NewStatesman

Utilities that work smarter

The future of enterprise asset management services

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The paper in this magazine originates from timber that is sourced from sustainable forests, responsibly managed to strict environmental, social and economic standards. The manufacturing mills have both FSC and PEFC certification and also ISO9001 and ISO14001 accreditation.

First published as a supplement to the *New Statesman* of 29 June 2018

This supplement and other policy reports can be downloaded from the NS website at: newstatesman.com/page/supplements

Lightsource BP is Europe's largest operations and maintenance provider for solar energy, managing over 2GW in solar assets. Sara Ver-Bruggen talks to Mark Turner about maintaining an industry in rapid development

Managing the fastest-growing energy market

Those not at ease with their own company may not be the best fit for the role of solar photovoltaic (PV) field engineer.

"In commercial property maintenance, there's usually someone at the facility to meet you and chat with. In this job you could turn up at a solar farm and quite often not meet anyone, except maybe the local farmer," says Mark Turner, managing director for operations and maintenance (O&M) at Lightsource BP. They make up for it, he says, with great Christmas parties.

Lightsource BP started in 2010 as a developer and operator of solar plants, but set up its own O&M business in 2013. In just five years the company has emerged as Europe's largest solar O&M service provider. Around 80 per cent of the assets the firm manages are under third-party ownership, reflecting the growth of the secondary solar market, in which assets that have been built and are producing power are sold on, often as investments.

This expansion has been encouraged by government-backed subsidies which cover 25-year periods, making solar assets attractive to institutional investors and other funds. Returns can be improved through refinancing, but a better strategy is to maximise output, and that takes good management.

After the first wave of solar PV plants in the UK became operational, it soon became clear that some of the engineering, procurement and construction (EPC) firms that built them would not be able to manage and maintain these plants to the standards Lightsource BP expected.

"We decided we could do a better job on our own assets than anyone else," says Turner. "Back then, performance targets were a lot softer, so assets could be left if there was a fault without breaching guarantees. But as the owner, you were still impacted by underperformance."

Solar plant asset owners expect solid and consistent reporting, which Turner says is only achievable if one service provider does the work.

"We are control freaks. Initially we did low-voltage electrical servicing, then we moved onto high-voltage capability, communications and supervisory control and data acquisition (SCADA), as well as panel cleaning and grounds maintenance."

The initial O&M team recruited from Europe, as few people in the UK had the skills required to maintain solar plants. Now, Lightsource puts new recruits through an induction and training academy. "We recruit electricians and other people with relevant skillsets, but with the right attitude, and we turn them into PV technicians."

These individuals, Turner says, need to be multi-skilled. "Because solar is so geographically widespread, you cannot have a supervisory control and data acquisition (SCADA) specialist, an

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enterprise asset management specialist, an inverter specialist and a high-voltage equipment specialist. PV technicians have to be able to take ownership of plants they manage."

Solar energy can seem simple at first glance. There are no moving parts, no gearboxes to oil. But there can be a big difference between the best and the worst performing assets. "A troubled plant can require 80 times more interventions. Done well, solar is simple. Done badly, it is a nightmare."

Where necessary, the company will even rebuild an existing solar plant. Turner says: "We've had to re-cable entire plants and put in new drainage systems. We'll sit down with owners of distressed assets and will provide a 'punch list' of what needs to be worked through. We see a solar plant as a 20 or 30-year lifetime asset and we tell owners that the bullet needs to be bitten now, to get it sorted, before moving onto monitoring and maintaining the asset."

"Done badly, solar can be a nightmare"

The data that the O&M business has accumulated over the past five years means it has a good idea of how a plant is performing when Lightsource BP takes it on, based on information such as which EPC firm built it and when it was built. "We do rigorous asset reviews physically and with available historical data, so that we know what the problems are. There is limited scope to achieve economies of scale with PV plant maintenance," Turner admits, so "the best approach is to develop economies of expertise."

Among the most valuable results of this expertise are the ability to perform predictive and preventative maintenance. Because solar is a generator, a key driver is performance; any downtime hits output. "Our technicians do planned maintenance. We are doing something wrong if they are chasing faults."

Drone inspections, thermal imaging and other technologies keep inspections minimally invasive. "If you have to take the cover off equipment like inverters, you can end up exposing them, creating situations for faults to occur."

