

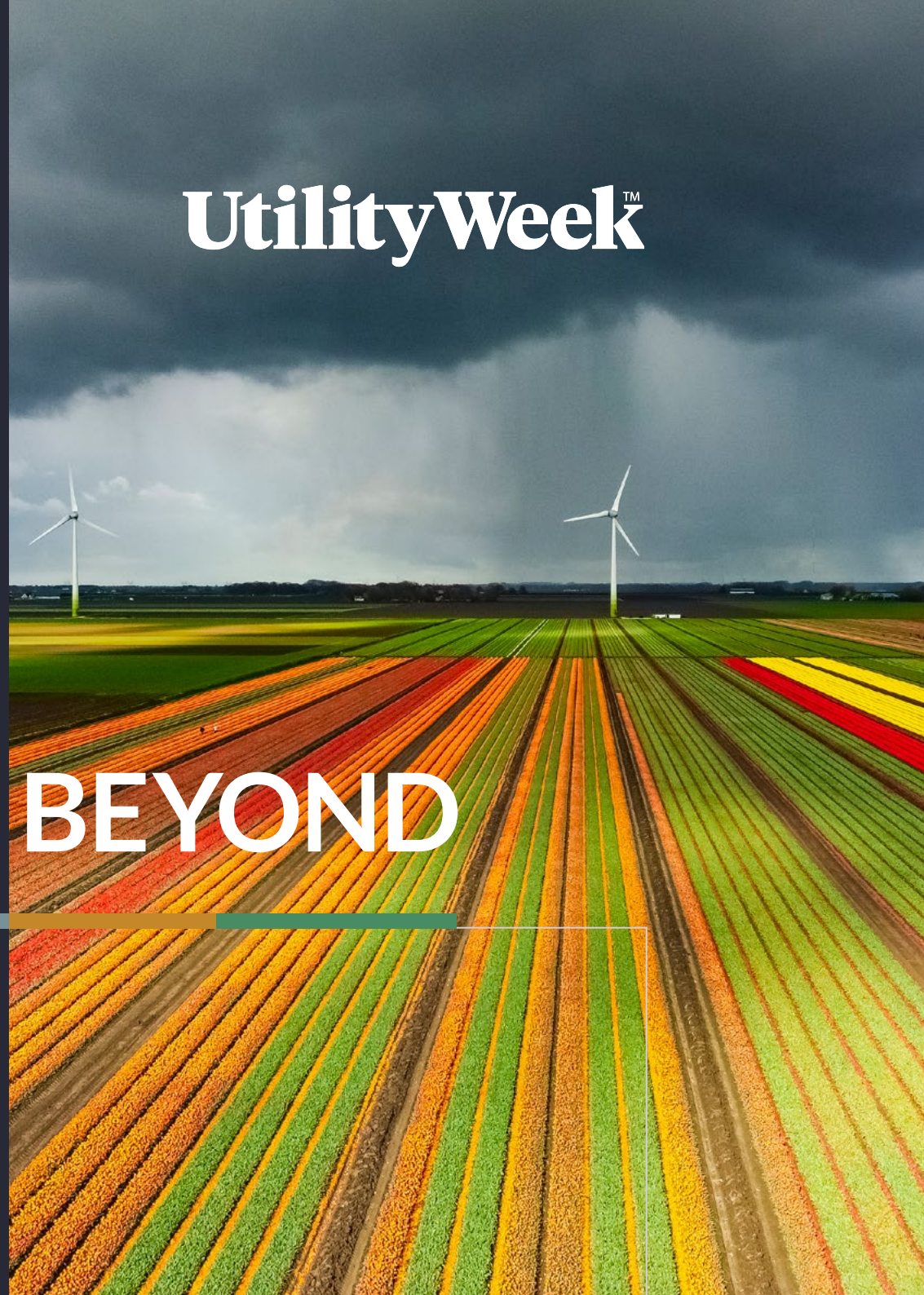


UtilityWeek™

COP26 AND BEYOND

How UK utilities are fighting
climate change

A Utility Week Insight report in association with Capgemini
October 2021



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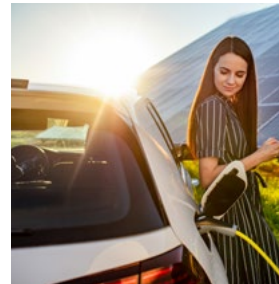
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We need people power too

Time to get the public's buy in to help utilities meet their net zero goals, says **Capgemini's Alain Bollack.**

UK utilities have accepted their responsibility to fight climate change. The UK energy mix is progressing towards full decarbonisation with great successes in offshore wind farming, an accelerated removal of coal and the resurgence of nuclear power generation.

The government has shown vision and leadership, establishing the clear, committed date to end the sale of combustion engine cars by 2030, and we can only expect an ambitious plan to transition away from gas heating in the remaining 23 million UK homes.

For the citizen, there is still a lot to do over the next 10 to 15 years to translate the government plan into our day-to-day reality. Consumers will have to make very important decisions regarding their energy consumption. They will have to move from petrol cars to electric vehicles. Gas cookers and boilers must be replaced with eco-friendly alternatives, such as induction technology or combined heat and power. They will also have to invest in insulation to satisfy new energy performance certificate

rating legislation; without this, homeowners will be unable to rent or sell their properties. Such a substantial requirement places a hefty financial burden upon households - the government must consider how to improve the affordability of such a project.

Can we collectively manage the costs of our net zero ambitions? Who will pay for it? Should we create means-tested subsidies? These are the future debates we need to address to ensure we do not lose consumers on the journey.

A big thank you to all the contributors to this report. Industry leaders from the energy and water sectors and consultants from Capgemini have shared their vision, projects and experience on the path towards net zero. I hope you enjoy reading the progress we have made so far.



For the citizen, there is still a lot to do over the next 10 to 15 years to translate the government plan into our day-to-day reality."

Alain Bollack is utility retail leader
Capgemini Invent

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Introduction

COP26 AND BEYOND



A time to shine and influence

Utilities in the spotlight as COP26 nears.

The UK's achievements and ambitions in tackling climate change will come under great scrutiny in November when 30,000 delegates from over 200 countries descend on Glasgow for COP26. As government policy and leadership comes under the spotlight, the global gathering will also provide a chance for utilities, which act as government's most important net zero delivery partners, both to shine and to influence.

The COP26 summit at the Scottish Events Campus (SEC) on the banks of the Clyde will bring parties together to accelerate action towards the goals of the Paris Agreement and the UN Framework Convention on Climate Change. The treaty agreed in 2015 was to limit global warming to well below 2, preferably to 1.5 deg C, compared to pre-industrial levels.

Ahead of the summit, countries are being asked by COP26 chair, cabinet minister Alok Sharma, to come forward with ambitious 2030 emissions reduction targets that align with reaching net zero by the middle of the century.

To do this they will need to accelerate the phase-out of coal, curtail deforestation, speed up the switch to electric vehicles and encourage investment in renewables.

The recent turbulent few weeks in the energy markets would not be the government's ideal build-up for the programme. But in terms of tackling climate change, the UK can hold its head up higher than many western nations. Progress may not be at the pace demanded by environmental protesters, but thanks largely to the success in delivering green fuel to industry and homes, Sharma will be able to legitimately claim the UK is leading the way.

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Meeting all of these taxing targets still to come requires energy leaders and their teams to demonstrate vision, ingenuity and partnership".

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As the minister notes on the COP26 website, between 1990 and 2019, this country achieved record clean growth. In that time, the economy grew by 78 per cent and emissions decreased by 44 per cent. That, claims the government, is the largest reduction in the G7.

Sharma says: "In 2012, 40 per cent of our electricity came from coal. That figure is now less than 2 per cent. The UK was the first country to pledge to reduce carbon emissions by 78 per cent by 2035, we will completely phase out coal power by 2024 and will end the sale of new petrol and diesel vehicles by 2030."

Energy firms have rolled up their sleeves since 2015. Meeting all of these taxing targets still to come requires energy leaders and their teams to demonstrate vision, ingenuity and partnership.

As this report highlights, they are embracing the opportunity and grasping the challenges, from increasing renewables generation to smartening the networks and trialling hydrogen, as well as incentivising customers to deliver energy back to grid. And all the while, dealing with increased demand for power and water and a cast-iron requirement to keep the cost of infrastructure down. As just one example of the scale of the challenge, since 1985 population growth and the rise of domestic appliances has increased the amount of water used by the average household in the UK by 70 per cent.

But meeting net zero targets will also need countries to protect and restore nature and biodiversity - the very source of life itself - on an unprecedented scale. Government is also

pledging to spend at least £3 billion of its international climate finance in the next five years on nature and nature-based solutions and planting trees on 30,000 hectares of land per year by 2025. As collectively one of the country's biggest landowners and custodians of its precious water resources, water companies too will hold the key to delivering on these aspirations. They are already rewilding land, working in partnerships with farmers to improve soil quality and helping to restore chalk streams and rivers and re-stock them with marine life.

Meanwhile, their pledge as a sector to achieve net zero by 2030 is itself world leading. This report explores the important work water and distribution companies are undertaking as they take environmental stewardship to another level.

The report is arranged around the critical junctures facing utilities: establishing the right generation mix, building security and resilience, ensuring adequate flexibility and the right approach to heating; and boosting biodiversity. Our research draws on the opinions and expertise of many industry leaders and what they see as being the key decisions needed around regulation, finance and policy.

To meet these zero carbons ambitions, energy and water companies will need to pull off a remarkable transformation and turn what only a few years ago might have been considered impossible into business as usual.

We explore these demanding and exciting plans in the following pages.

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Power struggles ahead

Will tried and tested renewables like wind and solar get us over the line to net zero by 2050 or will other technologies need to come into play? As demand for green electricity soars, we ask the experts what they think is the right generation mix.

When delegates from across the world finally converge on Glasgow for the UK-hosted COP26 climate change summit the home nation will have a good story to tell, at least in terms of decarbonising its power system.

As energy secretary Kwasi Kwarteng boasted in his first speech to an in-person audience in early September, the UK has reduced its carbon emissions by around 45 per cent over the past three decades.

Much of this reduction is due to the near eradication of coal, the most heavily emitting fossil fuel, from the power system by 2024. It also reflects a big increase in the role of renewable energy, which now typically provides more than 40 per cent of the nation's electricity generation requirements.

The reduction in emissions must also be seen in the context of an increase in the country's overall population from 57 million to 67 million since the early 1990s, points out Paul Spence, director of strategy and regulation at EDF Energy.

Over the same period the UK economy has grown by 80 per cent, meaning that the UK can justifiably tout itself to COP delegates as an example of how it is possible to decouple economic growth from rising emissions.

The UK's success in cutting generation emissions has been a "fantastic achievement", facilitated by "incredibly effective policy measures", says Lindsay McQuade, CEO of Scottish Power Renewables.

Citing the scheme that obliges suppliers to source a proportion of their power from

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renewable sources, she says: “The Renewables Obligation got a bad reputation, but it did what it was intended to do, fostering an industry and giving us the head start that the UK has had in decarbonisation of the electricity sector.”

Meanwhile the introduction of a carbon price provided a “very clear signal” to reduce coal production, says Spence, adding that the CfDs (contracts for difference) have done a “very good job” at helping to cut the cost of capital for low carbon technologies and wind in particular.

Lucy Whitford, managing director for UK and Ireland at renewable developer RES, says the low carbon subsidy regime has facilitated technological innovation that has boosted the size and efficiency of the wind farms developed off the UK’s coast.

