

FUTURE OF ENERGY

03 HOW TO BALANCE THE ENERGY TRILEMMA

11 THE ATTRACTIONS OF GRAVITY BATTERIES

17 IS DOMESTIC SOLAR A SMART INVESTMENT?



Hitachi Energy –
Advancing a sustainable
energy future for all

www.hitachienergy.com



HITACHI
Inspire the Next

 **Hitachi Energy**

Negative emissions, positive future



Bioenergy with carbon capture and storage (BECCS) at Drax will see the world's largest single site carbon capture project, created in the heart of Yorkshire. This innovative technology will help meet UK climate targets while creating and supporting 10,000 green jobs across the North, kickstarting the next chapter of the region's proud industrial heritage.

It's time to act now.
www.drax.com/LookNorth

Carbon Capture | by drax

FUTURE OF ENERGY

Distributed in
THE TIMES

Published in association with
œUK

Contributors

Jon Axworthy

A journalist specialising in science, tech and the future. He has had work published by T3, *The Ambient* and *Wareable*.

Sam Haddad

A journalist specialising in travel. She has had work published in *The Guardian*, *The Times* and the *Economist's 1843* magazine.

Charles Orton-Jones

An award-winning journalist and the former editor of *EuroBusiness*. He specialises in covering the fintech sector and high-growth startups.

David Stirling

A business journalist who writes for publications including *Bloomberg*, *The Sunday Telegraph* and *The Mirror*.

Nick Easen

An award-winning writer who covers technology and business for BBC World News, CNN and *Time*.

Rich McEachran

A journalist who covers the intersection of business, technology and sustainability for outlets including *Wired* and *The Guardian*.

Paul Sillers

An aviation journalist who specialises in covering the economic, technological and environmental aspects of air travel.

Jonathan Weinberg

A freelance writer whose specialisms include technology, business and the future of work and society.

raconteur reports

Head publisher
Cristina Cosenza

Managing editor
Sarah Vizard

Deputy editor
Francesca Cassidy

Reports editor
Ian Deering

Sub-editors
Neil Cole
Christina Ryder

Commercial content editors
Laura Bithell
Brittany Golob

Head of production
Justyna O'Connell

Design/production assistant
Louis Nassé

Design
Kellie Jerrard
Colm McDermott
Samuele Motta
Sean Wyatt-Livesley

Illustration
Elisabetta Calabritto
Celina Lucey

Design director
Tim Whitlock

Although this publication is funded through advertising and sponsorship, all editorial is without bias and sponsored features are clearly labelled. For an upcoming schedule, partnership inquiries or feedback, please call +44 (0)20 3877 3800 or email info@raconteur.net. Raconteur is a leading publisher of special-interest content and research. Its publications and articles cover a wide range of topics, including business, finance, sustainability, healthcare, lifestyle and technology. Raconteur special reports are published exclusively in *The Times* and *The Sunday Times* as well as online at raconteur.net. The information contained in this publication has been obtained from sources the Proprietors believe to be correct. However, no legal liability can be accepted for any errors. No part of this publication may be reproduced without the prior consent of the Publisher. © Raconteur Media

POLICY

Three-way stretch – how to balance the energy trilemma

The energy crisis has become a delicate conundrum for many national governments. Can they establish systems that provide acceptable levels of affordability, availability *and* sustainability?

Nick Easen

We are in the middle of the first global energy crisis.” Dr Fatih Birol, executive director of the International Energy Agency, wasn't mincing his words at the annual meeting of the World Economic Forum at Davos in May.

Summing up the scale of the problem facing great swathes of humanity, Birol told delegates: “In the seventies, it was the oil crisis. Now we have an oil crisis, a natural gas crisis *and* a coal crisis. All prices are skyrocketing. Energy security is a priority for many governments, if not all.”

He stressed that the clean and renewable sources of energy should form the basis of the solution, arguing that “we don't need to choose between an energy crisis and a climate crisis. We can solve both of them – with the right investment.”

With that proviso, Birol encapsulated the energy trilemma facing most administrations. They are struggling to strike the optimal balance between three important goals – energy security, sustainability and affordability – where the pursuit of any two always seems to come at the expense of the third.

Given the international socio-economic impact of Russia's latest invasion of Ukraine, the most pressing task for the many nations affected by the war is to keep the lights on in their countries – as Birol noted – at an affordable price. But if they look to new fossil-fuel sources to improve their immediate energy security, for instance, that's likely to increase global warming and exacerbate the climate crisis in the longer term. Or if they accept discounted energy imports from Russia, say, that could prop up the Putin regime and lengthen the war. The choices seem stark.

“In trying to find a solution, we risk creating a less sustainable situation that may deal with the here-and-now challenge – high energy prices, for instance – but place an economy at a disadvantage in the longer term,” observes Sharmila Jugessur, sustainability and strategy lead at US engineering firm KBR. “The need to look well beyond a single political term is vital.”

There is no easy way to solve the conundrum, as the UK's chancellor, Rishi Sunak, has been finding. He has just imposed a “temporary targeted energy profits levy” of about £5bn on the nation's energy sector – which has largely benefited from



Dr Fatih Birol, executive director of the International Energy Agency: “We don't need to choose between an energy crisis and a climate crisis”

This means that governments, energy leaders and investors need to agree a clear plan for both the short and long term, balancing every element carefully. They must progress with an array of solutions that work in parallel, as well as diversifying their sources of supply.

The situation is compounded by the fact that fossil fuels are heavily subsidised. The global industry received about \$5.9tn (£4.7tn) in 2020, according to research for the International Monetary Fund. That equates to \$11m a minute.

“The question is: how do we ensure that the billions of people who benefit from subsidised fuel can access green energy at no extra cost?” Jugessur says. “Shifting subsidies has to be gradual, ensuring that the social cost is minimal. Diverting funds from fossil fuels to renewables with no proper phasing would break supply chains, kill industries and create the conditions for an even bigger crisis.”

Improving energy efficiency would be one of the most effective responses to the challenge. Indeed, Birol cited it as a key solution at Davos, along with an increase in nuclear generation by countries that already possess such capabilities.

Niall Greeves, energy director at the Frazer-Nash Consultancy, agrees that focusing on energy efficiency would be a relatively cheap and simple approach to tackling the energy crisis in the short term.

“There are also benefits to be gained from better maintaining our energy generation and distribution assets and so prolonging their lives,” Greeves adds. “This would help to avoid the need to draw upon the planet's limited resources to replace them.”

Policy-makers should also be considering more innovative potential solutions, Jugessur suggests.

“One of the more left-field ideas would be to alter the way in which energy is traded,” she says, pointing out that the dollar is the standard currency that any oil-importing country will use when buying in hydrocarbons. “We need to create a new global currency that's attached to green energy, proven through a digitised blockchain economy. This would encourage investors into a market that is purely related to sources of zero-carbon energy. Confusion over greenwashing would disappear and allow for a transparent market to evolve.”