Technicians photograph the condition of an asset from the start of a task to the end, and these images are stored in a database that shows progression, helps to ensure tasks are completed and provides a record of more serious problems. To minimise the time engineers spend writing reports, the company has created apps that standardise tasks and make them simpler.

A third of the O&M team is office-based. Turner says: "The guts of this part of the business is performance analysis, identifying the gaps between plant design and performance. To do that we need big data tools, to deal with incoming data from all the sensors, on a second-by-second basis." Lightsource has built its own software to manage and sort incoming data. This works with monitoring systems across multiple plants. "We can produce a full suite of reports for clients within a month of starting to manage their assets. We now manage hundreds of plants, which requires an industrialised way of capturing information, to a very granular level."

Other O&M staff include a specialist engineering team. "If the problem is more challenging then we deal with it as a project. There are also people who work in planning and logistics, telling our 80 engineers where they need to be."

Turner acknowledges the company's biggest stakeholder, BP, has "extensive experience of running big, critical assets like refineries and oil and gas rigs. They have been doing it a long time." In this area, energy's future still has plenty to learn from its past.

The two tribes of asset management

Dan Scott, head of asset management transformation at SEAMS, examines the underlying causes of tactical and strategic asset management dysfunction

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Within large asset-owning organisations where there's an organisational separation between front-line "tactical" asset management and longer-term, "strategic" asset management, it's not unusual to see a level of friction and disagreement between these two "tribes".

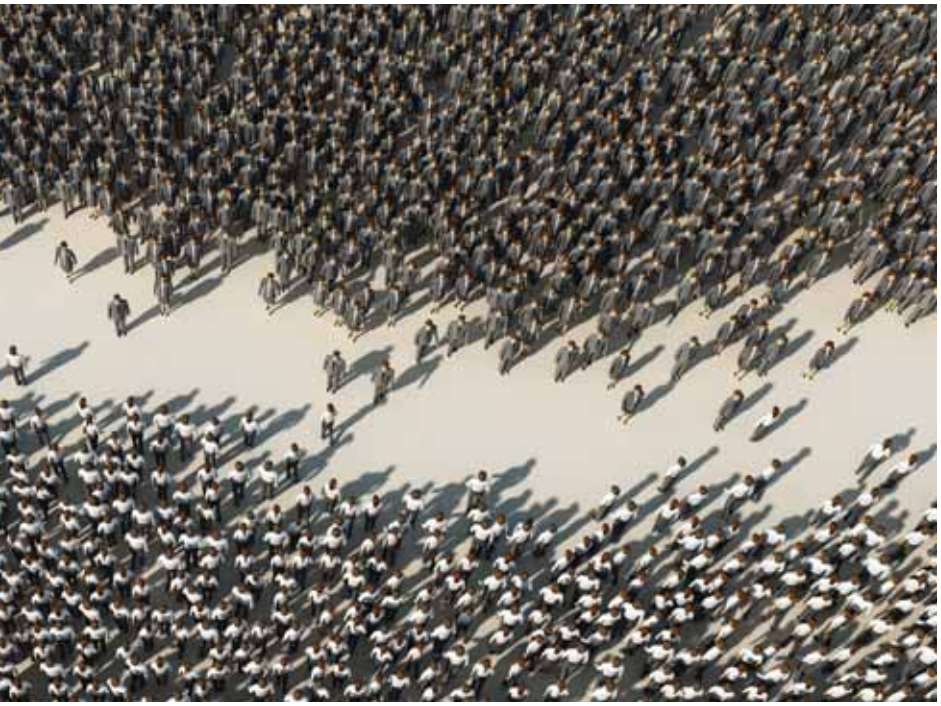
A simple analogy can be made between these two groups and the human unconscious and conscious mind, in that they collectively form the personality and traits of the individual or business, but they work in very different ways.

The front-line teams are like the unconscious mind; decisions are made quickly and seemingly automatically. But just as the unconscious mind isn't good at coming up with new ways of doing things, front-line teams often struggle to innovate, generally focusing more on minor tweaks to existing processes. As Einstein famously said: "We cannot solve our problems with the same thinking we used when we created them." It's often a lack of thinking space that limits the ability of front-line teams to innovate.