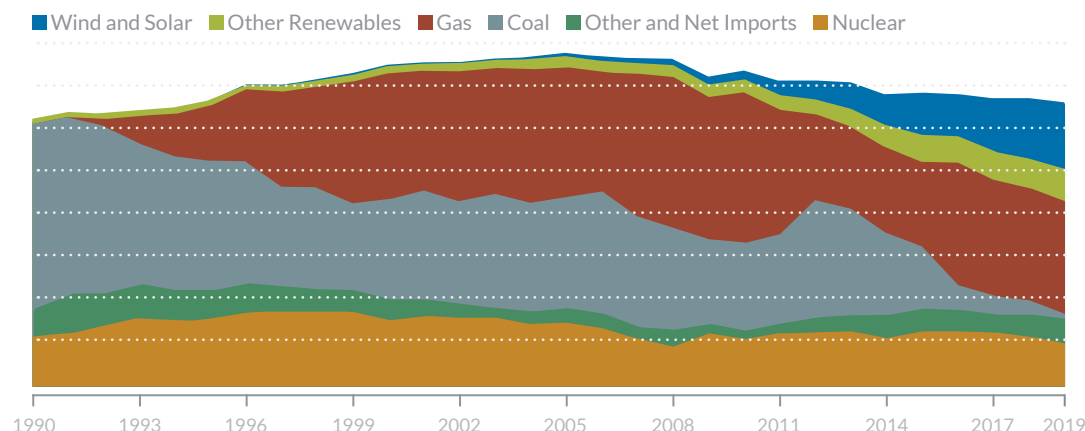
The UK’s ability to wean itself off coal has also been assisted by a suite of gas-cooled reactors, which were due to come offline during the last decade, generating about 30 per cent more power than expected, says Spence. “We have had a decade of low carbon luck: we got fortunate.”

|| Spending half a trillion on batteries and maybe carpeting the whole of central Manchester with containers with those doesn’t make sense for the system as a whole.”

Paul Spence, director of strategy and regulation, EDF Energy

Electricity supplied by fuel type, 1990 to 2019

Source: UK Energy in brief 2020, BEIS



New frontiers

The decarbonisation task is far from done. “The UK consumes about 2,000 terrawatt-hours (TWh) of energy per annum, including oil and gas, so we have to source that amount of energy,” says Peter King, global head of energy and utilities at Capgemini Invent. And to put that into context, only around a quarter of the UK’s energy’s needs are currently provided by electricity, he says.

The next stage of UK decarbonisation will involve electrifying areas like transport, which remains overwhelmingly reliant on fossil fuels and has recently overtaken power generation as the UK’s main source of emissions.

Will Steggle, head of strategy at SSE, says: “We’ve made good progress: now we are into decarbonising new sectors that are more difficult to abate and there is more requirement for customer engagement.

“It’s tempting to say that we are done but we are really not.”

The past year has seen record sales of electric vehicles, which made up one in ten of every new car sold in the UK during August, outstripping diesel for the first time. Within the context of the overall road fleet though, EVs remain a drop in the ocean.

However, the phase out of sales of new internal combustion engine vehicles from 2030, the government’s target date, means that after 2040, cars and vans will be almost exclusively electric powered, says Matthew Wright, head of strategy and regulation at National Grid ESO (Electricity System Operator).

This increased take-up of EVs, combined with the anticipated electrification of much home heating has fuelled the ESO’s forecast that the UK will need two to three times as much electricity generation by 2050 as it does now.

“We’re seeing constant increases in electricity demand going forward,” says Wright.

McQuade accepts the ESO’s core analysis. “We will need at least twice as much electricity on the

network to be able to serve demand and four times as much renewable generation,” she says. At the Conservative Party Conference in Manchester, Boris Johnson pledged that all electricity would come from renewable sources by 2035 without saying how.

The key issue for policy makers, therefore, is to establish the energy mix that will be required in 2050, says Capgemini’s King: “We need to start at 2050 and work back: then the picture becomes clearer. If you are going to base policy on 2050 it is solar, wind and nuclear with potentially gas if carbon capture can be solved.”

The right mix

So, what does the right generation mix look like in the net zero world?

ESO sees offshore wind power as the main source of generation by 2050, which tallies with the government target to quadruple existing levels of this source of power to 40GW by 2030. By 2050, the BEIS (business, energy and industrial strategy) department envisages that this level will have increased to 100GW.

“The bulk of energy will come from wind and other renewables, but particularly offshore wind,” says Steggles.

Relying on renewables brings its own challenges in terms of having strategies to deal with times when the wind doesn’t blow, for example, which we discuss in Chapter 3. The Climate Change Committee’s advice to government is that testbed technologies, like direct air capture of emissions from the atmosphere, cannot be relied on to deliver the level of decarbonisation required by 2050. In other words, we cannot wait for the miracle technology solution to change our energy mix. The known technologies and solutions are well tested and affordable.

The Renewables
Obligation got a bad reputation, but it did what it was intended to do, fostering an industry and giving us the head start that the UK has had in decarbonisation of the electricity sector.”

Lindsay McQuade, CEO,
Scottish Power Renewables

The critical nature of the 2050 timeline for delivering net zero means, McQuade agrees, that the power sector must concentrate on proven technologies, like solar and wind.

The precise split of the generation mix by 2050 depends on which technologies work and can be delivered economically, says Spence: “The answer is bit more of all those technologies.

“We need policies in place to keep up momentum, do the no-regrets bit while we find out about some of the uncertainties over the next five to ten years and then the government can fine tune after that.”

Nuclear would also appear be returning to the front of mind in government, with reports in the national media that building a second - and possibly a third - nuclear station was gaining favour as were reports of government potentially backing small modular reactors.



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Barriers to delivery

In the UK, RES's Whitford believes that the main barrier to delivery of renewable generation is access to finance.

"The investment community is there and companies have the ability to develop and operate projects but we need the right policy and regulatory framework and stability," she says, identifying a gap between the UK's policy on renewable energy and the mechanisms for implementing it.

"In the UK, the high level is there but not the detail," Whitford says, adding that certainty around the CfD process doesn't extend beyond the next auction at the end of this year.

"Beyond Round 4, we don't have certainty about what will be there in the future. We need a lot more certainty about grid infrastructure and facilitating the shift to net zero: it's the stability in the market that allows us to drive investment decisions and bring forward the pace and volume of development."

We're putting all our renewables eggs in one climatic basket. It is an absolute no no to draw all your power from one system: diversity is where security lies."

Simon Forster, director,
Shearwater Energy



Getting more timely decisions through the planning process would help too, she says, noting that taking an onshore wind farm from initial discussions with the landowners to opening can take eight to ten years.

Planning is also "definitely an issue" across western Europe, says Philippe Vié, group vice president-energy & utilities at Capgemini. The process is "too complex and too costly", compared with North America where getting projects approved in relatively sparsely populated areas is easier, he says. Vié, editor of Capgemini's World Energy Markets Observatory report published on October 21, points out that in the US only 22 per cent of energy supply currently comes from electricity, the rest is made up of burning gas and oil and of that electricity generation, only 10 per cent piece comes from nuclear and renewables.

Technology options

While North Sea offshore wind is often touted as the backbone of the UK power generation sector, other sources of power will have a crucial part to play, says Whitford.

Simon Forster at Shearwater Energy, which is developing a project that combines small modular nuclear reactors on the Isle of Anglesey and offshore wind turbines off the north Irish coast, capturing Atlantic wind, argues that it is risky to rely on so much resource in one area. "We're putting all our renewables eggs in one climatic basket. It is an absolute no no to draw all your power from one system: diversity is where security lies."

He argues that the UK cannot solely rely on the North Sea because wind speeds there are dropping because of climatic changes.

Solar power has a role to play, says Spence, pointing to EDF's partnership with Tesco to install PV panels on the roofs of the supermarket

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giant's superstores. This works for Tesco, which tends to need most power during the summer and daytime to run its chiller cabinets and air cooling, which is also when solar panels typically generate most power. The partnership offers an example of how solar generation correlates with demand for electricity, he says.

However, the contribution of solar power in the UK will be limited, says Steggles: "Solar provides some useful smoothing effect, but we are a wet and windy country so it won't have as big a role as will have in southern Europe or North America where you have more solar radiation. "It has a role, but it is clearly smaller than wind."

And solar, like wind, is an inherently intermittent source of generation. "There are days when solar and wind farms don't produce any power and it has to be supplied from elsewhere," says Wright.

However, the less intermittent but commercially unproven wave and tidal marine technologies are uncompetitive with wind, says Steggles: "Off shore wind costs have come down so much and it's so scalable, it's difficult to see a role for wave and tidal. The costs are so high and the number of sites viable for tidal in particular are limited."

McQuade agrees: "At a time when energy bills are really important to people, we need to be sure we are making the right decisions."

|| We have had a decade of low carbon luck: we got fortunate."

Paul Spence, director of strategy and regulation, EDF Energy

Interconnectors have their limits

For the UK government, one of the key planks for maintaining the future stability of the grid will be the growing numbers of interconnectors that enable electricity to be traded with neighbouring countries like France and Norway.

Despite the UK's departure from the EU, policy makers assume that these fixed links are set to provide a growing share of power, helping to mitigate the ebbs and flows of a more intermittent electricity system.

EDF's Paul Spence says that interconnectors will "be part of the future answer". However, the company's experience of operating on both ends of the cables that link its home country with the UK means that EDF is cautious about over-reliance on interconnectors.

"We are not as confident as some of the modelling we have seen from the Climate Change Committee and the National Infrastructure Commission, who have more aggressive assumptions on interconnectors," he says.

The problem is that the weather patterns do not change much between the UK and its immediate neighbouring countries, meaning for example that the wind will tend to be blowing at the same time on both sides of the English Channel. Spence says: "You've got to go a long way, to the Iberian Peninsula, before you see genuinely different wind and weather patterns and a different solar footprint.

"If you can't export because they have wind at the same time, you will have to turn those wind farms off, not allowing them to produce economically. Therefore, the load factor goes down and the cost per unit goes up."

As a result, he argues, the UK must ensure that it has control over its own energy destiny by tapping all available sources of production and using interconnectors to finetune the grid.

The UK's requirement for inter-seasonal balancing points towards a big role for green hydrogen generation, says SSE's Steggles: "We have very strong winter peak demand with big swings in seasonal demand. We need firm capacity that can generate in winter, which is why low carbon thermal or gas with CCS is a key technology for the UK because you can store gas across seasons which makes it particularly well suited to the UK.

The UK has old gas fields that can be used to store carbon dioxide and huge renewables resources that can be used to generate green hydrogen. I struggle to think of another country better suited to low carbon thermal [generation]."

Flexibility is discussed in more detail in Chapter 3

A role for baseload?

Nevertheless, the low wind speeds seen during this summer and autumn which have helped to drive up energy prices, have provided a powerful reminder of the risks of relying on such intermittent source of power. As King says:

“We need to match supply and demand in near real time, which we can’t do at the moment.”

Key to solving this conundrum will not be additional generation but using flexibility to make more efficient use of the system’s assets, says ESO’s Wright.

Maximising flexibility resources, such as the EV batteries which will provide massive additional storage capacity when vehicle-to-grid charging has become commonplace, could deliver system savings of up to £16 billion per annum, according to the ESO’s research.

However, lithium ion batteries can store electricity only for short periods, which means that they will not be able to help with the longer duration and even inter-seasonal balancing that the grid will require, says Spence: “Even if all UK cars are free batteries on wheels, there is only enough capacity to store energy for half a week.”

“We need to start at 2050 and work back: then the picture becomes clearer. If you are going to base policy on 2050 it is solar, wind and nuclear with potentially gas if carbon capture can be solved.”

Peter King, global head of energy and utilities, Capgemini Invent



Nuclear power is the only tried and trusted source of low carbon, firm power, says Capgemini’s King: “You need a baseload technology there to keep the lights on and the only proven technology for doing that is nuclear. The alternative is gas but it must be discounted on the basis that it is a fossil fuel.”

EDF has calculated that between 10 and 20GW of nuclear capacity will be required during the next decade to provide low carbon power when wind speeds drop for prolonged periods

of one or two weeks, says Spence: “Our model shows it is a cheaper solution for consumers than any other system even with pretty aggressive assumptions about energy efficiency, cost reductions on batteries and renewables.”

“Spending half a trillion on batteries and maybe carpeting the whole of central Manchester with containers with those doesn’t make sense for the system as a whole,” he says.

However, while nuclear may a low carbon technology, it comes with plenty of downsides, says McQuade: “It is expensive compared with renewables and the build time is much longer, which is key when considering a transition as quickly as possible to a net zero economy.”