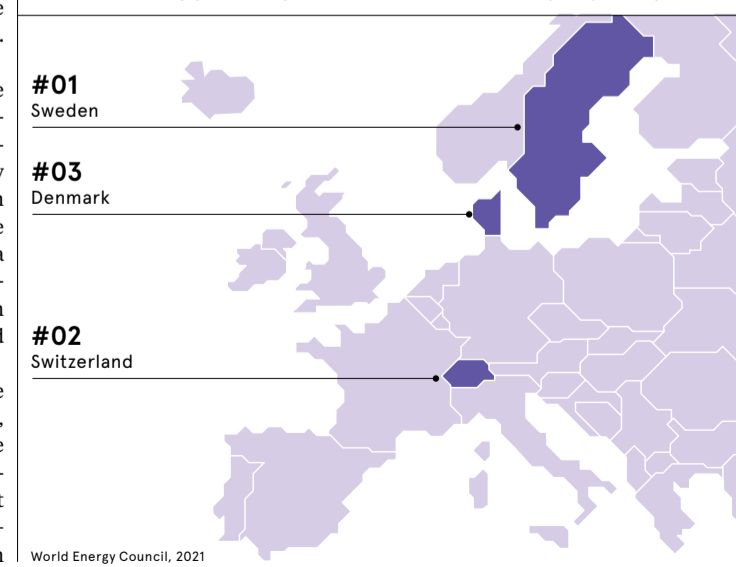
There's a penny, or an electro-dollar, for your thoughts. ●

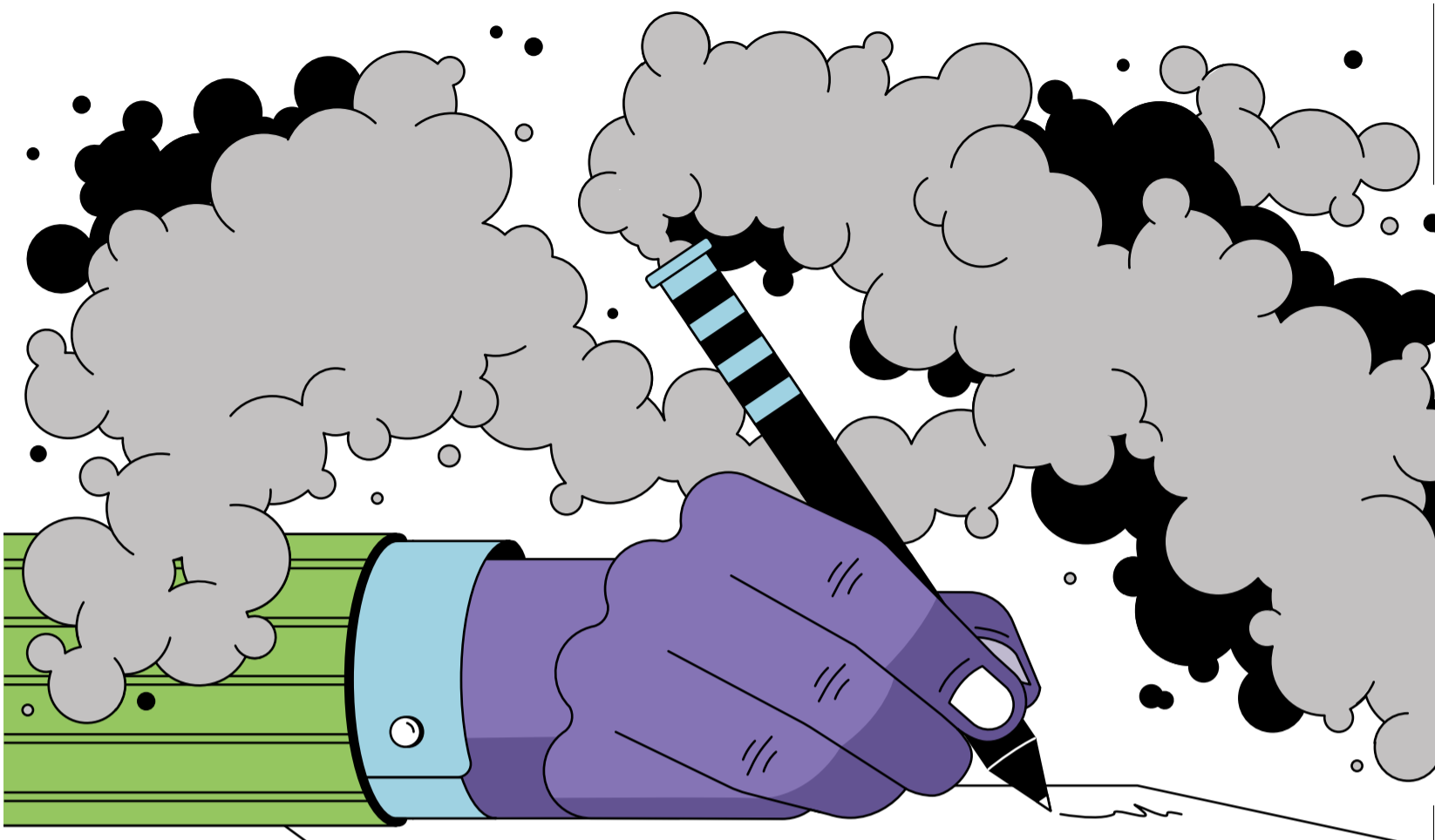
the war in Ukraine – to part-fund a domestic relief package aimed at alleviating the cost-of-living crisis as the threat of stagflation looms. Energy firms that reinvest their profits in UK oil and gas exploration will be able to claim back 90% relief on this windfall tax, but no such arrangement exists for those that reinvest in renewable sources.

What's sorely lacking in many cases is a detailed picture of what is truly at stake, according to Gavin Watson, a partner specialising in energy at global law firm Pillsbury Winthrop Shaw Pittman.

“Honesty, transparency and open dialogue about the real issues would be a good start. The energy trilemma will not be solved if it becomes even more politically weaponised than it already is,” Watson argues. “The evangelical pursuit of energy transition in recent years masks a fundamental reality: it is a luxury that's based on energy security. I see security and energy transition as two sides of the same climate currency coin.”

THE THREE MOST EFFECTIVE TRILEMMA BALANCERS IN 2021





LEGISLATION

Why the energy charter treaty has transformed into an entente terrible

An obscure international trade pact, which has protected investments in the energy sector since the 1990s, is deterring governments from taking decisive action on climate change

Sam Haddad

In April, a report by the UN's Intergovernmental Panel on Climate Change warned that international trade deals could hinder member states' decarbonisation projects. The panel cited the energy charter treaty (ECT) – a legally binding pact protecting investments in activities such as oil and gas extraction, coal mining and petroleum refining – as the most egregious case. It noted that several claims brought under the ECT had been "settled in favour of foreign investors" at the expense of "much-needed climate action".

The treaty, which took effect in 1998, has 53 signatories, including the UK and the EU. Its original aim was to protect western firms investing in newly independent former Soviet states, but the ECT's reach has broadened to include countries such as Cyprus, Jordan and Yemen.

"Its main goal was to promote energy security where investors were unsure about going into new places, because there was a chance of having their assets expropriated or nationalised," says Rachel Thrasher, a researcher at the Boston University Global Development Policy Center.