Strategic teams are arguably more similar to the conscious mind of the organisation, better able to explore new ways of doing things, or assess complex trade-offs, but decision-making is generally slower, less efficient and more laboured. Think of the difference between a new and an experienced driver – both know how to drive, but the new driver uses their conscious mind, while the experienced driver will generally use their unconscious mind. The difference is noticeable.

It would be easy to suggest, then, that front-line teams are better at making decisions since they can do so faster, but this ignores the complexity of the decisions being made. On the front line, yes/no decisions are based on the immediate evidence presented and lend themselves to "rule of thumb" approaches. Strategic decisions are potentially much more complex, with competing objectives and constraints meaning the goal is often to find the best answer, rather than simply the right answer.

It's this difference that can sometimes result in friction between the two, with the front-line tribe seeing the strategic



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tribe as slow, ponderous and detached from the urgency of their day-to-day lives. When the front-liners are relying on the strategics to solve a problem for them, it takes too long. On the other hand the strategics may see the front-liners as missing the bigger picture, demanding too much and failing to provide the information needed to solve these difficult problems.

For a business to thrive, both the front-line and strategic tribes need to be able to support each other to do their jobs as efficiently as possible. Both the conscious and unconscious mind, working together, are vital to waking life. The ability of the front-line tribe to effectively carry out their duties is key to business survival today, but the ability of the strategic tribe to carry out their duties is the key to business survival tomorrow and in the future.

In the body, the unconscious and conscious minds both make use of the same brain structures for things like visual recognition, sound interpretation and memories, which they use to inform their actions. Within an asset-rich organisation, the enterprise asset management (EAM) system is comparable to those structures as the source of the data upon which decisions are based. The more the processes, experience and decision-making tools of the strategic and front-line tribes and the EAM system are in harmony, the better the overall health of the business and the more likely it is that the organisation will thrive in a changing business landscape.

So what are the common causes of poor organisational mental health? One problem can be a weakness in the strategic tribe that hinders decisions being made. With many factors and opinions to consider, the inability to reach a decision quickly that everyone accepts is often blamed upon the data, or lack of data, in the EAM system. Decision-making problems, it's often suggested, could be fixed "if only we had that extra information". While it's always true that data could be better, and often true that improving data leads to improved decisions, focusing purely on data quality in the EAM is likely to be a misdiagnosis. Data gathered from sources in the real world will never be perfect, and driving towards perfection will have diminishing returns. Instead, the decision support tools and processes used within the strategic tribe should be designed to be resilient to bad data. A symptom of this problem is usually the request to collect greater volumes of data during inspection and maintenance activities. This creates more work for the front-line tribe (which is usually charged with collecting the data) with additional time spent collecting information that they may not believe is useful or valuable. This also tends to reinforce their belief that the strategic tribe is inefficient. A better cure is for the strategics to take a careful look at their tools and, as far as possible, design them for the existing data and quality level.

Another problem is often how the front-line tribe approach the delivery of their activities. If the approach to maintenance is highly reactive, very little data is actually required to plan and deliver the work. High-level failure frequency analysis can guide where to situate reactive resources, but the question of what to fix on site is usually obvious, as it's the asset sitting in a puddle of oil with smoke coming out the top. This can lead front-liners to see most of the data that's required to populate the EAM as irrelevant to their delivery of work, and the collection of that data as a waste of time. This perception is particularly strong if there's a lack of communication. One way to cure this is to take a hard look at why this data can't be used to inform the work plans. If it's important for setting overall strategic decisions for the future, it must have some bearing on decisions today – and it could potentially make the current approach more efficient.

Treatment of these problems needs to focus on the health of the overall system. Processes need to be put in place to treat not only the symptoms, but the underlying causes too, leading to a strong, robust organisation, mentally prepared to face the challenges of a changing business landscape.

As distribution grids adapt to accommodate widespread power generation, the "wires" companies must innovate. Sara Ver-Bruggen asks Sotiris Georgiopoulos from UK Power Networks about building a smart grid

A utility, but not as you know it

These days, electricity customers are increasingly likely to generate their own power, sending what they don't use back to the grid. The shift to renewables means a shift in focus from steady baseload power plants to more distributed, intermittent generation.

And while the low and medium-voltage network can accommodate a certain degree of peak demand, there isn't room for every customer to switch on every appliance at full power at once. But this is the impact electric vehicles (EVs) could have on the distribution grid, as they become more popular.