And Wright questions whether the traditional notion of baseload power, which provides power on a constant basis, will be relevant in the power system of the future. The sheer size of generation capacity that 100GW of offshore wind could deliver will overcome some of the problems associated with the intermittent nature of the power that it produces.

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You need a baseload technology there to keep the lights on and the only proven technology for doing that is nuclear."

Peter King, global head of energy and utilities, **Capgemini Invent**

Noting that the typical offshore wind farm will be generating some electricity 90 per cent of the time, he says: "They are running at some level most of the time and the days when they don't run at all are comparatively few and far between.

"There will be so much installed capacity that a certain amount of the baseload needs of the system could be comfortably supplied by installed capacity. Certainly, in the summer, solar is becoming much more efficient and predictable. There will be times when we have lots of generation at pretty much zero cost, available on the system."

With bigger and more advanced turbines, which are able to operate at load factors of around 50 per cent, a combination of solar, wind and large-scale storage will be able to deliver near baseload levels of capacity, says McQuade.

Coupled with large-scale storage, this offshore capacity will be able to simulate the baseload capacity currently furnished by gas and nuclear plants. She says: "Ultimately you have a nice mix of clean generation with a degree of resilience built in, which in terms of baseload is what we are seeking to deliver."

We will need at least twice as much electricity on the network to be able to serve demand and four times as much renewable generation."

Lindsay McQuade, CEO, **Scottish Power Renewables**

Wright agrees: "There will be a need for generation to fill gaps but it may be better providing peaking plant than traditional baseload."

This analysis leaves nuclear as "an answer in search of a question", says Steggles. "If it is taken as a given that we will have a wind-dominated system, you need flexible technologies and you don't need baseload technologies, which take us further away from the system we need."

Research carried out by SSE suggests that building 20GW of offshore wind instead of 8GW of nuclear could deliver customers £7 billion, says Steggles: "Technologies can comfortably deliver a system that avoids the need for nuclear: we don't see strong need for nuclear."

However, there will be a limit to the amount of offshore wind that can sensibly be rolled out, says Spence, because there will come a point when much of it will not be needed most of the time. "If you build too much, the last one you build is not worthwhile."

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Strength in numbers



The challenge of improving network resilience and water infrastructure as the chance of flood, droughts and other extreme weather events increase means it is vital companies work together, and with regulators and the government.

Germany suffering its worst flooding in living memory; deadly wild fires in North America, Greece and Italy; or, closer to home, the rare sight of the Thames bursting its banks. This year has already seen more than its fair share of extreme weather events.

And the worrying truth is that these events are likely to become the norm, rather than an exception. This year's Intergovernmental Panel on Climate Change (IPCC) report provided a sobering analysis of the impact man-made climate change has already had and will continue to have in the near future. It has served as a wake-up call for governments, most of whom already had climate change close to the top of their agenda.

But what of the utilities sector? How much - if at all - have the increasingly stark warnings about climate change brought about a rethink in how utilities invest in their assets to ensure resilience? And how sure can we be that services will continue to be delivered through the unprecedented energy transition of the next 10 years and beyond?

For Giles Stevens, director of policy at the National Infrastructure Commission (NIC), the case for investment in resilience is strong, regardless of the latest warnings about climate change, especially given the greater interconnectedness of infrastructure assets.

"Even without the threat of climate change, you'll need increased investment in assets that

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are going to suffer from future deterioration or failures,” he explains. “We’re much more aware of systemic failures now, where one system knocks on to another. So I think there is a case for investment but obviously climate change puts a real onus on action now.”

The NIC last year set out a framework for resilient infrastructure, based on five actions: anticipate; resist; absorb; recover; adapt/transform. Within that framework, the commission drew up three broad recommendations that could improve resilience in the face of greater and more frequent threats to service delivery. These are: establish clear resilience standards; regular stress testing for infrastructure operators; and ensure that operators and regulators focus on long-term resilience issues beyond price review periods.

As Stevens says, explaining why the NIC focused on these recommendations: “My personal worry from experience is that naturally things are only looked at when they go wrong.”

He cites the 2018 “Beast from the East” storm, which disrupted water supply across the country, as a moment that demonstrated how unprepared some companies are for extreme events.

“That brought home to people the importance of the reliance on water supplies, and that companies hadn’t prepared sufficiently and didn’t know how to get alternative supplies. There was a real variance in how to think about this,” Stevens recalls. “Some companies were really quite on the ball; they were getting weather forecasts early on, they were reacting a good five days out, and therefore getting alternative bottle supplies ready, letting other utilities know and working together, thinking about vulnerable customers.”

On the other side of the fence, Stevens says some companies responded only to events as they happened, with one - he claims - only

“We can’t have 12 hours without supply anymore. We know we need to be more resilient than that. It isn’t just about climate change in isolation; climate change is one factor in big resilience picture that is about making sure UK PLC can carry on.”

Carl Ketley-Lowe, engineering policy manager at **Western Power Distribution**



providing bottled water for customers five days after the storm hit.

His reflection on the interconnectedness of services and therefore the need for utilities to work across different sub-sectors to prepare for extreme events is echoed by others in the industry.

Carl Ketley-Lowe, engineering policy manager at Western Power Distribution (WPD) - a DNO that delivers electricity to more than 8 million people across an area larger than 50,000 square kilometres - agrees that utilities can no longer afford to operate in silos.

“As an industry, we’re definitely seeing an increase in flood zones that would affect our assets,” he tells Utility Week. “And we’re starting to look at whether these flooding events would

affect all the utilities: telecoms, gas, water, and then how the electricity [supply] brings all of those different assets together. That’s because quite a lot of the time now, the electricity is a central point for those things to work, because if it goes off you tend to not be able to pump or supply. So we’re looking at resilience in the wider round.”

Part of that different way of looking at resilience planning is driven by the energy transition, which is only likely to increase our dependence on a reliable power supply. “We make sure that our resilience plans don’t just focus on the asset itself,” says Ketley-Lowe. “It’s about a bigger picture nowadays because we’re facing the move to electricity, whether that be for your heating or your vehicle.



It is not just about the assets themselves needing to become more resilient. Our systems and services need to be more resilient because that is what customers want, and this is on top of the impacts of climate change."

Steve Wilson, managing director of wastewater, business customers and energy, **Welsh Water**

"We can't have 12 hours without supply anymore. We know we need to be more resilient than that. It isn't just about climate change in isolation; climate change is one factor in big resilience picture that is about making sure UK PLC can carry on."

To illustrate the more interconnected nature of utilities' resilience planning, WPD's latest adaptation report to DEFRA, submitted this year, includes references to gas networks for the first time. "There's no point spending a couple of hundred million pounds making something very resilient from a gas regulator point of view for the electricity to go off next to it and it's not able to be used," explains Ketley-Lowe.

Among a range of interventions that WPD has carried out to improve resilience across its network, the DNO has installed lightning protection on all pole-mounted assets, such as transformers, cable boxes, surge diverters and surge arresters. If these assets are struck by lightning, the energy is diverted into the ground to prevent failure and potential outages. Ketley-Lowe continues: "The overhead network then tends to go off and come back on, which isn't a sustained interruption, and we don't lose the asset."

He says that the work has meant "a small cost increase at the point of installation" but this is balanced by the increased longevity of the asset.

"We have seen a reduction in the number of failures on those types of asset through lightning storms," he adds. "That small investment upfront makes quite a big difference."

UK Power Networks is another DNO that has been investing heavily in resilience in recent years. It's annual spend on maintaining safe and reliable supply throughout its network is around £600 million. It has spent £11.2 million on permanent flood defences to protect substations since 2010 as part of its Distribution Price Control Review 5 (DPCDR5) and RIIO-ED1 commitments. This year, it has spent around £19 million on trimming tree branches away from electricity lines.

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Northern Powergrid, meanwhile, says that understanding the risk of and preparing for adverse weather events is one of its major focuses throughout the RIIO-ED2 regulatory period. It is investing £22.5 million in climate resilience through RIIO-ED2, with the majority going towards flood protection, while a further £16 million is already earmarked for 2023-28.

However, Peter Collinson, Northern Powergrid's investment planning and delivery manager, points out that bespoke adaptations to counter extreme events "don't always present the best value for customers".

"Resilience is not just about making the assets stronger so that they can resist climate change impacts," he adds. "It's also about how you respond and recover if your defences become overwhelmed. Therefore investments to recover supplies more quickly can be used to restore under multiple fault scenarios and can present better value for our customers."

Monitoring and analysing performance data in real time can be just as - if not more - valuable as building concrete flood barriers.

The best way to track how a changing climate will affect our assets is to gather as much information as possible."

Peter Collinson, investment planning and delivery manager, Northern Powergrid

"The best way to track how a changing climate will affect our assets is to gather as much information as possible," continues Collinson "By doing this we can understand what the changes are, how this will affect equipment and what measures need to be taken on the ground and in the future to maintain asset resilience. We are already starting to do this on the low-voltage network gathering real-time condition data enabling us to predict where faults are likely to occur and repair them before they fail."

This approach is very much in line with the NIC's instruction to utilities to "anticipate" and "adapt" when faced with the impact of climate change. But each of these actions comes at a price, and there is an inherent tension when some cost is inevitably passed on to customers.

In the water sector, that tension is captured in Ofwat's methodology for its 2019 price review, which embedded "securing long-term resilience" as one of its defining principles. In its methodology for the price review, the regulator states: "We expect companies to undertake a systematic and integrated assessment to understand the risks to resilience across the entire business, and mitigate these risks in the way that provides the best long-term value for money for customers."

Steve Wilson, managing director of wastewater, business customers and energy at Welsh Water, acknowledges that the expectations of both customers and regulators alike are higher and that more investment and better planning are needed to meet them.



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Improvement needed

"We will need to do more to ensure our systems and services remain at least as resilient as they are today," he says. "Some will have to improve further if services are to be maintained at current standards. This has to be seen against the context of customers' increasing expectations of improving resilience - and so services - at a time when climate change and other factors are making that more difficult to achieve. It is not just about the assets themselves needing to become more resilient. Our systems and services need to be more resilient because that is what customers want, and this is on top of the impacts of climate change."

There's an absolute onus on them [utilities] to think more about the impacts on their customers."

Giles Stevens, director of policy, the National Infrastructure Commission

Wilson says that the challenge of improving network resilience as the chance of flood, droughts and other extreme weather events increases demands that companies work together with regulators and the government. In part, he says, that's driven by the demands of customers. "Customers find it difficult to place a value on avoidance of a rare event of which they have no personal experience," he explains. "With climate change, there is a degree of uncertainty on what that future looks like with multiple possible scenarios, and customers may well ask, 'what future should we plan for?' This is why government and regulators need to work alongside the industry and be bold, to protect the interests of future generations."

Conversely, Giles Stevens at the NIC insists that if utilities are to weather the storm of climate change and build more resilient network, they can't wait to be told what to do. "There's an absolute onus on them to think more about the impacts on their customers," he says. One thing they should do, Stevens adds, is develop much longer-term investment models, detached from the five-year cycles of price review periods. Nevertheless, he agrees that it is only by working together with policymakers that this kind of investment and planning will come to fruition.

"The need is absolutely there for companies to be thinking about this, as is the regulatory framework and the government direction to tackle climate resiliency," he concludes. "It has to happen, and we need to make those decisions now."