Aside from its "neo-colonial historical context", as Audrey Changoe, trade campaigner at Friends of the Earth Europe, puts it, the biggest problem with the treaty is its investor-state dispute settlement system (ISDS). This mechanism enables energy companies to sue foreign governments privately in courts of arbitration.

Despite the clear public interest in such proceedings, "it's all done behind closed doors", she says. "Documents aren't publicly accessible and many of the arbitrators are corporate lawyers, even though

a lot of taxpayers' money is at stake. This is a huge problem for transparency and democracy."

Climate was neither high on the global political agenda nor especially relevant to the treaty when it was signed in 1994, but that has changed in recent years. When the Slovenian government required UK energy firm Ascent Resources to conduct an environmental impact assessment to obtain a fracking licence, for instance, the company refused to do so and pursued an

“ This is a huge problem for transparency and democracy

ISDS compensation claim in 2020 for €120m (£103m). Early this year, the government backed down and permitted all small-scale fracking. A state's weakening of environmental controls for fear of costly litigation is an example of what's become known as regulatory chill.

Claims brought under the ISDS can go into billions, which is money that could be far better used on the green energy transition. After the Dutch government revealed its plans to close all coal-fired power plants in the Netherlands by 2030, German energy companies RWE and Uniper issued lawsuits in 2020 for €1.4bn and €1bn respectively to compensate them for their impending loss of business there.

Changoe notes that governments are "phasing out fossil fuels because of pressure from civil society. Dutch citizens had actually sued their own government in 2015 for failing to protect them from the climate crisis. This is a democratic process that big fossil-fuel companies are seeking to undermine."

The UK government's exposure to ECT litigation risk is significant. According to research by Thrasher and her colleagues at Boston as part of work published in the journal *Science*, if Westminster were to cancel all projects that don't fit the International Energy Agency's pathway to net zero, it would render the UK liable for potential ECT claims totalling £9.4bn.

The mere threat of such litigation can often lead to regulatory chill. In 2017, for instance, Canadian firm Vermilion Energy indicated that it would sue the government of France if it went through with its proposals to end the extraction of oil and gas in the country by 2040. France's environment minister, Nicolas Hulot, later watered down

his plans considerably. He resigned in frustration the following year, complaining that corporate interests were wielding too much power over environmental policy.

Thrasher notes that some law firms are even advising clients to restructure their businesses in such a way that entitles them to use the ISDS system. This practice can't realistically be viewed as in the spirit of the treaty and it "feels underhand", she says.

The problem of ISDS liability is compounded by the existence of a so-called sunset clause, which enables firms to continue filing claims against any government that leaves the treaty for up to a decade thereafter. This means that a country cannot expect to walk away unscathed. For instance, Italy ditched the ECT in 2016 and banned gas drilling along its coastline, yet the country was still sued by UK company Rockhopper Exploration the following year.

The European Commission is working to modernise the ECT and align it with the UN's Paris accord on climate change, but Changoe doesn't hold out much hope of a satisfactory solution. Any reforms must be approved unanimously – and some member states still want to protect the fossil-fuel sector. Given that the sunset clause could be neutralised if countries decide to drop the treaty en masse, she believes that the best solution could be for governments to withdraw from it at the same time.

Changoe is worried that the ECT secretariat is seeking new members and trying to bring oil-producing countries from the global south – including Bangladesh, Colombia and Nigeria – into the fold. Such an outcome, she predicts, would "lock developing countries into this fossil-fuel spiral again".

Thrasher points out that the poorest signatories rarely get sued, as potential claimants seem to find it less worthwhile. "The middle-income countries get sued more, according to the data on ISDS disputes," she says. "They lose about half of their cases, whereas higher-income countries lose about a quarter of theirs."

When it comes to reforming the treaty, Thrasher suggests that legislators could ensure that environmental concerns take precedence over treaty claims or even remove the ISDS, which she describes as "a departure from what's usually allowed in international law".

Ultimately, other forces may play a part in deterring companies from suing countries that are trying to decarbonise. Given the explosion of interest in ESG principles among the investment community and the wider world, might the risk of bad publicity be enough to make the more far-sighted firms think twice? "If public opinion forces them to behave better and it has a chilling effect on their bringing such cases", Thrasher says, "that would be a favourable outcome." ●

Tackling the climate crisis today

There is no silver bullet for climate change. We have to stop hoping that future solutions will arrive in time to save us and act now. **Ben Richardson**, CEO of green fuel technology company SulNOx Group Plc, explains how we can all immediately consume less fossil fuels and reduce our carbon footprints

One of the most difficult questions facing organisations chasing carbon neutrality and wanting to drastically cut back their emissions is what they can do right now," says Ben Richardson, CEO of SulNOx, the greentech company focused on next-generation, natural solutions for a carbon-neutral future. "Since I joined SulNOx just over a year ago, there has been a lot of talk about long-term targets and clean energy, which absolutely needs to be the ultimate goal. Unfortunately, we have to acknowledge that is a long way off and we need immediate solutions with significant, lasting impacts to bring down emissions today."

It's certainly been a very interesting first year for Richardson, a former chief operating officer and chief commercial officer with over 25 years' industry experience.

Since taking up the role last May, he's already seen the staging of COP26 in Glasgow and the introduction of E10 petrol on UK garage forecourts.

He believes that things are not moving fast enough when it comes to decarbonisation targets. "One of the key aims of COP26 was to get the world to agree to reaching net zero emissions by 2050 and even if that had been achieved, that's still almost 30 years away. 30 years during which industry and transport will still lean heavily on fossil fuels."

"The introduction of E10 in the UK was designed to reduce CO2 emissions and estimated to remove 750,000 tonnes of CO2 annually, a 2% reduction equivalent to 350,000 cars, from UK Roads," explains Richardson.

"While it's a start, it's a drop in the ocean. What isn't yet being looked at seriously is the huge potential to reduce emissions and increase fuel efficiency through fuel formulation."

There has been much scepticism, supported by numerous studies and reports, largely negating aggressively marketed fuel products' claims to increase fuel efficiencies and reduce emissions, typically lacking credible scientific data or fuel compliances.

Richardson states, "SulNOx have fuel-compliant green products that have been repeatedly proven to significantly increase fuel efficiencies of hydrocarbon liquid fuels, reducing harmful particulate matter, NOx gases, soot, carbon and other air pollutants. It's the ideal solution to the challenges we face right now."

This is all the more relevant in light of a recent report by the International Energy Agency (IEA), which stated that the world's reliance on hydrocarbon liquid fuels will continue and is likely to still account for 80-90% of transport consumption in 2030.

The number of industries that run on liquid hydrocarbons is legion and it's not just those running fleets of buses, coaches, vans and trucks. Shipping, oil companies, fuel storage and distribution, mining, generators, agriculture and construction all rely heavily on fossil fuels, which gives an indication of the size of the task facing organisations as they make good on their obligations to decarbonise in accordance with global governance.

SulNOx's advanced proprietary SulNOxEco™ Fuel Conditioners, which are both natural and biodegradable,



Image courtesy of Tarmac

have not only been proven to significantly reduce greenhouse gases, but also particulate matter by over 50%, which is largely responsible for poor air quality and millions of deaths globally each year.