According to Ernst & Young, these changes are placing increasing pressure on distribution network operators (DNOs) – the regional utilities that supply electricity to your home – to deliver electricity reliably and affordably. EY's research found that greater and more dynamic load profiles increase asset deterioration and raise asset risk profiles, in turn demanding more active management of the network.

UK Power Networks is working to adapt to these challenges. In the longer term, the DNO envisages an evolved role as a distribution system operator (DSO). In this role it would buy services for balancing and managing constraint, rather like a transmission system operator, but at the regional level. There are also opportunities for DSOs to facilitate trading where energy customers with surplus energy or capacity can find another to sell to and vice versa.

Where rooftop solar photovoltaic (PV) systems and other forms of distributed generation have previously been viewed as a constraint, Sotiris Georgiopoulos, head of smart grid development at UK Power Networks, says times are changing.

"The view now is that distributed generation sources, EV chargers and other low-carbon technologies are resources that can be made available to ensure there is enough capacity," he says.

UK Power Networks manages the medium and low-voltage electricity networks from Brighton to Norfolk and the capital. Its assets include over 190,000km of overhead wires. Across domestic, commercial and industrial customers, the utility is responsible for distributing a third of the UK's electricity.

More than 200,000 distributed energy resources are connected to its network. These are mainly residential photovoltaic (PV) panel systems, but also wind and solar farms, grid batteries and combined heat and power plants. At all of these points, electricity can supplied to or demanded from the network.

Georgiopoulos says this "creates a need to see where these two-way flows are happening. Bidirectional sensors that would often be used between the transmission and the high-voltage, or sub-transmission, portion of the power grid are now installed at the secondary

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distribution substation level."

UK Power Networks is also one of the first utilities to use a type of power electronics technology known as fault-limiting circuit breakers, which operate more quickly than conventional circuit breakers and allow the faster control that a smart grid needs. From 2019, UK Power Networks will install fault-limiting circuit breakers at a customer's premises as a trial. Installing these devices will make it quicker and cheaper to connect distributed generation in urban areas, where fault level headroom is the main constraint. Rolled out across the UK, fault-limiting circuit breakers could free up nearly half a gigawatt of capacity for distributed generation to be connected and save £400m, according to Ofgem.

Ensuring the distribution network can accommodate more distributed generation means services must be made more flexible. For a utility, this can be thought of as a power adjustment at a specific moment, for a certain amount of time, at a specific location within the network. For example, solar generation can be stored in batteries until later in the day when demand peaks. EVs can be set to charge outside of peak times, and bidirectional chargers can enable groups of EVs to function as grid batteries. In a smart grid, owners of loads or generators can respond flexibly to demand.

Last summer, UK Power Networks issued its first tender based on the need for flexibility to support the network at times of high demand. But to expand these types of programmes in future, utilities need to know where distributed resources are across their networks and what they are doing in real time.

A few years ago, UK Power Networks began piloting two types of active network management (ANM) systems. The technology is software-based and is designed to integrate the functions and capabilities of distributed generation assets, sat at the ends of the grid, with utilities' control centres. ANM software differs to a supervisory control and data acquisition (SCADA) system in that it can control a generator's output in real time as well as manage power system problems, such as voltage constraints.

"When we began piloting ANM software," Georgiopoulos says, "there were very few providers. Now, there are more providers and more software offerings out there, so we wanted to be able to make sure we get the best in terms of value for money."

To date 120MW of capacity on UK Power Network's grid is managed by ANM software and over three years the utility has saved £70m on reinforcement costs.

"ANM lets us offer connections, which in the past might only have been possible through expensive upgrades," he says, pointing out that the cost of these upgrades would in the past have been passed on to businesses and energy customers.

Following meetings with stakeholders, which include electricity consumers on its network that also operate and own distributed generation assets, UK Power Networks has pushed ahead with its ANM rollout, bringing its completion forward to 2019, from 2021.

"It allows us to maximise flexible capacity on the grid, and they really value that. We're faster than other UK DNOs in rolling out this type of software and well ahead of other parts of the world, including New York and Canada."

Another important feature of ANM software is that it will let UK Power Networks develop application programming interfaces (APIs) – how different pieces of software talk to each other – to enable communication with third parties, such as aggregators, which manage multiple individual resources, coordinating them to provide grid services as virtual power plants. APIs specific to the transmission system operator (the National Grid) are also being developed by the utility.