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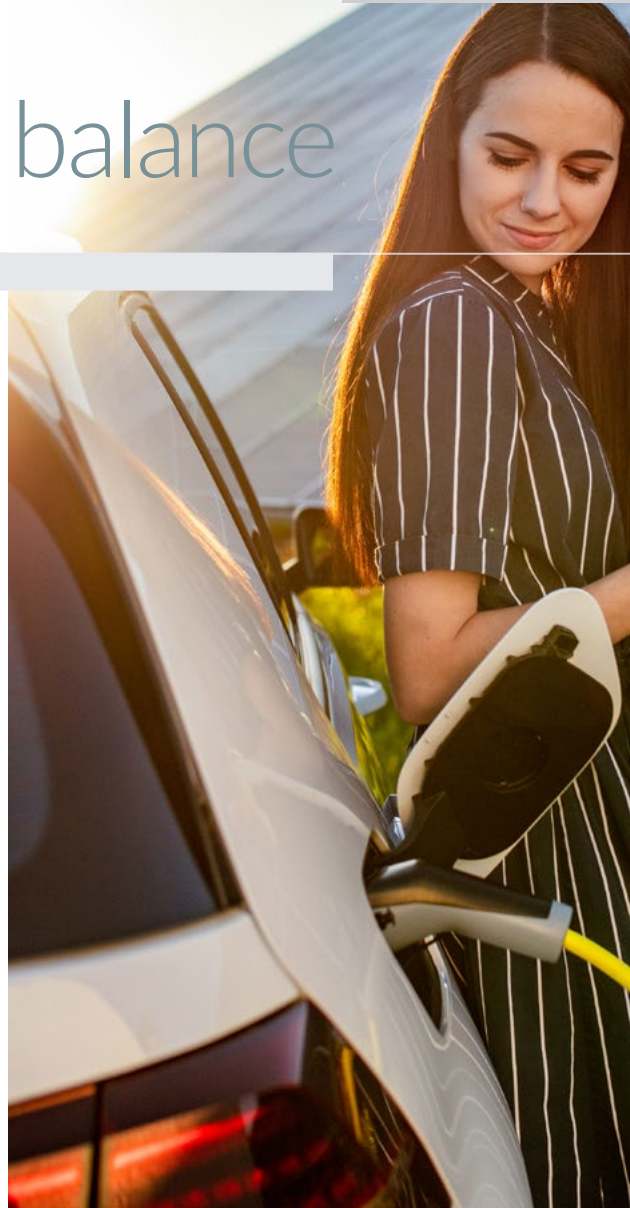
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It's in the balance

Balancing the supply and demand of energy is a crucial but highly complex part of the jigsaw puzzle that moving to net zero represents. To be affordable, decarbonisation will require energy to be used and stored in new ways, and consumers to be engaged. Can the sector deliver?



Over the past few weeks we've witnessed at first hand just how difficult balancing up the energy system can be. Most consumers take for granted that electricity and heating is only the flick of a switch away. Yet soaring wholesale gas prices - 10 times more than in June 2020 - plus a lack of wind, damaged interconnectors and ageing nuclear power stations out of service for maintenance, have combined to create a crisis. Matching supply and demand has forced National Grid Electricity Systems Operator (ESO) to once again fire up two coal-fired power stations. Even that was not enough to stop two industrial plants making fertiliser from closing down because of sky high prices creating a knock-on interruption to food production. Yet just last year ESO was reporting a 68-day stretch without needing to call on the black stuff.

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For all the UK's undoubted successes on the transitioning path to zero-carbon generation, these recent events have highlighted just how far there is to go in ensuring a resilient and workable energy system as we move towards 2050. There have been a number of factors that have come together to create the 15-year high surge in gas prices, including restriction in supply from Russia and countries returning to pre-pandemic levels of industrial demand and prioritising gas over coal to reduce carbon footprints.

Prime minister Boris Johnson has argued that as we become less reliant on imported gas, energy prices should become more stable. On the other hand, taking coal and then gas out of the generation equation leaves ESO having to find reserves elsewhere. A rise in demand for electricity to provide power for transport and heat makes the challenge of maintaining sufficient flexibility in the system tougher still.

A recent report from Imperial College London forecast that by 2050 the UK could be generating 150GW of offshore wind. But as Dr Jeff Hardy, senior research fellow at the Grantham Institute, Imperial College London, observes: "If the wind isn't blowing that leaves a big hole in electricity - and demonstrates just how important having flexibility to call on will be."

As demand for power increases and more distributed generation assets like electric vehicles (EVs) are connected to the system there is also another dimension to flexibility to think about.

|| If the wind isn't blowing that leaves a big hole in electricity - and demonstrates just how important having flexibility to call on will be."

Dr Jeff Hardy, senior research fellow at the Grantham Institute, Imperial College London



This is ensuring that the capacity of the network to deliver greater demands for power will also be met affordably. In the past as demand grew, it would be fed by installing more cables; but now, to make it economical, networks are being asked to manage extra demand in a smart way, levelling peak demand through local flexibility. That will mean networks won't need to invest to the same degree in upgrading infrastructure.

This "flexibility first" approach will be a key plank of the network's forthcoming ED2 business plans.

Andy Huthwaite, director of ED2 programme at Scottish and Southern Electricity Networks (SSEN) Distribution, explains how the

network has been responding to the changing landscape: "For quite a number of years now we've been taking a flexibility first approach. So if someone wants a new connection which could trigger the need for reinforcement, irrespective of whether that was demand or generation, we've put a range of things in our system that allows us to present flexible options to them.

"In our Scottish Highlands distribution network, for example, we've introduced active network management. That has allowed people to participate and connect to the network without us having to do five years of reinforcement at x million pounds."

However, moving to a more flexible system will still require networks to invest in technology to monitor the network, analyse data and improve communications, says Huthwaite.

The levels of local flexibility contracted by the network operators in 2021 are already 38 per cent higher than the total for the whole of the last year, comments Randolph Brazier, director of innovation and electricity systems

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Getting consumers to flex their muscles

“Flexibility at the consumer level is yet to become business as usual because assets and controls are not yet fully deployed, smart meters are still being rolled out, and commercial propositions are not widely available,” says Maria Brucoli, smart energy systems manager at EDF, summing up the current position on demand-side response in the domestic setting - seen as an essential strand of the energy transition.

The ongoing transition will see smart meters rolled out more widely and hourly residential tariffs put in place, followed by electrification of heating and transportation. “By then, energy and flexibility providers, with the right support from government and Ofgem, will create the right commercial offerings to engage, attract and enable consumers’ interest and actions,” she says.

However, judging by the apathy that has greeted the smart meter rollout, unless industry and government can learn from that, demand-side response from domestic customers could prove elusive.

Simon Osofrot, co-founder of So Energy, is confident that the adoption of EVs will provide the catalyst for greater energy engagement. “EVs do make people understand the kilowatt-hours,” he says. Also, the surge in energy prices could make the benefits of using energy at times when it was cheaper more obvious and incentivise more decisions around usage.

Jeff Hardy, senior research fellow at the Grantham Institute, Imperial College London, says that as we move to a system based on renewable energy, the costs “will no longer be about how much



at the Energy Networks Association. At the moment, flexibility is contracted typically through an aggregator or directly with industrial and commercial customers, says Brazier, but it could develop more widely. “The local flexibility markets only started in the back half of 2018 from scratch and don’t exist anywhere else in the world. The reason why we are ahead of the pack is that policies and regulation are in place to drive adoption.” He cites the ban on sales of combustion engine vehicles, the RIIO model which incentivises networks to be innovative, and the research and development allowance, which allows innovations to be trialled and tested.

Huthwaite points to SSEN Distribution’s ambitious plans for flexibility in ED2, the next price control, and is looking to increase its flexible connections up to about 3.75GW and within that is hoping to procure around 5GW of flexible services from 600MW currently. “That’s a step change for us, but as a country if we’re going to hit our net zero ambitions then the deployment of flexibility is going to be absolutely critical,” he says.

In terms of balancing supply there are broadly four types of flexibility ESO can consider:

- **Flexible generation** - like biomass
- **Electricity storage** - like batteries, hydro power - compressed air
- **Demand-side response** - turning demand for energy up or down, on or off, such as industrial processes
- **Interconnectors** - importing electricity from the continent.

Hardy says this adds up to a diversity of options.

energy you consume; it will be more about when you consume it. And if you consume when the wind blows, it will cost almost next to nothing”.

Giving consumers an opportunity to benefit financially by feeding back into the grid would, say others, help sweeten the cost of paying for net zero - though less well-off and vulnerable customers must not be left behind.

EDF has been trialling a local energy market in Brixton, south London, which aims to bring together local low-carbon generation, flexible assets like small batteries and end users. Brucoli says: “The local energy market trial enables Brixton residents to trade electricity generated from a solar panel system on the roof with one another [peer-to-peer] using blockchain technology, as well as offering flexibility services to the distribution network using our assets as well. The second part of the trial, project Urban Energy Club, looked at how the same energy users can provide flexibility services through a community battery.

“Both projects were successful in delivering value to the participants. Testing the more technical aspects such as the market platform and data/comms infrastructure, reaching and onboarding participants received a lower uptake,” she explains.

Given that half of all consumers never bother to switch their supplier, Hardy thinks the secret of getting consumers involved in demand-side response will be to keep it very simple, or “more or less invisible”.

He says: “The supplier provides the magic in the background - the PV, the battery - all for a monthly cost. The consumer gets reduced bills, the supplier gets the capital of the equipment paid, plus a margin. But it has to be really simple.”

Brucoli says that, going forward, consumers need to be given clear incentives to facilitate the behaviour changes needed and start learning more about the concept now. “There is a fantastic opportunity this year presented by the UK hosting COP26 to engage consumers further with a joined-up narrative that explains in simple terms the steps they can take in their own homes to enable flexibility, both in terms of household energy savings and carbon footprint reduction.”



“The local flexibility markets only started in the back half of 2018 from scratch and don’t exist anywhere else in the world. The reason why we are ahead of the pack is that policies and regulation are in place to drive adoption.”

Randolph Brazier, director of innovation and electricity systems at the Energy Networks Association

“Although demand-side response from the domestic side is currently negligible, you shouldn’t under-egg that - we could be looking at 35 million EVs and 20 million heat pumps, that’s a vast array of things that can be turned on or off,” he says.

Government is aware of the need to use EVs to boost flexibility. It is proposing phased legislation to ensure that all charge points are smart and in time wants to give powers to network operators to be able to delay battery charging for the benefit of the grid. It’s current thinking on this was set out in a paper published in July: Electric Vehicle Smart Charging Government Response to the 2019 Consultation on Electric Vehicle Smart Charging.

Hardy acknowledges that the use of EVs and heat pumps doesn’t provide the answer to the huge variation in demand between summer and winter, but says it does provide a solution to those variations during the day. “However, there is no evidence yet to support what we can deliver this way because the system is not up and running yet.”

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Meanwhile, Huthwaite says that SSEN will be looking at a range of options in its procurement of flexibility. "It could be aggregators, it could be demand-side response arrangements, it could be storage facilities, it could even start moving into vehicle-to-grid if we can get that enabled and open that more widely given the projections of EVs. It's a whole sheet of options."

Right now, flexibility supplied from EVs and heating is negligible and it is acknowledged that scaling this up will require significant consumer engagement. That amounts to a change of mindset in our relationship with energy and will require a number of levers to bring that change about (see box out). Ovo and Octopus have introduced a flexible EV charging tariff to move the demand during the night, but it is too early to see the overall value.

Maria Brucoli, smart energy systems manager at EDF, says that while there is huge opportunity to tap into EVs and heating devices in future, grid scale batteries have a big part to play with another 30GW of growth expected by 2050. "There is currently around 10GW of low carbon flexibility currently available to the UK power market. This includes 4GW of electricity storage (3GW pumped hydro storage and 1GW of lithium-ion batteries) and 6GW of electricity interconnectors," she notes, adding: "There is a growing pipeline of energy storage and interconnector projects, but the final sum is short compared to the estimates from the latest Smart Systems Flexibility plan developed by BEIS together with Ofgem and published in July."

Their report, Transitioning to a Net Zero Energy System: Smart Systems and Flexibility Plan 2021, suggests that to meet the net zero target set for 2050 by the sixth carbon budget, while at the same time operating a secure and efficient energy system, a total of 30GW of low carbon flexibility will be required by 2030 and 60GW by 2050.