In addition, the use of SulNOx offers significant fuel and maintenance savings; something that is also topical given current fuel prices. Not only does this help to alleviate the current cost-of-living crisis, but could make the difference in the survival of businesses.

In a recent report, the Road Haulage Association (RHA), stated: "Fuel represents over a third of a truck's operating costs, yet profit margins are between 1% and 2%...every penny increase makes a massive difference."

To demonstrate SulNOxEco™ Fuel Conditioner's track record, concrete hauler Besblock have been using the conditioners across their fleet over an extensive period, enjoying around 8% fuel savings and considerably less maintenance and downtime costs, while also reducing CO2, particulate matter and other greenhouse gas emissions.

Similarly, bus and coach operator E&M Horsburgh saw a reduction of 9% in fuel consumption.

Last week, Tarmac, the UK's leading sustainable building materials and construction business, announced its trial with SulNOx at its Hopkins concrete plants, as part of ongoing corporate commitments to reduce emissions across its nationwide fleet of heavy goods vehicles.

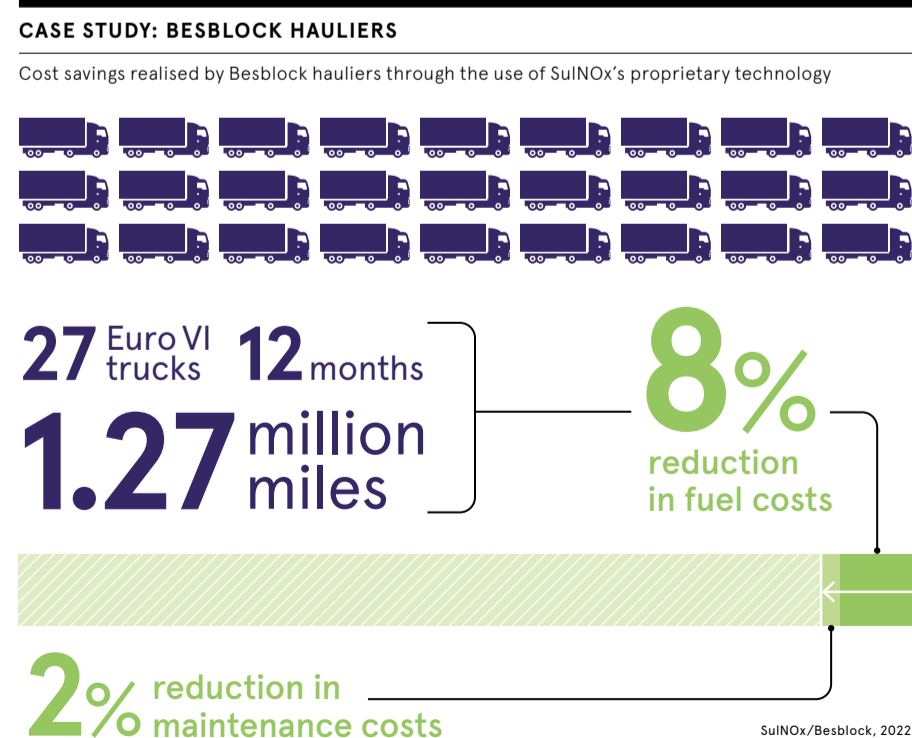
John Anderson, national logistics director at Tarmac, said: "As a leading sustainable business and the operator of one of the largest HGV fleets in

“ What isn't yet being looked at seriously is the huge potential to reduce emissions and increase fuel efficiency through fuel formulation

the industry, it's critical that we continue to explore, pursue and identify ways of reducing emissions and boosting fuel efficiency."

Richardson states: "This is the sort of real action businesses must take to drive down emissions immediately and we are delighted to be working with Tarmac who have a strong sustainable ethos."

By adding SulNOx to the diesel, petrol or biofuel used by an engine you are increasing the surface area of fuel available to mix with oxygen, as well as releasing additional oxygen to improve combustion efficiency, which reduces fuel consumption and costs, at the same time as reducing emissions. And unlike traditional fuel additives, SulNOx's additives also add significant lubricity, surfactants and detergents to continuously clean the engine – like a continuous service, also helping to reduce maintenance costs."



The need for increasing efficiencies of internal combustion engines was collectively highlighted recently by world-leading authorities including the United Nations, IEA and International Council of Clean Transportation, stating fuel economy must improve in new vehicles on average by 4.3% per year, if environmental pledges are to be met by 2030.

SulNOx conditioners can make a significant contribution not only across new vehicles, but much further to the existing 1.4 billion vehicles globally and across the spectrum of other significant sectors reliant on hydrocarbon liquid fuels.

"Our mission is to provide immediate and tangible progression towards carbon neutrality for these users," adds Ben Richardson. "The stark reality is that fossil fuels will continue to dominate our energy requirements as we work towards net zero and every company has a responsibility to immediately reduce emissions from their existing operations while they work their way towards bigger goals."

In my first year as CEO, I've witnessed lots of talk, a lot of promises to achieve X by Y, but I hope in the next year, I will see more action and interventions that can have an immediate effect for a future that's cleaner and greener."

For more information visit sulnoxgroup.com



AVIATION

Thrust issues

The process of decarbonising air travel started years ago, but concern about oil supply problems, especially in light of the Russo-Ukrainian war, is adding impetus to the sector's efforts

Rolls-Royce has been developing an engine for Vertical Aerospace's all-electric VX4 aircraft – a new entrant to the so-called urban air mobility market

Paul Sillers

Aviation has yet to end its 70-year dependence on the highly polluting cocktail of hydrocarbons known as kerosene, but several initiatives are propelling the industry towards a cleaner future. These are focused on sustainable aviation fuel (SAF), liquid hydrogen and electrical power.

SAF can be obtained from a range of renewable sources – for instance, forestry waste, used cooking oil, food packaging and even disposable coffee cups that would otherwise be destined for landfill. Because much of the biomass that's used in its production absorbs carbon from the atmosphere, SAF has "the potential to reduce greenhouse gas emissions by up to 80% compared with conventional jet fuel", according to Shell.

Several airlines have pledged to adopt SAF. For instance, BA's owner, International Airlines Group, has

committed to powering 10% of its flights with the fuel by 2030. In May it took delivery of a batch of SAF made in the Lincolnshire refinery of US oil firm Phillips 66. This will be added to the pipeline infrastructure that feeds UK airports.

Meanwhile, United Airlines has agreed to buy up to 52.5 million gallons of SAF from Finnish refiner Neste over three years to fuel its services from Amsterdam's Schiphol airport. The airline's chief sustainability officer, Lauren Riley, reports that "demand from customers to limit their flying emissions is growing exponentially. This agreement means that customers taking flights from Amsterdam and, potentially, other airports will be partners in our sustainability efforts."

Despite these leading examples, more concerted action is required to ensure industry-wide adoption,

according to Simon Burr, director of engineering and technology in Rolls-Royce's civil aerospace arm. Barriers to the large-scale use of SAF remain, he says. Chief among them are its current lack of "availability, scalability and affordability. We therefore need action on a global scale in forums such as the general assembly of the International Civil Aviation Organization. It's vital that governments agree on a long-term decarbonisation target."