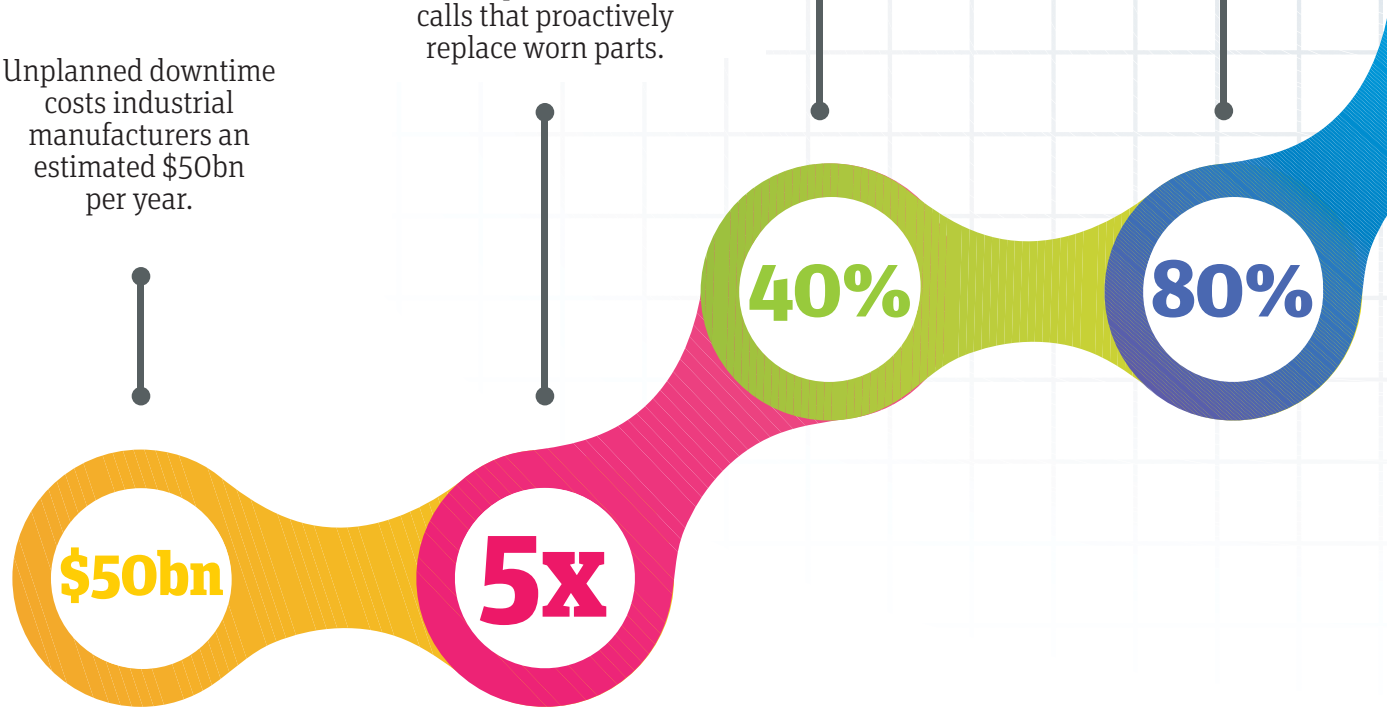
In a smart grid future, utilities need to be smarter too.

Unplanned downtime costs industrial manufacturers an estimated $50bn per year.

Reactive maintenance work costs four to five times as much as planned service calls that proactively replace worn parts.