However, if flexibility from batteries is to be ramped up, markets need to be developed that put a value on their services. In the past they may only serve one function, but to be commercially viable they need to offer a number of functions - or "value stack", says Hardy, adding: "To make value stacking work the systems needs to know

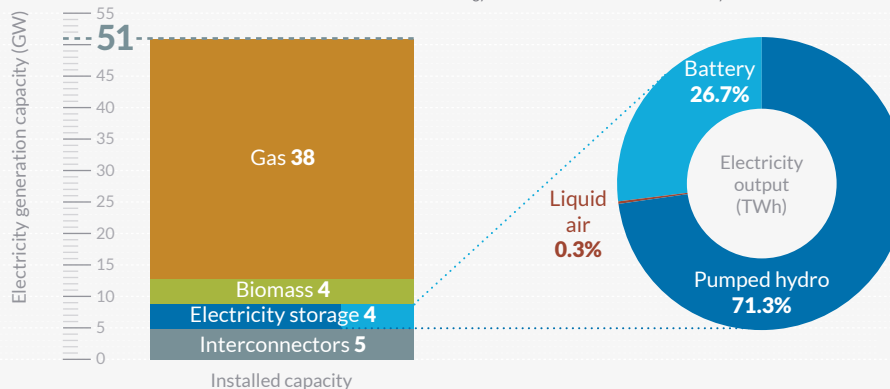
what assets are connected and assets need to realise the value of the action they take."

Brucoli says that EDF is contributing by enabling commercial solutions for large-scale flexibility projects and providing asset owners a "route to market" service with a guaranteed minimum price for battery storage.

"EDF leads the way in offering 'floor price' contracts for battery storage projects, enabling developers to demonstrate returns on investment required to proceed with developing the assets," she says. "EDF Renewables is also developing a battery storage portfolio through its acquisition of Pivot Power."

Installed flexibility capacity in the GB electricity system in 2019

Source: National Grid/ Future Energy Scenarios 2020/Carbon Trust/ Flexibility in Great Britain



As a country if we're going to hit our net zero ambitions then the deployment of flexibility is going to be absolutely critical."

Andy Huthwaite, director of ED2 programme at **Scottish and Southern Electricity Networks (SSEN) Distribution**

Flexibility at consumer level is yet to become business as usual because assets and controls are not yet fully deployed, smart meters are still being rolled out, and commercial propositions are not widely available."

Maria Brucoli, smart energy systems manager, EDF

Long-term flexibility

For all the work going on in this field, government and the industry is yet to get to grips with the scale of flexibility needed in the system, says Dr Keith MacLean, managing director of Providence Policy. MacLean, along with Dr Grant Wilson and Noah Godfrey of the Energy Informatics Group at the Birmingham Energy Institute, have been looking at the flexibility challenge of replacing natural gas. They published their findings in September in a paper Net Zero - Keeping the Energy System Balanced. Says MacLean: "At the moment, the heavy lifting in balancing Great Britain's electricity and heat sectors is done by natural gas, capable of contributing 3-4TWh towards managing imbalance daily, and over 100TWh seasonally.

"We did some work to check on the orders of magnitude of balancing needed in the future. It will be basically the storage capacity that we have with natural gas."

As MacLean points out, that's a fuel that can be stored and transported and used when and where it's needed and that enables the difference in needs between summer and winter to be bridged, especially for heat.

"We need to understand that heat in particular imposes a seasonal variation and a

seasonal imbalance in what we need that requires tens of terawatt-hours' worth of capacity."

MacLean adds: "For shorter scale lower energy applications you can use batteries, pump storage and demand-side management, but they don't solve the key challenge that we have which is the longer time scales. And when we talk about the flexibility that domestic consumers can offer, that is on the intraday level - which means shifting something from the morning to the afternoon, or from the rush hour to the quiet times. We have got a bit myopic and preoccupied with the intraday stuff, and without a clear idea of the bigger challenge.

There is a fantastic opportunity this year presented by the UK hosting COP26 to engage consumers further with a joined-up narrative that explains in simple terms the steps they can take in their own homes to enable flexibility, both in terms of household energy savings and carbon footprint reduction."

Maria Brucoli, smart energy systems manager, EDF



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Although demand-side response from the domestic side is currently negligible, you shouldn't under-egg that - we could be looking at 35 million EVs and 20 million heat pumps, that's a vast array of things that can be turned on or off."

Dr Jeff Hardy, senior research fellow at the Grantham Institute, Imperial College London

"Most batteries in the UK are working in a time scale of up to one or possibly two hours, but what we need to balance the system are things capable of working over many days, over seasons and in some instances over years, and that's what natural gas, previously coal, oil or wood have allowed us to do."

While this might suggest that having more nuclear power in the system could be the answer, MacLean says that's not the case because nuclear can't be turned up or down to respond to fluctuating demand. "Our research shows that you need more balancing capability in a pure nuclear system than you do in a pure renewable system. Wind, in particular, is actually well correlated to heat; people tend to need more heat at a time when the wind is blowing more and vice versa. Solar does the opposite because the sun tends to shine in the summer when we don't need heat, and it hardly shines at all in the winter when we do."

"Therefore, adding solar into the mix for heat makes the imbalance worse - you're actually better eliminating solar completely."

Flexibility and the EV network

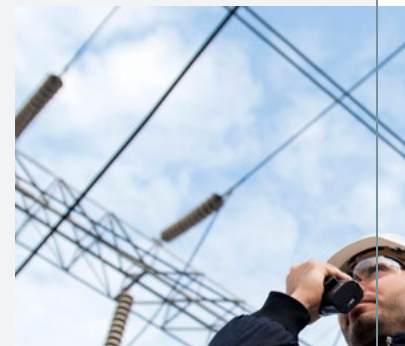
The accelerated rollout of EVs across the UK in the coming years will, it is hoped, both help the decarbonisation agenda and reduce the cost of energy systems. But if EVs are to be the panacea many hope, guaranteeing resilience on the charging network will be critical as will engaging consumers in using their EVs to provide demand-side response.

"Historically, networks have been typically designed such that each household needs 1-2KW of electricity on average. However, a residential EV chargepoint is typically 7KW. If everyone turned on an EV chargepoint in the street at the same time, this could be a big challenge to networks without solutions such as strategic investments and flexibility being applied," explains Randolph Brazier, head of innovation and development at the Energy Networks Association.

Ofgem has this year unveiled a suite of measures designed to ensure that network capacity is in place for the estimated 14 million EVs that will be on the road by 2030.

Half of the regulator's £300 million green recovery scheme funding, for example, has been allocated to develop better EV infrastructure, including 200 charging point projects. Recently, a further £450 million of innovation funding has also been announced, which will support "big, bold and ambitious projects" centred on the net zero agenda, including those that support the EV network. This second pot of funding is part of Ofgem's next price control (RIIO-ED2), which promises "billions of pounds of investment in the local distribution networks which will help support EV charging infrastructure".

Ofgem also plans to make it easier to connect EVs to the power grid and reduce connection costs. It is currently reviewing network charges and will



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"These are the sorts of topics that you only uncover if you look at the actual challenge over the longer term, and that's what we've done in our research, and I think it's certainly raised a number of questions we weren't expecting to come out," he says.

For MacLean, the finger points to hydrogen as the obvious solution "because it is another chemical fuel which may not be as energy dense as natural gas, but it's not far off. And moving and storing hydrogen is much cheaper and easier to do than moving and storing electricity".

MacLean says that because of the duration and flexibility that hydrogen can provide, it makes sense to set up an electricity system to produce hydrogen, and then use that hydrogen to transport and store the energy for use when it's needed.

There is not yet anywhere near a consensus on the role hydrogen can play in the energy mix as we discuss in the next chapter. Certainly, making hydrogen the heavy lifter of flexibility would be expensive, MacLean acknowledges that - but there is not a solution at the level required that isn't, he says. "It will cost a few trillion pounds to build a system with batteries."

With diverging opinion on levels of flexibility and the use of hydrogen, how we can pay for it and what technologies to back, this is a transition issue that will continue to vex minds for some time to come.

We explore the role of hydrogen in Chapter 4

give a final decision by the end of this year ahead of changes being implemented from 2023. It has said it will incentivise DNOs to reduce connection times for customers.

Ofgem chief executive Jonathan Brearley has said: "We intend to go further, building a smart and flexible energy system that can utilise the huge number of EV batteries that are going to be plugged into our system to keep costs down for everyone."

Part of this revolution will be the further development of vehicle-to-grid (V2G) systems that allow EV users to earn money by exporting electricity back onto the grid.

Energy platform company Kaluza, a subsidiary of Ovo Group, has been operating a V2G network since 2018. Conor Maher-McWilliams, head of flexibility at Kaluza, believes the energy transition has already created the demand for a more flexible use of grid assets.

"The nature of demand on the grid has changed through the integration of more EVs and electric heating systems to aid the decarbonisation of those sectors," he says. "That enhances the potential for a volatile energy system."

"On the network side, there's less control over generation, and more demand potentially correlated to weather. Hopefully, the networks can manage those potential peaks in a way that guarantees security of supply but also doesn't mean they have to over-invest in those networks, which ultimately flows back to the customer's bill."



Kaluza's V2G network currently features 350 charge points across the UK, which enables vehicles to import energy when there is an oversupply and discharge up to three hours a day at peak times to offset local network needs.

Kaluza estimates that the V2G system has the potential to save £3.5 billion per year in areas such as grid infrastructure reinforcement, storage and generation, as a result of the support it offers during periods of increased energy demand.

As the sale of EVs accelerates the race is on to create a charging infrastructure that provides resilience and ease of use. That requires putting in place a whole host of standards and protocols that ensure charging points can be used by different vehicles; similar payment processes and establishing data protocols that will satisfy consumers, vehicle manufacturers and the networks, explains Brazier.

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Still in the mix

The government wants hydrogen to play a key role in heating UK homes and businesses, but how does the fuel stack up against the low carbon competition, is it really clean, and will safety and technical issues scale back an ambitious national roll out?

Heating is the largest source of greenhouse gas emissions in the UK, accounting for around 19 per cent of total emissions, yet decarbonisation efforts lag well behind other sectors, such as power, transport and industry.

With the shortfall increasingly apparent, a switch to low-carbon heating has risen up the political and environmental agenda and among the options on the table, hydrogen is considered a key contender backed by serious investment in research and development.

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Replacing natural gas with hydrogen in homes and businesses has many benefits. It can potentially take advantage of existing distribution pipework and infrastructure; gas boilers can be modified to run on pure hydrogen; and customers are familiar with the technology. Hydrogen is already considered critical to the decarbonisation of UK heavy industry, potentially making it simpler to build a market and supply.

But questions remain over long-term viability. Hydrogen demands the creation of nothing less than a new end-to-end energy system, from production to consumer, with related regulatory controls, commercial incentives and contractual mechanisms. Safety, technical and environmental concerns that still need to be resolved include planned long-term reliance on blue hydrogen, made using fossil fuels rather than renewable electricity, and the impact of high hydrogen concentrations on existing gas grid infrastructure which could mean significant investment in upgrades.



Ore Catapult
Demonstration wind
turbine in
Levenmouth Fife

At a fringe meeting on home heating at the Conservative Party Conference in October, organised by the thinktank Bright Blue and Citizens Advice, energy minister Lord Callanan outlined his thinking on the main heat decarbonisation options.

The peer, who is overseeing the government's heat and buildings strategy in his role as parliamentary under-secretary of state at BEIS said: "I'm a little bit of a hydrogen sceptic. It has great potential but at the moment, it is quite expensive to produce."

He said the role of hydrogen will be "significant but we don't know yet how significant."

"The jury is out on how much the cost will fall but the idea that we could produce enough hydrogen at reasonable cost to displace mains gas is pretty much impossible."

As a result, alternative low carbon heating solutions, such as electric heat pumps, may gain dominance in future, explains Julian Keates, chief architect at Capgemini Invent and an expert in energy and utilities innovation: "Hydrogen has to be introduced at a point on the network and then you have to figure out how to switch over all the customers downstream, which is a major challenge. In contrast, air source heat pump installations typically only affect an individual building and upgrading the electricity supply is relatively straightforward, subject to broader network capacity constraints, so your only challenge is the fabric of the building and related disruption."