Promoting the use of SAF is a key part of Rolls-Royce's sustainability strategy. The company has successfully tested several of its engines to verify their compatibility with the fuel. Its next-generation engine demonstrator, UltraFan, is set to undergo similar trials.

"Thanks to rigorous testing, we know our engines can operate on SAF," says Burr, who adds that, if

production can be scaled up sufficiently, "uptake will improve affordability and create an environment where more airlines can adopt SAF as part of their flight to net zero".

Liquid hydrogen is another cleaner alternative to kerosene that's come on to the industry's radar. The UK government is pumping £27.2m into a scheme led by GKN Aerospace to develop a hydrogen propulsion system for smaller aircraft that could be scaled up. The H2Gear project is aiming to enable flights by 2026, using a system that converts hydrogen into electricity using a fuel-cell system. The process emits no CO₂.

Partners in the initiative include Aeristech, Intelligent Energy and the universities of Birmingham, Manchester and Newcastle, while easyJet will provide insights into operational requirements and options for flight demos.

"Technology is a key driver to achieve our decarbonisation targets, with hydrogen propulsion a front-runner for short-haul airlines like us," says easyJet's director of flight operations, David Morgan. His company is optimistic that "it could begin flying customers on planes powered by hydrogen combustion, hydrogen-electric power or a hybrid of both by the mid- to late 2030s".

While the arrival of hydrogen-fuelled aircraft will create a new category of cleaner air travel, another approach is to retrofit existing planes with the technology.

ZeroAvia's HyFlyer II project is developing hydrogen engines for demonstration on a 19-seater aircraft that it hopes will fly next year. The Anglo-American company will work with Canada's MHRJ Aviation Group to design and equip regional jets (aircraft designed to carry no more than 100 people on short-haul flights) with a 600kW powertrain.

At the annual summit of the World Economic Forum at Davos in May, the founder and CEO of ZeroAvia, Val Miftakhov, declared that the hundreds of regional flights taking place daily across North America "can and should be zero-emission well before the end of this decade". He called his firm's collaboration "a giant step forward in delivering hydrogen-electric engines to the regional jet segment".

The venture has obtained air-safety experimental certificates for its prototype aircraft from the UK and US airworthiness authorities; passed significant flight tests; and established partnerships with original equipment manufacturers and global airlines. It's on track to start commercial operations in 2024.

ZeroAvia is also developing a 5MW modular powertrain for use in 40- to 80-seat turboprop aircraft – a project with supporters including United Airlines and Alaska Airlines.

As urban road networks struggle to accommodate commuter traffic, the only way is up. That's the rationale behind the evolution of a new category in aviation: advanced air mobility – a mash-up of urban air mobility (flying taxis) and commuter aircraft.

"These aircraft will introduce all-electric flying, which is quieter and more efficient, enabling us to reduce travel times dramatically," says Matheu Parr, customer business director at Rolls-Royce.

The company is planning to introduce both all-electric and hybrid-electric engines for service by the mid-2020s. To this end, it's using next-generation test aircraft, including the Spirit of Innovation. Powered by a 400kW unit, it can claim to be the world's fastest all-electric vehicle, having topped 387mph during a test flight.

Rolls-Royce has also been collaborating with manufacturers Rotax and Tecnam to flight-test a hybrid-electric aircraft powered by parallel-hybrid propulsion – tech that could be applied to larger planes.

Data obtained from testing is already being applied in the urban



Above: Spirit of Innovation, Rolls-Royce's all-electric test aircraft, has been breaking speed records. Far right: GKN Aerospace's H2Gear project is aiming to enable hydrogen-powered flights by 2026. Right: Rolls-Royce has successfully trialled sustainable aviation fuel in its engines



air mobility market. A Rolls-Royce unit has been chosen by Vertical Aerospace for the VX4. This all-electric vertical-takeoff aircraft is designed to transport a pilot and four passengers, emission-free, over 100 miles at 200mph. The Bristol-based firm is aiming to secure certification for the VX4 in 2025 and has obtained conditional orders and pre-order options for up to 1,350 aircraft from players including Virgin Atlantic and American Airlines.

Whichever alternative source of power turns out to be the prevalent choice, one certainty is that tomorrow's skies will feature a broader spectrum of vehicle types. This presents an opportunity for disruptors to shape the future of energy-saving propulsive technology.

Bedford-based firm Blue Bear Systems Research is leading a seven-member consortium that's been developing "a highly power-dense, quiet and efficient propulsion module with zero tailpipe emissions". The design can be adjusted for general aviation aircraft, large cargo drones, air taxis and regional airliners. Co-funded by the government's Aerospace Technology Institute programme, the Integrated Flight Control, Energy Storage and Propulsion Technologies for Electric Aircraft (Inception) project is focused on optimising the conversion of electrical energy into thrust.

The Inception project started in January 2021 and production of the

“The way the industry supplies evidence of airworthiness needs to change if we're to do this more quickly and thoroughly

completed design is under way, with wind-tunnel testing due to start imminently. The plan is to install the module on an aircraft platform, aiming for airworthiness certification in 2026.

The industry needs to have more faith in disruptive new entrants if it's to have a greener future, argues Blue Bear's CEO, Dr Yoge Patel. "The UK is one of the most inventive nations, attracting lots of investment – and Blue Bear has had great government support," she says. "But how do you get that brand credibility when you're a startup?"

The next big challenge, once you have established a foothold in aviation, is staying in the game, Patel says. And the third is to grow your business, either organically or through investment, without losing the innovative culture that "keeps you sharp, stops you becoming complacent and prevents you from being process-driven".

Her firm, for instance, "set out to become an agile systems integrator. It was also important to create an

agile culture and not to be dependent on any of the large companies".

Vertical integration has been crucial to the Inception project. As well as producing the engine, Blue Bear provides all the testing and evaluation infrastructure too.

"We aren't dependent on a third party for that. We also do our own certification and assurance," Patel explains. "We have verticals that we've joined together to allow us to go from an idea to the delivery of flight-tested goods."

That level of control is unusual for an SME. And, while this has given the firm freedom, there is a crucial factor over which it has no sway: the regulation of the next generation of energy-efficient engines that will serve many forms of aviation, potentially using the same airspace.

"The rules and procedures will change," Patel says. "The way the industry supplies evidence of airworthiness also needs to change if we're to do this more quickly and thoroughly. Along with funding, that is an absolute barrier." ●



Phasing out fossil fuel heating from 2026 – is the countryside ready?

For the UK to reach net zero by 2050, emissions from heating will need to drastically reduce. Off-gas-grid homes and businesses are starting almost 10 years before on-gas-grid homes, but do they have the support they need?

Nearly a quarter of the UK's greenhouse gas emissions come from heating buildings. If this heat isn't significantly decarbonised it will be impossible for the country to reach net zero by 2050. The government's heat and buildings strategy, published in October last year, provides proposals to achieve this by phasing out installations of replacement fossil fuel gas and oil boilers. This will begin in 2026 for off-gas-grid homes, and 2024 for larger off-gas-grid business. This 'rural first' approach is almost 10 years earlier than the mooted 2035 phase out start date for gas boilers for homes on the gas grid.