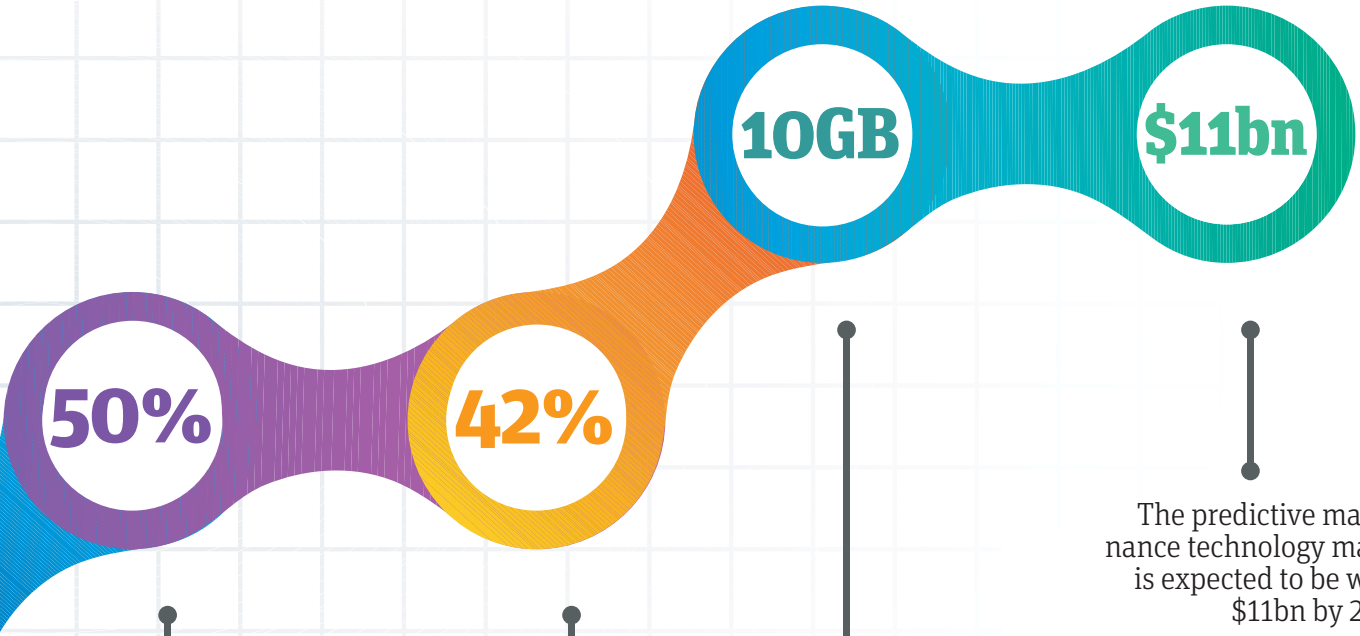
Maintenance management typically takes up at least 40 per cent of a company's operational budget.

Energy businesses spend 80 per cent of their time reacting to maintenance issues, and only 20 per cent preventing them.



BY THE NUMBERS

What does predictive maintenance mean for businesses?



A computerised maintenance management system (CMMS) can create a 50 per cent improvement in performance for machine equipment.

Nearly half of unscheduled downtime is due to ageing equipment.

A modern airliner creates 10GB of data that can be used for predictive maintenance every second of its flight.

The predictive maintenance technology market is expected to be worth $11bn by 2022.

The severe weather this spring exposed cracks, real and metaphorical, in the UK's water grids. Sara Ver-Bruggen asks water companies what they're doing to improve management and safeguard supply in the future

A resource worth preserving

In March, the UK water system came perilously close to breaking point as sub-zero temperatures swept across Britain, leaving frozen and cracked pipes and 200,000 households without water.

Rachel Fletcher, chief executive of the regulator Ofwat, told the press: "When the taps are back on we will take a long, hard look at what has happened here, and we won't hesitate to intervene if we find that companies have not had the right structures and mechanisms in place to be resilient."

The extreme weather exposed under-investment in the management of the sector's assets and its operational resiliency, which is needed to better equip water networks to handle shocks and extremes. Following reports in 2017 that some water companies are in so much debt that they risk bankruptcy, it is little wonder that public trust in the UK water utility sector is fast going down the plughole. Accordingly, Ofwat has made "resilience" in all areas – including financial resilience – a key theme of its next price review.

But Peter Simpson, chief executive of Anglian Water, says the sector as a whole should not be held responsible for the failings of a few companies.

"Over the last two years and including 2019, we're investing £165m into investment in assets, in areas such as increasing the water grid, as well as in schemes to move water around our network to provide more flexibility as well as invest in more storage, all of which will enhance resiliency," he says.

