMPLICATIONS

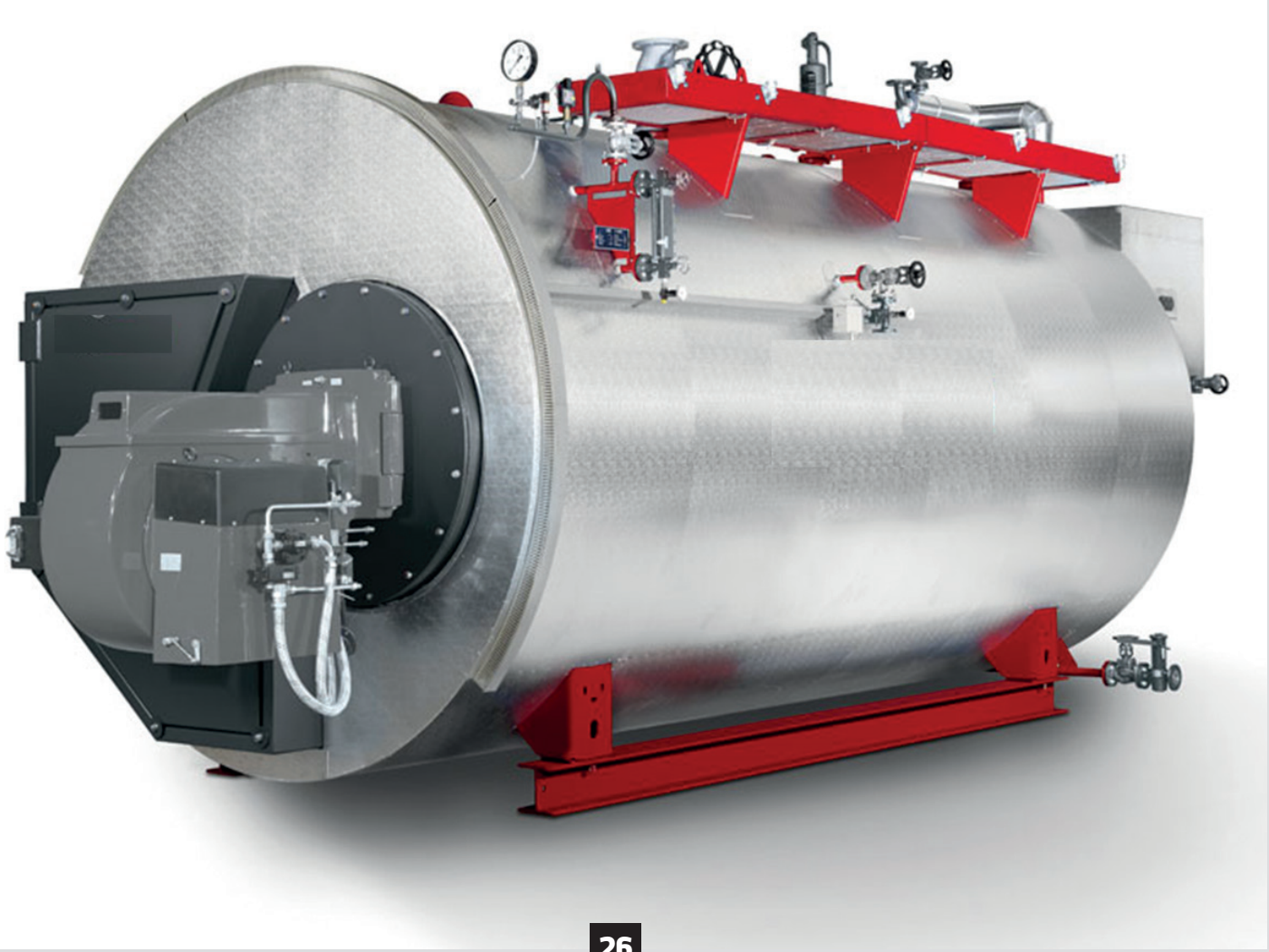
Clearly these areas of uncertainty represent a major headache for the manufacturers as a lack of clarity makes it difficult to reach informed decisions about where best to make future investment in production.