But what does this mean for off-gas-grid homes and businesses? While accepting not all homes are suitable for heat pumps, they are the government's favoured low-carbon heating solution. But while heat pumps are undoubtedly a key technology for decarbonising heating, they cost considerably more to install than a gas boiler and much more in a typical off-gas-grid home, and the installation takes much longer and is more disruptive to households.

To bring down prices and increase innovation, the government's Boiler Upgrade Scheme is providing homeowners with up to £6,000 off the cost of low carbon heating systems up to 2025. But even with this financial help, typical heat pumps are still likely to work out more expensive than a conventional gas boiler. In fact, estimates for retrofitting them on many existing rural homes can cost more than £30,000, when considering energy efficiency upgrades too, depending on the complexity of the job.

Other complications could also hamper the shift to heat pumps. For one thing, there simply aren't enough

heating engineers with the expertise to install them today, so more will need to be trained. Ground-source heat pumps also require considerable outdoor space for a deep hole or long trench, making them unsuitable for certain types of building.

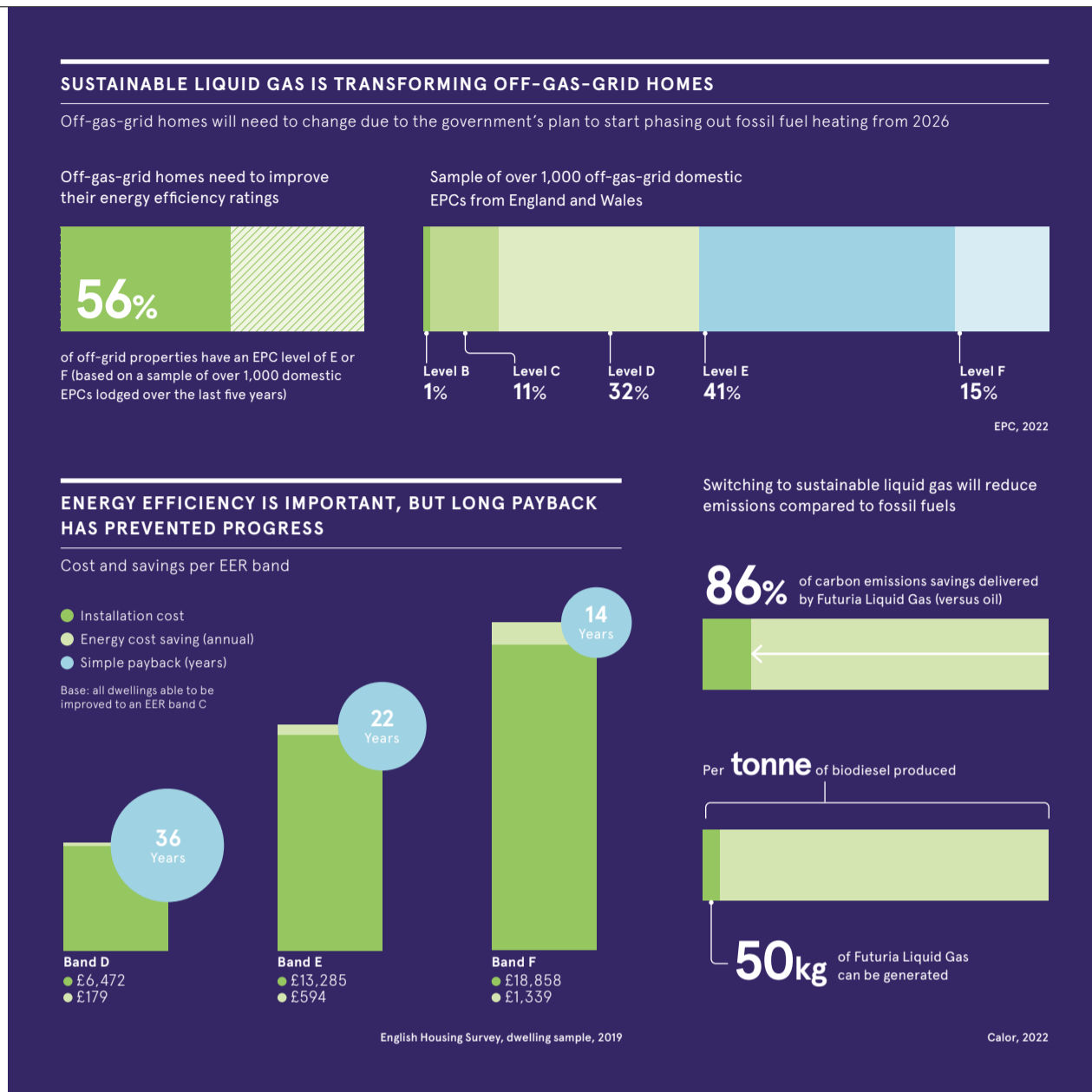
Rural insulation challenge

Currently, 88% of homes are below EPC band C, and the government target is for all homes to have an EPC rating of C by 2035. Many will therefore need extensive improvements to their insulation and heating system – including replacement or additional radiators, hot water tanks, upgraded windows and doors – for a heat pump to work effectively. They also vary considerably in design compared to suburban homes, which makes installations more complicated. In short, off-gas-grid properties could be the guinea pigs for the UK's heating transition.

"Domestic off-gas-grid homeowners are going to be tasked with moving from a well-established heating system with a boiler and a set of radiators, in a property that is built to accommodate that level of heating, to one that is very different," says Andy Parker, head of strategy and corporate affairs at Calor.

The cost of properly insulating a four or five bedroom off-grid rural property could run to over £30,000 in some cases, according to independent analysts Gemserv – and that's on top of the cost of the heat pump itself. "The housing stock in the off-grid market is harder to treat with insulation and other heat saving measures," says Andy Parker, head of strategy and corporate affairs at Calor. "...[and that's] before you even get to finding an installer."

Worryingly, Parker says there is a complete lack of awareness about the



“The government should adopt a ‘heat pump ready’ approach, targeting the most suitable homes for deployment first

proposals in the consultation document. "We've done research with off-grid communities – not just our customers, but those running on a variety of other heating systems – and very few people know about the 2026 date. We strongly advocate that the government should adopt a 'heat pump ready' approach, targeting the most suitable homes for deployment first both on- and off-gas-grid." This will allow installers and the supply chain to increase their experience and capacity by focusing on more straightforward installs.

Alternatives to heat pumps

In under four years, many off-grid homeowners could face an unexpectedly large bill if their heating system breaks down. The government's rural first proposal also appears to have come at the expense of support for other available sustainable solutions that could help to ease the transition from fossil fuel heating systems.

Some of these alternative solutions are more practical than others. Biomass boilers, for example, can negatively impact air quality. Calor's consumer research confirms that off-gas-grid households want to choose from a range of low-carbon heating choices, but they do not expect to pay more for their central heating system than the cost and installation of a conventional boiler.