Rather than wait for a price review, Simpson says shareholders have opted to forgo dividends so that money can be reinvested. One recipient of this funding is the Grafham water resilience project. The original plan was to build a new pipeline to bring water down to the new service reservoir at Grafham, in Cambridgeshire, from a water treatment works in Rutland. The original cost was estimated at around £60m, but to save costs, Anglian Water used existing equipment to reverse the direction of flow through one of the company's biggest water mains linking Grafham water treatment works in Cambridgeshire with Hannington, in Northamptonshire, in the event of an emergency power outage. The entire scheme was delivered for £32m less than the initial design, and also halved the project's carbon footprint.

Over the next five years, Anglian Water will commit a further £800m to continued expansion of its water grid. "Out of the £165m being invested by Anglian Water now, the remaining £65m will extend the grid to take water from the Humber Bank south to Lincoln and Grantham, as both cities are expanding. The £800m will be partly invested in expanding the pipeline to serve almost the whole of Lincolnshire," says

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Simpson. A portion of the money will also be spent on rolling out smart meters to customers, to encourage water efficiency and to reduce consumption.

Wessex Water has also made recent investments in extending its water grid. According to Drummond Modley, grid programme manager at the utility, the £228m water supply grid is the largest, most ambitious scheme ever undertaken by Wessex Water. Modley says it will ensure customer demand can be met for the next 25 years.

"Built in areas of environmental and archaeological importance, the pipe can transfer more than 20m litres of water a day," he says. The new grid consists of a 74km pipeline from Dorset to Wiltshire, enabling water to be moved around the utility's region depending on whether there is a surplus or shortage of supply. It has been developed to function as an automatic, closed-loop system, managed by software controls that optimise flow. Modley says this is a first for the UK.

In the past, Ofwat has also criticised water companies for a lack of innovation. Not so at Anglian Water, according to Simpson. "We run our own innovation network, where small and mid-sized enterprises can exchange ideas to help cut carbon and also costs. If successfully deployed, our suppliers can then go on to supply other water companies – or even the gas sector, if there is a crossover application in the area of pipes."

Anglian has also invested in an extensive telemetry system, the largest of its kind in Europe, which monitors over 700,000 points on its network in real time using sensors and software. The company is able to identify potential leakages before they happen, rather than having customers report leaks.

This system has helped to give Anglian Water the lowest leakage rate of any water utility in the UK.

"But we want to go further," Simpson says. "At Newmarket, where our innovation centre is, we are deploying big data and analytics to reduce the leakage rate by a further 25 per cent. To do this we are trialling bringing together different sources of data, such as information we hold on trees, soil and the impact of rainfall, combined with information on pipes, including location, age and other factors. Bringing it altogether for analysis means improved predictive leak detection."

Yorkshire Water, too, is investing in the wider use of sensors and data to improve the performance of its existing asset base, using more meters, pressure sensors and flow loggers in its water and sewage networks. In the city of Leeds the utility has installed a "calm network"of smart valves that manage pressures and calm the network at times of high demand, reducing the chances of bursts and subsequent leakages. A commitment to reduce leakage by 40 per cent by 2025 will, the company says, negate the need to develop new resources.

One of Yorkshire Water's biggest projects is in Hull, where a smart network is being planned to optimise water resources and provide more resilience in the region. Yorkshire Water has partnered with two local authorities, Hull City Council and East Riding of Yorkshire Council, as well as the Environment Agency, to establish a unified approach to managing water. As the catchment is bowl-shaped with the city at its centre, Hull floods regularly, with potentially devastating results. The partnership is not only developing systems to protect areas that are flood-prone, but is investing in the rural catchment to slow flows and store water to protect the city. The initiative has already won the recognition of the Rockefeller Foundation, identifying Hull as one of five global water-resilient cities alongside Amman, Cape Town, Mexico City and Miami.

Water grids around the world are coming under increased pressure, and this will only get more severe; good management and innovation have never been more important.

Decommissioning oil and gas assets – once an afterthought – is becoming a fast-growing area of expertise within the energy industry

When the last drop is squeezed

Very few people will ever get to visit what might be regarded as one of the UK's greatest feats of modern engineering. That's because it lies 116 miles north-east of Shetland – closer to Norway than the Scottish mainland – and has been built in the North Sea with the purpose of extracting and pumping oil.

Shell considers its Brent rigs, which have been in situ for 41 years, to be national assets, having contributed over £20bn in tax revenue and supplied more than 12 per cent of the UK's oil demand in the 1990s. From seabed to tip, each of the four rigs – called Alpha, Bravo, Charlie and Delta – stands as tall as the Eiffel Tower.