However, it is not just manufacturers that are affected as the absence of a clear policy potentially creates issues for building owners/operators and specifiers as well. For example, it could potentially encourage the use of less efficient boilers in the range between 400kW and 1000kW as these will only have to meet existing regulations. Similarly, if the specification is for a 1.2 MW boiler it would fall within the remit of the MCP Directive, whereas 2 x 600kW boilers would not necessarily be covered by the new regulations.

Moreover, a specifier selecting separate boilers and burners under 400 kW has no meaningful guidance as to what performance criteria will ensure compliance. This could lead to specifications as vague as 'in accordance with the Ecodesign Directive'.

However, the situation isn't all negative. Ultimately these regulations serve to improve energy efficiency and reduce emissions, and progress is already being made with the issues described above.

The Industrial and Commercial Energy Association (ICOM) is one of the key bodies representing UK interests on the various technical committees involved, working with other bodies to try to achieve the right balance between regulation and practicality. Compromise is inevitable but the overall direction is forward, and that's what counts.



A word on multi technology heating

Report sponsor Baxi Heating UK's commercial companies, Andrews Water Heaters, Potterton Commercial, Remeha Commercial and SenerTec, outline the benefits of hybrid heat systems in delivering substantial cost and carbon savings

Within a matter of months, the government will announce its fifth carbon budget, making it even more vital for designers to start thinking outside of the box when it comes to heating and hot water system specification. But often it's not just individual components of a system that are important - a combination of products working together can also greatly increase efficiency.

"Multi-technology heating systems deliver a number of key advantages," says Mike Hefford, head of low carbon technologies at Remeha Commercial.

"The first is improved reliability, as hybrids offer built-in redundancy that allows the system to supply continuous heating even if one technology should fail.

"Well-designed and fully-integrated hybrid systems can also maximise the system's overall seasonal efficiency. Take combined heat and power (CHP), for example, where a well-sized system will supply all the electricity and heat in the building. As the thermal output from CHP is a by-product of the electrical output, often the most efficient solution is to specify condensing boilers in conjunction with CHP units, with the boilers meeting the supplementary heat requirements."

It's an approach that's echoed by Neville Small, sales director at Potterton Commercial.

"While CHP and biomass are more than effective as the lead heat source for a centralised system, it's important to remember that the heat load required for a building can fluctuate, and that gas boilers should be an integral part of any hybrid system to ensure any increase in demand can be met."

Headlines last year suggesting projected shortfalls against the fourth carbon budget are a cause for concern for specifiers, as pressure to further reduce emissions through the built environment can only increase. Here too, hybrid systems can help.

"The UK is still highly dependent on gas as an energy source for heating," continues Hefford. '"Bolting on' fully-compatible low-carbon technologies such as gas absorption heat pumps (GAHPs) and CHP units to an existing boiler room to form a well-controlled hybrid system is a practical, affordable route to a lower carbon footprint."

Some specifiers have already begun experimenting, achieving new standards in carbon and energy efficiencies, as Gary Stoddart, general manager at SenerTec explains.

"We partnered GSHPs with CHP at Notre Dame primary school in Glasgow, creating a system that delivers substantial cost and carbon savings.

"If the heat from the CHP is not needed to produce hot water, it automatically diverts to the GSHPs, replenishing the 100 metre-deep boreholes from which they take their energy. This ensures a steady, efficient supply of heat during times of high heat demand. As with all effective CHP systems, here the CHP was sized according to the hot water base load."

That method to sizing CHP is vital, says Chris Meir, sales director at Andrews Water Heaters. "When it comes to working alongside water heaters in a hybrid system, CHP units should effectively be designated as the lead heat source, providing pre-heated water to the water heaters via storage or buffer cylinders."

"When integrating low carbon technologies into a water heating system, where possible it is beneficial to source all components from the same experienced manufacturer or group of brands. They will have in-depth knowledge as a group about the products, and will understand how best to combine them – resulting in better design and best practice installation."

Looking forward, as the industry awaits word on the Government's strategy to fulfil its Paris Agreement commitments, it's essential that integral systems are designed as efficiently as possible. Combining low carbon technologies in a hybrid system offers a future proof, highly efficient solution that delivers energy and cost savings.

James Porter, Sales Director, Remeha

Gary Stoddart, general manager, SenerTec

Chris Meir, sales director, Andrews Water Heaters

Neville Small, sales director, Potterton Commercial

Published by

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