"I can see hydrogen has a role to play in niche applications, industrial and, large transportation. But the distribution and the retrofit are huge barriers to making it practical, on a retrofit basis for domestic rollout."

There is also on-going concerns around safety and costs.

People often talk about average heat demand, but you need to focus on peak heat demand and a 1 in 20 winter. Peak periods often coincide with low solar and wind output, weakening renewable generation."

David Watson, head of energy transition, Cadent

Line of sight

Efforts to decarbonise heating have become a political hot potato in recent months as ministers grapple with how to meet the exorbitant cost of a national switchover as well as incentivise homeowners to adopt low-carbon heating systems. Just who would pay and how to socialise the cost of the transition are still very much moot points.

Fierce debate over what to include in the much anticipated "heat and buildings strategy" has delayed its publication until sometime this autumn before COP26.

Some direction is provided by the new national Hydrogen Strategy, published by the Department for Business, Energy and Industrial

Strategy (BEIS), which outlines key steps towards creating a hydrogen economy spanning multiple sectors including transport, heavy industry and heat.

The document describes plans to build a hydrogen economy worth at least £4 billion, providing 5GW of hydrogen production by 2030 and forecast to ramp up over time to cover 20-35 per cent of national energy consumption by 2050.

Heat for buildings could become a “very significant” source of future demand for hydrogen, totalling up to 45TWh by 2035, the strategy states, although specific decisions on how to develop a market for home heating and a potential mandate to make new gas boilers easily convertible to use hydrogen by 2026 are still out to consultation.

“The Hydrogen Strategy sets out the key targets and evidentiary steps required and while there's some debate about scale of ambition, it is a pragmatic approach,” says Angus McIntosh, director of energy futures at gas distribution company SGN. “The two key things we have to evidence are technical viability and customer want, if both of those land then hydrogen is positioned as a terrific decarbonisation option and a lower-cost, lower-disruption solution.”

Debate over the future landscape for heating has triggered a format war between advocates of hydrogen boilers and those of other low carbon solutions, principally electric heat pumps, but the specific limitations of each makes it likely that a patchwork of solutions will ultimately roll out.

As potentially a curveball scenario you could imagine mass production of clean hydrogen elsewhere in the world, and potentially being shipped to geographies that can't make it economically, similar to what happens with liquid natural gas today."

Julian Keates, chief architect, Capgemini Invent



Hydrogen ready boilers, like this one from manufacturer Baxi, can be fitted as direct replacements for conventional units.

Heat pumps are expected to be popular with housing developers and consumers, due to their commercial availability and relatively simple installation. Gas boilers are set to be banned from installation in new homes by 2025. However, the high cost, ranging from £5,000-15,000 for a fully installed air or ground source pump, may be a sticking point for existing households in the absence of government subsidy. Retrofitting units also requires substantial upgrades to building insulation.

A recent report by the Energy and Utilities Alliance, in partnership with Leeds Beckett University and UK gas distribution networks including Cadent and SGN, found that 37-54 per cent of UK homes currently using gas either do not have the space for a heat pump or would require disruptive measures to install one, such as solid wall insulation.

System level challenges also need to be addressed, says David Watson, head of energy transition at Cadent: “People often talk about average heat demand, but you need to focus on peak heat demand and a 1 in 20 winter. Peak periods often coincide with low solar and wind output, weakening renewable generation, so it's likely that you're going to need a mix of energy and a balanced pathway.”

Proving grounds

Hydrogen has the advantage that properties are already equipped with compatible infrastructure and gas boilers are pre-configured to handle a 20 per cent hydrogen blend. The big four boiler makers, Worcester Bosch, Vaillant, Baxi and Ideal, recently issued a joint pledge to sell hydrogen boilers for no more than the cost of a natural gas boiler at current volumes.

However, the fuel is heavily constrained by the current lack of production capacity and a supply chain and the absence of a proof of concept for heating homes safely and reliably. Hydrogen is lighter and more flammable than natural gas, which is mostly methane and there is on-going concern about its suitability for use in a gas grid supply to homes. The greater risk of explosion has been highlighted in a study from Arup for BEIS, although it also pointed to the fact that the risk could be mitigated by installing extra equipment, known as excess flow valves, in the pipe network as standard. But it is acknowledged that the public may need convincing to swap natural gas for hydrogen because of perceived safety concerns, even if these could be mitigated.

A number of trials, either currently under way or planned, should provide more direction and clarity of the role hydrogen can play in heating over the coming years. The HyDeploy pilot, led by Cadent, is feeding a 20 per cent hydrogen mix into commercial and domestic boilers at Keele University's private gas network to establish real-life performance. A report published in September into the groundbreaking project that was the first in the UK to blend hydrogen into the domestic gas supply, hailed it a success.

Mark Horsley, CEO at Northern Gas Networks, said: "The results delivered by the Keele project gave the Health & Safety Executive the confidence to approve the first blending of hydrogen with natural gas on the public gas network."

The success of the trial at Keele University has paved the way for a larger pilot project at Winlaton, near Gateshead where 668 houses, a school and some small businesses have been receiving hydrogen blended gas on a network operated by Northern Gas Networks (NGN) since early August 2021.



I can see hydrogen has a role to play in niche applications, industrial and, large transportation. But the distribution and the retrofit are huge barriers to making it practical, on retrofit basis for domestic rollout."

Julian Keates, chief architect,
Capgemini Invent

Adopting hydrogen blending across the UK's gas network could save an astounding 6 million tonnes of carbon dioxide emissions every year, the equivalent of taking 2.5 million cars off the road - without any disruption to households.

The world's first neighbourhood trial of 100 per cent hydrogen, the H100 project mentioned in Boris Johnson's Ten Point Plan for a Green Industrial Revolution, is currently being organised by SGN in Fife on the east coast of Scotland.

Due to begin in 2022, it will see 300 homes heated using renewable hydrogen produced by a dedicated electrolysis plant powered by a nearby offshore wind turbine. Key objectives are to test customer appetite for hydrogen and prove the operational viability of repurposing the gas distribution system.

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McIntosh comments: "We want to make it as easy as possible for customers so they benefit from the existing features of their natural gas systems, including the same footprint in the home, the simplicity of use, and the same applications without major disruption. Customers just need to sign up for the new free appliances and maintenance - we sort out all the other aspects to ensure the customer is not disadvantaged in participating."

At national system transmission level, the first-of-its-kind hydrogen test facility FutureGrid is being built by National Grid to test hydrogen blends of 2 per cent, 20 per cent and then 100 per cent at transmission pressures to assess the impacts on the performance of existing equipment and steel pipelines. Trials include extensive safety testing, with the results anticipated in 2023.

"Based on our analysis to date we're confident that the majority of our pipeline infrastructure will be able to transport the different blends of hydrogen up to 100 per cent," says Antony Green, project director for hydrogen at National Grid. "Other key equipment such as compressors, which pump gas through the pipes, will likely need a retrofit or upgrade given the fundamentally different properties of hydrogen and natural gas."

The hydrogen experiment will scale up in 2025, when the first hydrogen village is due to complete, transforming up to 2,000 occupied homes, offices and other buildings to use 100 per cent hydrogen for heating, hot water and cooking for a period of at least 12 months. A decision on whether to proceed with plans to trial the conversion of a whole town to the low carbon fuel is expected in 2026.



|| The Hydrogen Strategy sets out the key targets and evidentiary steps required and while there's some debate about scale of ambition, it is a pragmatic approach."

Angus McIntosh, director of energy futures at gas distribution company SGN.

Scaling up

With hydrogen considered a key part of the UK's future energy mix, the focus is on defining how policy can support innovation and increase demand to make it economically viable.

The government is supporting the development of localised clusters and hubs for hydrogen production and distribution to serve multiple applications, including heavy industry and transport, so it's likely the first homes to run on the gas will spring up near these locations.

"Those industrial concentrations could make it easier to attract focused investment, attain planning permission and permitting, etc, to build hydrogen-ready homes," says Keates.

Environmental concerns over the method of hydrogen production may need further scrutiny

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|| The results delivered by the Keele project gave the Health & Safety Executive the confidence to approve the first blending of hydrogen with natural gas on the public gas network.”

Mark Horsley, CEO,
Northern Gas Networks

and could impact on the final roadmap. The government currently supports a “twin track” approach to hydrogen supply, covering both blue hydrogen, produced by reforming methane and capturing emissions, and green hydrogen, made by electrolysing water using renewable energy.

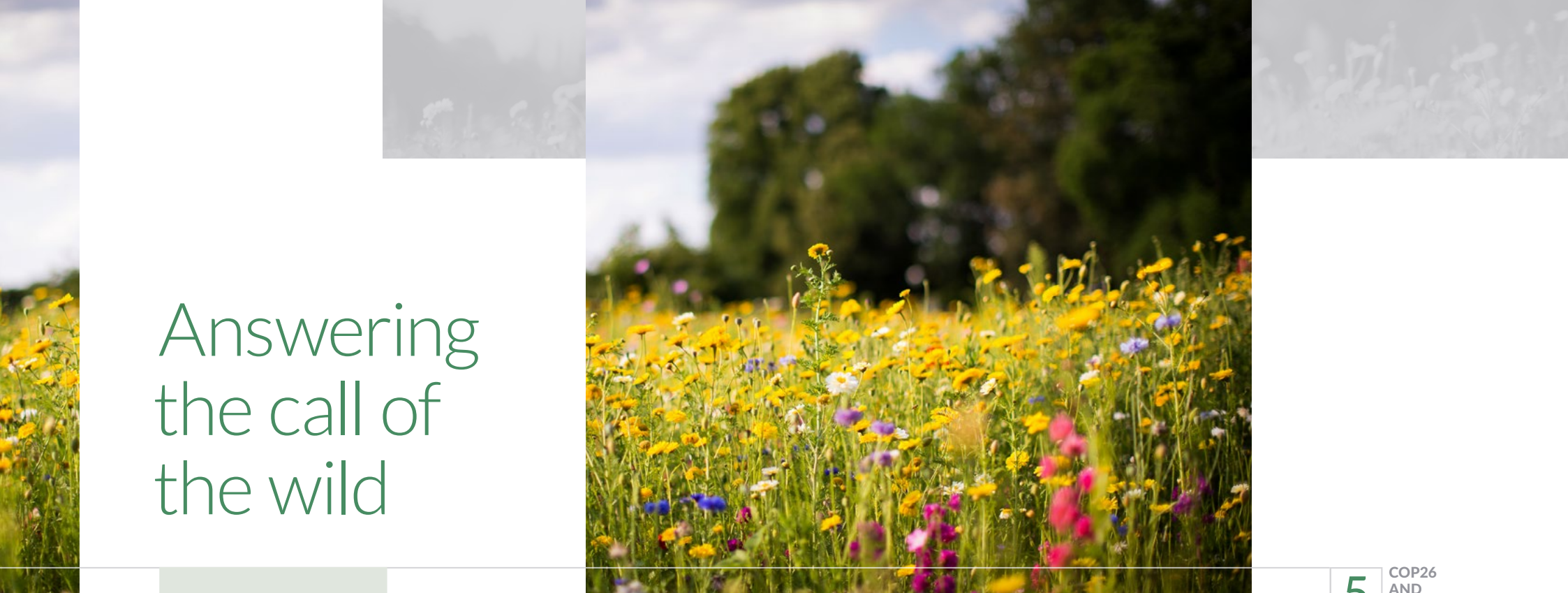
Blue hydrogen may need to function as a transition fuel for several decades as green hydrogen production is scaled up, but it relies on fossil fuels and leaks methane during production and transportation. According to analysis of government figures by Friends of the Earth, if the UK used green hydrogen to meet a third of forecast hydrogen demand, blue hydrogen would create the same emissions as around a million cars a year until 2050. While green hydrogen would be preferable, it is also far more

expensive. The government’s hydrogen strategy puts the current estimated cost of producing it at £197 per MWh. By contrast, the average gas-user in Britain is currently paying around £40 per MWh. This is expected to come down, however the government’s hydrogen strategy is still working on the assumption that it will cost £71 per MWh (at current prices) even in 2050. The strategy puts the cost of producing blue hydrogen at £62 per MWh, still a third more than natural gas.