When the rigs were built, little thought was given to how they would be decommissioned. The challenge of how to take these rigs out of operation, to agree what can be disassembled and what should be left, has been a decade-long endeavour requiring Shell to work with the regulator, over 100 different groups and an independent scientific committee.

Last year the first topside was lifted off, in one piece, and transported to shore for dismantling and recycling. As so few oil and gas assets have been taken out of operation, compared with projects to construct them, Brent is providing lessons in how to do things better, to reduce time and costs, and to enhance safety.

Alistair Hope, Brent decommissioning project manager at Shell, says that when an asset reaches late life, a clear strategy will be in place for how it will continue producing up to the end, how it will be run safely and the essential maintenance required up to that point.

"With Alpha since we didn't know the precise time that it would reach the end of life," Hope explains, "we continued with the same cranes, adding more safety provisions, such as only using them in fair weather. For the decommissioning the decision was made to replace, but it would have made sense to replace the crane years before, since it would be used for the decommissioning and not just for eking out the remaining productivity of the rig."

The decommissioning of Brent is a uniquely complicated endeavour because of the size and scale of the four platforms and the extent of the subsea structures.

Plugging and making safe wells, known as plugging and abandonment (P&A), accounts for as much as half of all decommissioning costs, according to research by the Oil and Gas Authority (OGA). Oil and gas operators are legally and financially liable even after sites have been decommissioned, so P&A is a laborious but critical step that operators must take to prevent hydrocarbons from leaking.

At Brent there are around 154 wells in total, and it can take up to 40-50 days to

SHELL

After 41 years at sea, the Delta topside arrives at Teeside for decommissioning

plug a single well. The drilling teams, which comprise around 50 people, have plugged two thirds of the wells so far.

"Typically to plug a well, we drill a hole and we add 100 foot of cement. We're at the stage now that we have accumulated data on plugging and making safe wells. We can analyse that data and know where natural barriers in the rock layers occur, which we can take advantage of. Initially we thought we needed to plug more than we now know that we actually need to," Hope explains.

Shell has also learned that P&A, which can take several years, can begin while a rig remains in operation. This is being applied to Charlie, the last rig still producing.

"We started plugging wells sooner, so that the last coincides with ceasing operations – then everyone is off the platform much sooner."

Charlie has 38 wells, and six have been plugged and made safe since P&A started earlier this year. Charlie will end production by the end of 2019.

This approach also goes towards meeting one of OGA's aims, which is to reduce the cost of decommissioning by up to 35 per cent. In the British North Sea, decommissioning activity is expected to be around a third to a quarter of activity, valued at around £2bn.

"In recent years, when the price of oil was $100/barrel there was seen to be little point in decommissioning," says Hope. "But that is changing and the costs are coming down. There is an engineering saying that you have to do projects to be good at projects. That's also true for decommissioning projects."

If oil and gas companies in the past did not see a competitive advantage in decommissioning, that is changing. "We have a forum where operators can get together and share concepts and approaches. It has become very collaborative," says Hope. "We've looked to other industries. Offshore wind is a good example, where operators will work with their supply chain partners to overcome challenges cost effectively. The automotive industry is another good example of the supply chain innovating."

Competition, Hope says, has helped the supply chain emerge. "When we tendered the topside removal a few years back, only two contractors were doing it. The costs were high, sustained by $100/barrel prices."

Then AllSeas came along with its vessel, Pioneering Spirit. "They were new and we could see Brent would give them first-mover advantage. The technology is now proven and they did a great job."

The removal of the Delta topside in 2017 taught Shell that platforms need to be strengthened, using large amounts of steel, to be lifted in one go. "Bravo is similar, but we have been able to reduce the amount of strengthening required by over 70 per cent because we were more conservative in that first go and we'll continue to reduce costs with Alpha and Charlie," says Hope.

According to Hope, the other heavy-lift contractors are being more innovative, not just in their technology but in how they manage the supply chains.

Contractors are now coming up with bundles of services, or are forming consortia and joint-ventures to reduce the number of companies involved. This reduces the number of main contractors that Shell has to deal with directly.

"Somewhat ironically, but good for the sector as a whole, is that the knowledge gained is applicable to new capital projects," Hope says.

"We drill a hole and add 100ft of cement"

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