Calor's Futuria Liquid Gas, also known as BioLPG, can be dropped into existing LPG heating systems today. Futuria Liquid Gas is produced from a range of sustainably sourced feedstock including plant and vegetable waste material and can reduce CO2 emissions by up to 86%. This could be of particular interest to the 69% of off-grid homeowners who indicated it was very important that their future fuel supplies come from renewable sources, according to Calor's own research.

Futuria Liquid Gas is chemically identical to conventional LPG, so it is compatible with existing LPG supply networks and boilers, without modification. This also avoids the cost and disturbance associated with installing a heat pump, by providing the high temperature heating necessary for many poorly insulated rural homes and businesses.

"If you think about the old building stock in the commercial arena, whether that's hotels, pubs or care homes, a lot of these are even harder to heat than some [rural off-grid] homes," says Parker. "The majority of them are running on either LPG or oil boilers. A commercial heat pump install could take several days, so the benefit from

reduced disruption for a business is quite significant. A switch to Futuria Liquid Gas from LPG is seamless, and from oil it just requires a new boiler and storage tank, with no internal refurb work."

Calor Futuria Liquid Gas can also form part of a hybrid heating solution by combining with a heat pump. For example, during relatively mild weather a heat pump may be capable of providing all the heating needed. "But when the weather is at its coldest, or during moments of higher demand, a boiler could be used to supply both the heating and the hot water," says Parker.

There's no silver bullet for decarbonising heat for homes and businesses. Indeed, a range of solutions will be needed to decarbonise heat across the UK's 30m buildings. But the government's current 'heat pump first' strategy means there is not enough focus on other options. And as Parker says, while "heat pumps are going to be a really significant factor in the transition, they're not suitable for every property that's out there."

To find out more, please visit calor.co.uk/futuria



STORAGE TECHNOLOGY

Towers of power

Advances in gravity battery technology have the potential to produce a cheap, effective and sustainable method of storing renewable electricity. This could prove key to our clean energy transition

Jon Axworthy

On the evening of 16 June 2020, the UK notched up a remarkable achievement. While it wasn't a spectacular feat of the headline-grabbing, Guinness Book of Records-troubling kind, it was arguably far more momentous. The country had come to the end of a 67-day, 22-hour and 55-minute streak in which it had satisfied all its energy needs without using any coal power – something it hadn't managed for nearly 140 years.

Although the first Covid lockdown had undoubtedly played its part by drastically reducing the nation's energy consumption over that time, this was still an impressive milestone. With the race towards net zero very much on people's minds, it served as a timely reminder of the International Energy Agency's forecast that renewable energy will become the largest source of electricity generation worldwide by 2025.

But a fundamental technical problem needs to be solved before the UK can achieve its clean-energy revolution. The problem is that the supply of renewable energy cannot always match the demand, so all the excess megawatts generated by the

nation's numerous solar parks and wind farms need to be stored somewhere until they're required.

In the spring of 2021, one potential solution to this problem could be found on an industrial site in the port of Leith, Edinburgh. The 15m latticed steel tower looked very much at home in its surroundings, but it wasn't there to unload freight from ships in the harbour. It was there to store green electricity.

This so-called gravity battery was a small-scale prototype created by Gravitricity, a Scottish startup that was aiming to work out what a full-sized version might achieve.

"The purpose of this demonstrator was to test our technology in a real-world environment, verify the speed of response and confirm our modelling," says Jill Macpherson, the firm's senior test and simulation engineer. "It allowed us to measure the performance of a real grid-connected system, compare it with expectations and learn technical lessons at a reduced cost."

The system worked by using excess electricity generated by solar arrays to power motors that hoisted a pair of 25-tonne weights on steel



“The demonstrator was rated at 250kW – enough to sustain about 750 homes, albeit for a very short time

cables to the top of the tower. In effect, it converted the sun's energy into gravitational potential energy. When the weights were allowed to drop (at a highly controlled rate), this converted the motors into generators that released electricity back to the grid.

"The demonstrator was rated at 250kW – enough to sustain about 750 homes, albeit for a very short time," Macpherson explains. "But it

Gravitricity's test rig at the port of Leith was able to deliver full power in less than a second

confirmed that we can deliver full power in less than a second, which is valuable to operators that need to balance the grid second by second. It can also deliver large amounts more slowly, so it's very flexible."

This way, the gravity battery can store much of the solar power that is generated during the daytime, when household demand for it is relatively low, and then release it in the evening, which is when domestic consumption peaks.

According to an assessment by researchers from Imperial College London before the Covid crisis, Gravitricity's system offers energy storage at a cost of £137 per MWh averaged out over 25 years. That's less than half the cost of a comparable set-up using lithium-ion batteries: £293 per MWh – an estimate that doesn't account for the ethical and environmental costs incurred in their production.

Gravitricity's prototype also gives encouraging indications about the potential longevity of a full-scale version. The company estimates that it could last 10 times longer than an equivalent lithium-ion battery.

"The demonstrator proved that we could control the system to extend the lifetime of certain components," Macpherson says. "For instance, we tested control methods to reduce peak forces and maximise the number of lifting cycles that the cabling can tolerate. The system is also designed so that parts can be replaced easily, so there is real scope for it to have an operational lifetime running into decades."

Gravitricity is planning to use abandoned mine shafts, many of which go hundreds of metres deep. These would be repurposed to house full-scale batteries.

The irony in the notion that old coal pits can help to supply the nation with renewable energy isn't lost on the firm's MD, Charlie Blair.

"Full-scale energy stores in former mines can make good use of existing infrastructure and create jobs where they're most needed," he says. "The emotional aspect of this is also important. Whole communities once worked in these mines – and generally they're very happy to see them being reused this way."

There is also potential for the batteries to be housed in modular buildings, each containing thousands of weights, with the design of each building corresponding to an energy demand specific to the grid to which it's connected. A tall, slim tower could provide a lot of energy in a relatively short time, for example. But, if the footprint of that building were increased, it would also lengthen the period over which that energy could be released.

These structures could be constructed in many more locations than, say, pumped hydro systems, which require far more land and are restricted to highland tracts with a plentiful supply of water.

With enough foresight, there is even an opportunity for gravity batteries to be incorporated into the design of new tower blocks.