Says Capgemini’s Keates: “Our solar generation potential is modest compared to many other countries, where the inefficiency of generating clean hydrogen is perhaps less of a concern. As potentially a curveball scenario you could imagine mass production of clean

hydrogen elsewhere in the world, and potentially being shipped to geographies that can’t make it economically. So you can imagine a similar kind of situation to what happens with liquid natural gas – LNG – today.”

A clear line of sight is critical for the industry and investors if hydrogen is to move from concept to commercial reality. If satisfactory answers to key environmental questions and others around technical performance, safety, and customer appetite and costs to produce are forthcoming then hydrogen could become the fuel of choice for millions of UK homes. But at the moment that is still a big ‘if’.



Answering the call of the wild

Protecting critical ecosystems will also feature on the agenda at COP26 and, once again, it's an area where utility companies are playing a critical part. Here, we look at how water companies are enhancing biodiversity and environmental stewardship and how networks are also addressing the challenge.

From creating pollination corridors in East Anglia, to bringing back trout to chalk streams in the Chilterns water and growing habitats for nesting birds, water companies are at the heart of the UK's move to enhance biodiversity and reduce man's impact on the environment. They're doing it in many ways, through reducing abstractions, or using nature-based solutions to improve quality and by using their land to boost biodiversity and cut carbon dioxide emissions.

"Water companies are one of the biggest landowners and, collectively, through abstraction and discharge, they have an enormous impact on bodies of water. It is absolutely right that we're at the centre of

tackling biodiversity decline," says Tom Kelly, wholesale director at SES Water.

Granville Davies, manager of water and catchment strategy at Yorkshire Water, concurs: "As a water company we are inherently dependent on the natural environment for our raw product, so it makes absolute sense for us to protect and enhance it."

Andrew Ball, technical director at the research organisation, HR Wallingford, is impressed by their efforts. "Water companies are passionate about the environment. They understand they need it to be resilient - they need rivers to flow and ground water to rely on. Restoring rivers and aquifers is something they have been doing for almost 40 years."

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Since privatisation in 1989, the English water sector has spent £25 billion on measures to improve the environment, with another £5 billion of investment in environmental measures planned during the PR19 price review. Welsh Water, a not-for-profit organisation points to huge investment since it was formed 20 years ago, including £1 billion improving bathing water around the Welsh coastline. State-owned Scottish Water alone has invested £3.6 billion since 2015.

Water UK says that this investment has helped river pollution fall by 70 per cent since 1995, resulting in more than 10,000 miles of river being improved.

Across the industry, serious pollution incidents have fallen by 90 per cent since the 1990s.

Meanwhile, water companies are using their position as the country's biggest landowners to play a central role in restoring vital carbon stores such as peat bogs, planting trees and restoring wildlife habitats. The water sector's plans are nothing if not ambitious; it is the first business sector to commit to reaching net zero operational emissions by 2030 - a full 20 years ahead of the UK's national target. To deliver this, many water companies will use their land to generate renewable electricity. As some of their carbon footprint will still need to be offset they have also pledged to plant 11 million trees over the next decade.

While the sector has made great strides in its commitment to environmental stewardship, there is still some way to go - and water companies acknowledge that. Increased consumption of water, coupled with changing weather patterns due to climate change, is toughening the challenge. For example, the amount of water used by the average household in the UK has increased by 70 per cent since 1985.

Water companies are passionate about the environment. They understand they need it to be resilient - they need rivers to flow and ground water to rely on."

Andrew Ball, technical director,
HR Wallingford

The Environment Agency's annual report on the environmental performance of England's nine water and sewerage companies published in the summer 2021 was not entirely glowing.

The report showed that while five water companies achieved the highest rating (four stars), four still required improvements and no single company achieved all the environmental expectations set out for 2015 to 2020. This included full compliance for wastewater discharge permits and a 50 per cent reduction in serious pollution incidents compared with 2012.

Northumbrian Water, Severn Trent Water, United Utilities, Wessex Water and Yorkshire Water achieved four stars, while Anglian Water and Thames Water were rated as three-star (good). Southern Water and South West Water were rated as two-star (requiring improvement), with both their performances being flagged as consistently unacceptable.

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What would you like to see come out of COP26

I would like to see the recognition that climate and biodiversity crisis are one and the same thing and that offsetting is beneficial to the environment in the wider sense.

Putting biodiversity back on the map can contribute to solving the climate crisis. Planting trees offers all kinds of benefits, not just offsetting carbon dioxide emissions. All habitats help to sequester carbon and help us to adapt to climate change. And I would like to see restoring biodiversity a key component of the climate change solution.

What I'd also like is the recognition of the importance of soil quality. In East Anglia we have 40 per cent of the country's Grade I and II agricultural land. Soil health is important for water retention and carbon sequestration and we would like to see the introduction of a soil code alongside a code for peat and trees.

Chris Gerrard,
natural catchment and
biodiversity manager
Anglian Water

There have already been a lot of announcements. From a personal perspective, it would be nice if we stopped having policy announcements and had a lot more activity - and more money would help speed things up.

Also, I'd like to see more opportunities for 'no regrets' attempted solutions - let's just try things and see whether they work.

And also, being measured against outcomes that help biodiversity/ecology, rather than fixed regulatory targets.

Granville Davies
manager of water and
catchment strategy
Yorkshire Water



Anglian Water wetland

Environment Agency Chair Emma Howard Boyd said at the time of publication: "Over half the water sector is now achieving the highest industry rating, showing that clear targets and regulatory focus combined with investment in the environment delivers change in the water sector. But some companies are still failing in their duty to the environment and there remains a tendency to reach for excuses rather than grasp the nettle. As last week's £90 million fine for Southern Water showed, environmental laws must not be undermined.

She added: "I have been meeting water company chairs in the last few weeks to set out our expectations for them to redouble their efforts to improve or maintain their environmental performance, something which continues to be a priority for both customers and shareholders."

Yorkshire Water's Davies acknowledges, "Yes, it's been a bit of a mixed bag for the industry, but looking forward, there's an increased degree of aspiration, certainly at Yorkshire Water and I'd imagine elsewhere too."

Kelly from SES echoes his views: "In terms of environmental stewardship, water has been a bit late coming to the party and high-profile pollution incidents do enormous reputational damage to the sector and wipe out the good work that's being done.

"What has increasingly happened in recent times is the acceptance of the scale and breadth of the impact water companies have on the environment - not just in the way they abstract it and return water to the environment but also with the energy they use in pumping, processing and building treatment works and networks."

There is an expectation that more emphasis will be placed on environmental performance in PR24 he says. "In PR19, 60 per cent of the

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SES performance commitments were customer focused and 40 per cent environmentally focused. In the next price review there will be at least parity in terms of environmental commitments and potentially more. And rightly so - we have a limited amount of time."

A parliamentary briefing published last year points to the urgency: "The UK is one of the most nature-depleted countries in the world. The State of Nature report from nature-based charities has shown that since the 1970s 41 per cent of all UK species surveyed have declined, while 15 per cent of species within the UK are said to be threatened with extinction. Though it's not considered too late to change course, urgent action is needed."

Water companies like SES are already signing up to reverse biodiversity decline before such measures are expected to become law in the Environment Bill, still going through parliament. Broadly, "biodiversity net gain", as set out in the Environment Bill, requires development to deliver at least a 10 per cent improvement in "biodiversity value" when projects are undertaken. Its work on restoring habitats across its estate, including re-wilding, has earned SES three coveted biodiversity benchmark certificates from the Wildlife Trust in the past five years - the only water company to possess any.

Andrew Ball of the research organisation HR Wallingford, says that for the next round of Water Resource Management plans, we should expect to see an increased emphasis on leakage, improving river flows and chalk streams, water quality and the management of droughts and resilience.

Water Resource Management Plans are produced by water companies every five years in conjunction with the Environment Agency and are then fed into Ofwat's price reviews. Ball also expects there to be more details about



What would you like to see come out of COP26

COP26 appears to be creating a positive spotlight on the green agenda and there would seem to be a political consensus forming. I would like that consensus to be further reinforced. If we get this right, it creates a future opportunity for prosperity.

We're getting real momentum behind responding to climate change. It would now be good to see that expanded into nature.

Chris Burchell
managing director, distribution
SSEN

We hope that COP26 will reinforce the link between the natural environment and climate change, and the role the natural environment can play in addressing climate issues. For example, this could include carbon sequestration through activities such as tree planting and peat restoration, or addressing climate adaptation through natural flood defences.

Steven Thompson
UK sustainability manager
National Grid

longer-term planning to tackle water shortages including new reservoirs, as well as moving water from areas of surplus supply to deficit - both of which will require heavy investment.

Among the next steps being examined is a potentially more economic option suggested by HR Wallingford as it works with companies in Wales and SE of England - exploring the transfer of spare water using the River Severn and River Thames.

But, undeniably, the most important message in tackling water supply is effectively communicating the vital importance of using water wisely.

Says Ball: "As a society we don't really understand the relationship between turning on the tap and its environmental response - for example, the fact that we turn on the tap might mean there is less water in the river or in the ground. People don't realise that.

“So the key message from all of us - whether that’s organisations like ours, or water companies, regulators and environmentalists is to engage more with stakeholders and customers so that they understand that whenever they waste water they are having an impact on the environment.”

What those in the sector all emphasise strongly is that water companies tread a very fine line between managing the environment, reducing customer bills, and harvesting water resources.

HR Wallingford has produced a framework to help balance their plans. The UKWIR research project Deriving a best value Water Resources Management Plan was commissioned by water research body UKWIR to provide a comprehensive framework and guidance incorporating technical, economic, environmental and legal perspectives to allow organisations in UK and Ireland to derive a best value strategic water resources plan, which helps them look at the benefits to society as a whole. The framework is embedded in guidance from the Environment Agency.

But if water companies are to balance efficiency with environmental impact, they will need to scale up solutions. Karen Thompson, head of water at Capgemini UK, says: “Water companies have always had a strong environmental ethos and there has been an acceleration in the last five years in effort to reduce their environmental impact and increasing biodiversity. But the challenge is how they go from single projects to roll-out widely.

“I think some companies are doing a great job starting to make scalability work for them. But if water companies are to keep the bills low, improve efficiency and reduce environmental impact, they need to make sure they use technology innovatively.

What has increasingly happened in recent times is the acceptance of the scale and breadth of the impact water companies have on the environment - not just in the way they abstract it and return water to the environment but also with the energy they use in pumping, processing and building treatment works and networks.”

Tom Kelly, wholesale director at SES Water

“Technology can play a huge role in scaling up solutions. For example, we are using artificial intelligence and machine learning to understand fish biodiversity at a project in Heathrow. We’re also working with Scottish Water to use innovative sensing technology at waste treatment works to prevent environmental incidents from occurring.

“This sector is very good at proof of concept but the challenge is how they do it at scale across huge geographies. Ofwat’s innovation fund is a good opportunity to bring academics, supply chain partners together and challenge the status quo and share best practice, and technology will be at the heart of that.”



Nature-based solutions

One of the major changes going forward is moving from traditional treatment plants to nature-based solutions. Yorkshire Water’s Granville Davies says that Yorkshire Water is working with regulators like the Environment Agency and Ofwat to come up with a range of such solutions.

He says that this Yorkshire Water has taken a nature-based approach to upland catchment management and environmental protection for the last decade or more - but the harder task is to employ nature-based solutions for waste-water treatment as it can be very challenging to meet current regulation.

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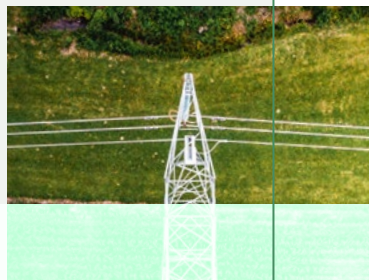
Networks support nature's way

Like the water industry, the electricity networks are under pressure to reduce their environmental impact and enhance biodiversity. In pursuit of these goals, they're often involved in projects that provide benefits far beyond their assets and operations. Though they own significant sites in their own right, for the most part their cables and equipment pass through or under others' land, and it's there where they are beginning to promote biodiversity and protect the ecology in addition to delivering 10 per cent net gain on their own construction projects.

One such project is being undertaken by SSEN, which is looking to restore sea grass beds close to its seabed cables in the Scottish Highlands.

Over the last century, 92 per cent of the UK's seagrass has disappeared, a significant loss for biodiversity and the local ecology. The network company is working with Project Seagrass, a marine conservation charity dedicated to ensuring that seagrass meadows are protected around the world.

Chris Burchell, managing director, distribution, SSEN says: "The project will help improve the carbon store potential of the underwater area, reduce coastal erosion and storm impacts and support sea life and fish populations, which in turn can support the local fishing community.



In catchment management, for example, rather than build drinking water treatment plants for upland reservoir sources where the quality of water has deteriorated in recent years - because of the condition of the catchments and the peat and bogs around those reservoir locations - Davies says the approach now is to think more sustainably and carry out activities within the catchments to improve the raw water quality, and hopefully reduce the amount of treatment work required.

"We've done a lot of work in the uplands to restore peatland, working in partnership with groups like Moors for The Future and the Yorkshire Peat Partnership to re-wet peatland areas, building dams to retain water and replanting those areas with moss.

"That's been fairly easy in the regulatory climate. We know the Drinking Water Inspectorate wants us to prioritise catchment and management solutions over treatment if we can.

"There are also other benefits including carbon sequestration, improved soil health, increased biodiversity and water retention, which can provide resilience against flooding and drought."

In lowlands catchments, working with farmers has also been a Yorkshire Water priority, in order to help improve land management to reduce run off, reduce sediment in rivers, protect soil and reduce leaching of nutrients into water

The environmental agenda is moving all the time around climate change and the issue of nature and biodiversity will gather pace so we need to be reflective of that."

Chris Burchell, managing director, distribution, SSEN

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“The environmental agenda is moving all the time around climate change and the issue of nature and biodiversity will gather pace so we need to be reflective of that. Our plans for enhancing biodiversity - including this project - are innovative and I think quite radical. Seagrass restoration brings broader benefits to society.”

Burchell says that leaving a positive impact on the environment will be a key component of ED2 business plans, for which the regulator has set down more ambitious targets.

But as in water companies, achieving compliance sets up a tension between environmental ambition and affordability. “When we draw up our strategies we have to ask ourselves where do we draw the line. We want to achieve net gain and we have committed to do so but have to balance what you can do with affordability and be supported by customers and stakeholders.

“The pace of the environmental agenda is moving fast and we need adaptive and agile regulation to mirror that.”

Steven Thompson, UK Sustainability Manager at National Grid, agrees and says balancing delivery of significant national infrastructure, which will create material environmental benefits through enabling low carbon generation, with the local and regional impact of these projects on the natural environment is a challenge.

“Considering the environmental and social effects of our projects is a significant element of our approach. We have seen a step-change in environmental commitments in RIIO T2,

reflecting increasing stakeholder and societal expectations. It’s important that environmental commitments and associated funding and incentives are built into regulatory deals to deliver positive outcomes for consumers.”

National Grid has committed to enhancing the value of the natural environment by 10 per cent across its operational and non-operational land holding and on its own construction projects. “That means ensuring the natural environment is in better condition after we have completed our works than before we started,” says Thompson.

“To date we have developed and delivered on plans to improve the natural environment at 50 of our sites, which has been achieved through local site-based sustainability action plans.

“We have a real opportunity in this area. By managing our landholding differently, we can help to address the depletion of the natural environment and the biodiversity crisis.”



supplies. Yorkshire Water has been encouraging farmers to plant cover crops once the main ones are taken out of a field to protect the field from rainfall which would otherwise lead to run off. The cover crops also help to recharge the soil and increase organic matter content, which in turn helps with carbon sequestration, soil structure and biodiversity.

Yorkshire Water is also working with other organisations in the food supply chain including Bird’s Eye, Heineken and Wold Top Brewery.

“It’s not something Yorkshire Water would necessary want to fund for ever, but we want to encourage and incentivise certain behaviours and new ways of working on farms. Once farmers see it working for them, they’ll not need us funding it,” he says.

But the big challenge to adopting nature-based solutions is the treatment of waste water, says Davies, because regulations will specify certain parameters and conditions be met before the effluent leaves the works and goes back into rivers. Water companies need to know that they will be able to comply if they ditch chemicals and rely on nature whose performance will inevitably vary over time. Yorkshire Water is trialling this

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“We’re now reaching a point where to deliver meaningful improvements in river quality, we need as an industry to work together much more.”

Granville Davies, manager of water and catchment strategy, **Yorkshire Water**

approach at Clifton Waste Water Treatment Works and is constructing wetlands that span the area the size of three Olympic-sized swimming pools and has planted over 20,000 wetland plants to help remove phosphorus from millions of litres of treated water. The performance of the wetlands will be studied over time so that Yorkshire Water can learn more about how these solutions operate.

Chris Gerrard, natural catchment and biodiversity manager at Anglian Water, also highlights the potential conflict between nature-based solutions and regulation, and his organisation is working with EA to address these concerns. Having conducted a successful trial at a wetlands water treatment centre in Ingoldisthorpe in north-west Norfolk, built in association with the Environment Agency and Norfolk Rivers Trust who run it, the company is now looking to develop 34 wetlands habitats to treat waste water.

This programme forms part of Anglian’s £800 million investment in environmental improvements in the current AMP - the biggest of any water company. This money will also be used to improve the quality of water discharges

and cease abstraction in east Norfolk. Anglian Water is one of four water companies that pledged in October 2020 to protect chalk streams, alongside Affinity, Southern and Thames

Chalk streams are recognised as ecologically important and the pledge by the four companies - whose regions include the majority of the world’s chalk streams - is intended to recover flows and ecological status. There are only 200 chalk streams known globally, 85 per cent of which are found in the UK in southern and eastern England.

The pledge will see the companies invest to reduce abstraction and cut pollution from sewage works and combined sewer overflows (CSOs) as part of plans to stop the decline of the waterways.



“Water companies are one of the biggest landowners and, collectively, through abstraction and discharge, they have an enormous impact on bodies of water. It is absolutely right that we’re at the centre of tackling biodiversity decline.”

Tom Kelly, wholesale director at **SES Water**

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Partnership working and investment is the answer

The biggest environmental improvements will come from working in partnerships with other stakeholders like river trusts and catchment partnerships, farmers and industry. Yorkshire Water and Anglia are well down this route, and similar collaboration is also going on elsewhere. On the River Lark in Suffolk, a chalk stream that in stretches operates more like a canal with steep banks and slow flowing water, HR Wallingford has been co-ordinating restoration efforts, including rewetting peatland on banks and encouraging sea trout and other spawning fish to return.

Moving to nature-based solutions needs a catchment-wide approach that brings together organisations that have an impact on water quality in that area. But achieving this requires a change of approach from regulators, says Yorkshire Water's Davies.

"Historically, water companies have been regulated at the point of discharge of effluent from the waste water treatment plant into a river, and what that means for the river quality.

"We're now reaching a point where to deliver meaningful improvements in river quality, we need as an industry to work together much more. There's no point in us continuing to deliver better and better-quality water out of our waste water treatment work if there are all sorts of other things going on upstream in our catchment areas that are contributing to poor water quality."

As we've seen, some of this is already happening but Davies explains that the regulatory

regime -- the Urban Waste Water Treatment Directive - is still purely on point source.

There is also the need to create an investment case - and although the next price review is likely to see more onus on environmental concerns, there will continue to be that tension between how much investment water companies would like to carry out, and how much that investment is going to cost and what that means for bills/affordability/vulnerable customers. In some instances this will mean investment over longer periods rather than the five-year chunks.

Anglian Water's Chris Gerrard, who joined in 2013 from the Wildlife Trust, says he would like to see more opportunity to work at the catchment level with all the stakeholders. "That way, we can make sure our investment is used as wisely as possible to achieve the best environmental outcomes.

"In future, we can expect to see a strategic map of nature recovery networks built up from the local level showing where investment in habitat should be made for maximum benefit - and water needs to be a key part of that. We need to be looking at habitat restoration in a joined-up way."

As a water company we are inherently dependent on the natural environment for our raw product, so it makes absolute sense for us to protect and enhance it."

Granville Davies, manager of water and catchment strategy, **Yorkshire Water**

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Conclusion

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Maintaining momentum and the question of money

How should consumers pay to tackle climate change?

It's hard not to be impressed with the progress achieved by the utility sector in our stock take in the countdown to COP26. Bold policies and support that has encouraged private investment and got buy-in from consumers have resulted in a dramatic reduction in carbon dioxide emissions and nurtured a great British success story.

For all the flak thrown at it of late, the Renewables Obligation did what it was intended to do, fostering an industry and providing a head start. The introduction of a carbon price provided a clear signal to reduce coal production while contracts for difference have done a very good job at helping to cut the cost

of capital for low-carbon technologies, and wind in particular. As others have told, the low-carbon subsidy regime has facilitated technological innovation which has boosted the size and efficiency of the wind farms developed off the UK's coast.

What the five chapters provide is a stark reminder of just how much there still remains to do in such little time. How can we speed up investment in renewables? What is the answer to decarbonising heat? How can we deliver the flexibility we need once natural gas is no longer available to call on? Can we develop a financial model that makes large-scale batteries and other storage technologies viable? Are we moving to embrace local markets quick enough to help reduce strain on the network and harness vehicle-to-grid supply? And what about community engagement? Can we learn from the apathy that has engulfed the smart meter rollout to win over consumers and generally take them on the smart energy journey?

Technology, policy, standards, protocols are all still being developed and formed, debated and joined up. At every part of the energy system there are question marks, quandaries, problems to solve and tough decisions to take.

|| We're getting real momentum behind responding to climate change. It would now be good to see that expanded into nature."

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There are some strong messages too from the leaders who have contributed to this report. Giving companies and organisations more opportunities to find solutions on a “no regrets” basis is one big ask.

Another big ask, unsurprisingly, is for regulators in both energy and water to approach price reviews with a completely different mindset. That is, in a way that not only prioritises environmental outcomes but provides organisations the financial headroom to deliver on net zero commitments, environmental stewardship and boost resilience.

And there’s the rub: money and how much should consumers pay. Adding a levy to energy bills rather than taxing pay packets has allowed governments to fund the energy transition in a way that has been less obvious to many consumers.

Industry would be justified in thinking that the time has come for government to be more upfront in paying to reach net zero. That’s both in terms of how much it will cost to make the next stage of the transition, which turns up the dial in difficulty, and also about who pays.

Yet Ofgem and Ofwat have both taken tough stances on keeping bills down. Both water companies and networks have complained that this is the stance even though they have carried out consultations showing the public would be prepared to pay a little more if it helped deliver a more resilient network for the future.

Though the 80 per cent increase in gas prices has been responsible for this autumn’s market turmoil, these dramatic turns of events have brought into sharper focus what it means to go green. It has highlighted the green levy on bills and a seemingly less than robust approach to energy security in the transition to net zero.

Tension between aspirations and costs to consumers are nothing new, of course. But the vast to-do list ahead mean that tensions can only get worse.

The sharp increase in energy prices has sparked growing calls for politicians to slow the pace of decarbonisation. Government cannot be steered off course by these sirens.

Technology, policy, standards, protocols are all still being developed and formed, debated and joined up. At every part of the energy system there are question marks, quandaries, problems to solve and tough decisions to take."

What has given utilities hope and excitement about COP26 is “that it seems to be creating a positive spotlight on the agenda. There would seem to be a political consensus forming and I would like to see that consensus reinforced,” says one contributor. “We’re getting real momentum behind responding to climate change. It would now be good to see that expanded into nature. If we get this right, it creates a future opportunity for prosperity.” These are words that sum up the opinion of many industry colleagues across the whole industry.



COP26 AND BEYOND

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