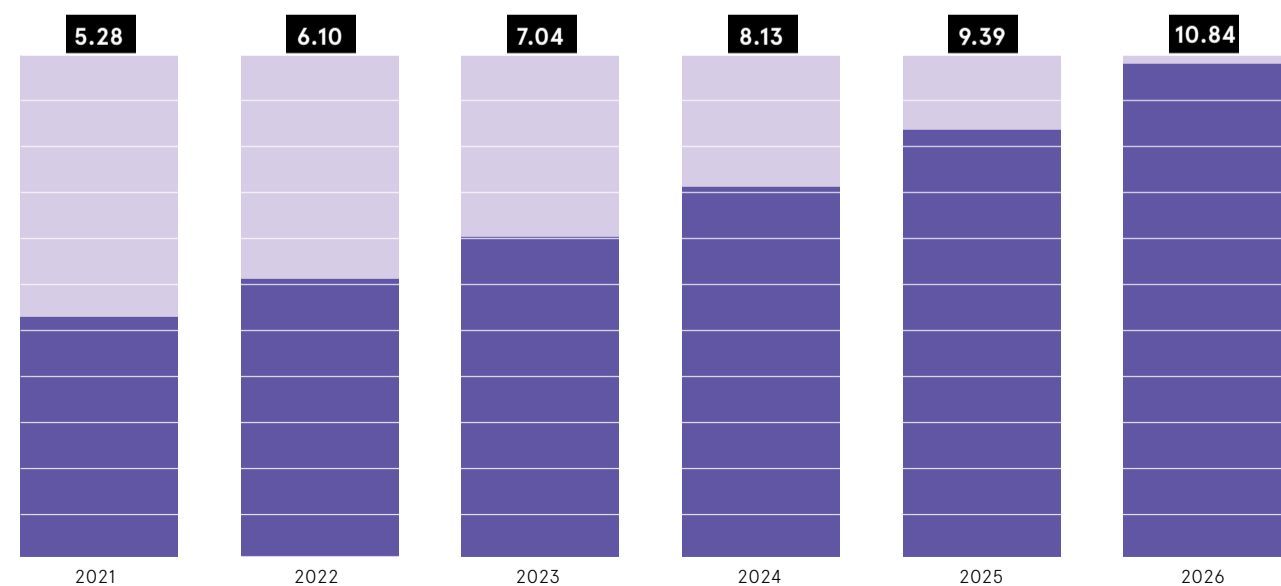
"There is also huge potential for improving storage capacity by increasing the density of the material being lifted," notes Asmae Berrada, professor of energy at the International University of Rabat, Morocco. "It could even be made of recycled materials, which would significantly reduce the system's cost. We are currently building a prototype using steel waste, for example."

The prospects seem promising for this fast-developing technology. At a time when we're desperate for certainty in our quest for a future powered by clean energy, what could be more reassuring than having a supply that's primed and ready for release on demand? After all, what goes up must come down. ●

DEMAND FOR BATTERY STORAGE IS SET TO KEEP RISING

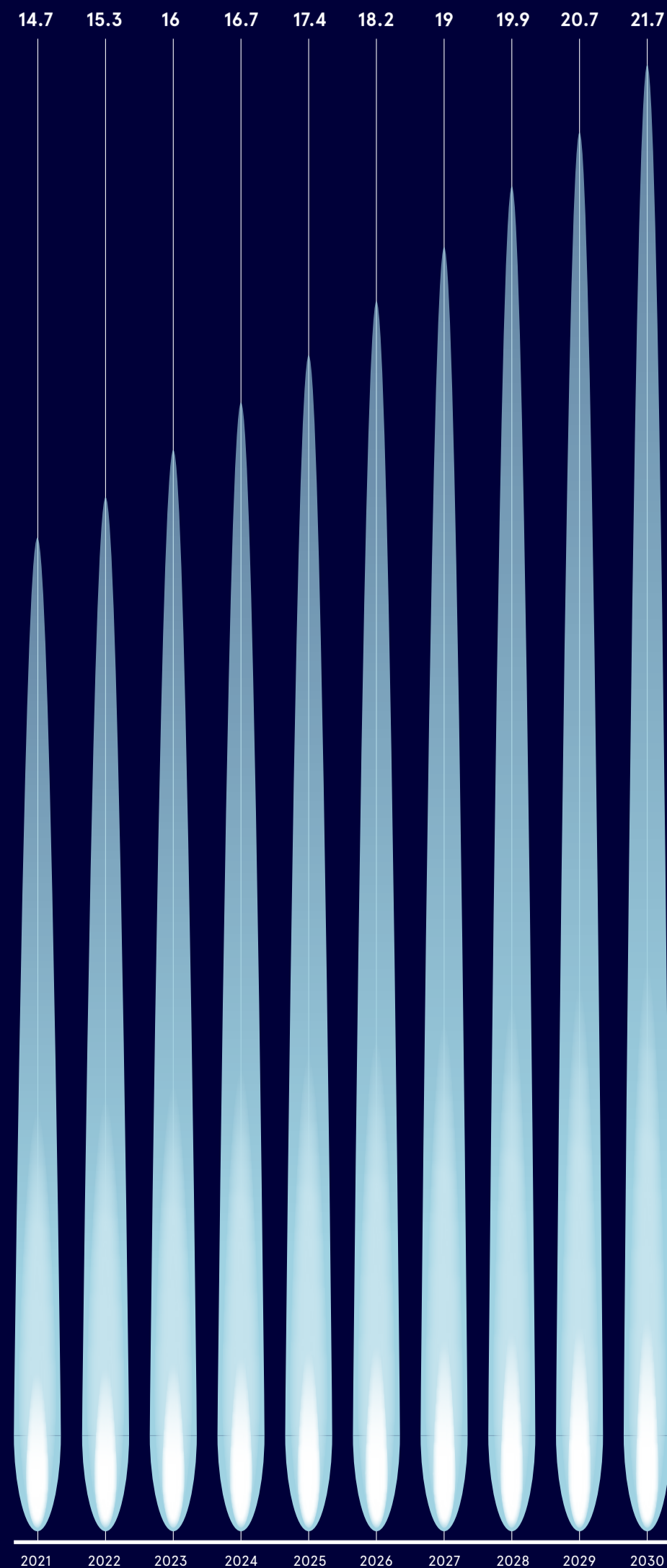
GlobalData, Statista, 2022

Forecast value of the global battery storage market (\$bn)



DEMAND FOR HYDROGEN IS SET TO KEEP RISING

Projected size of the hydrogen energy storage market over the decade (\$bn)



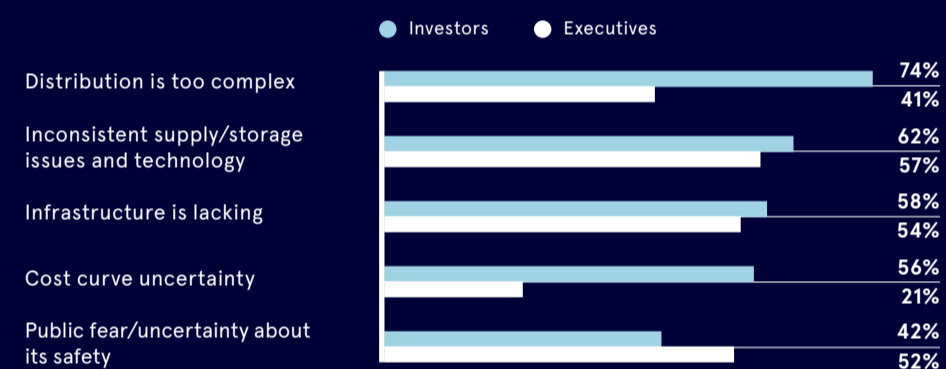
Grand View Research, Statista, 2022

HYDROGEN HYPE

As the world continues to move towards net zero, hydrogen (both green and blue) is becoming an increasingly important part of the energy mix, but it's not without its disadvantages

THE MAIN PROBLEMS WITH HYDROGEN

Percentage of investors and senior executives worldwide who cite the following as the key problems associated with hydrogen energy tech



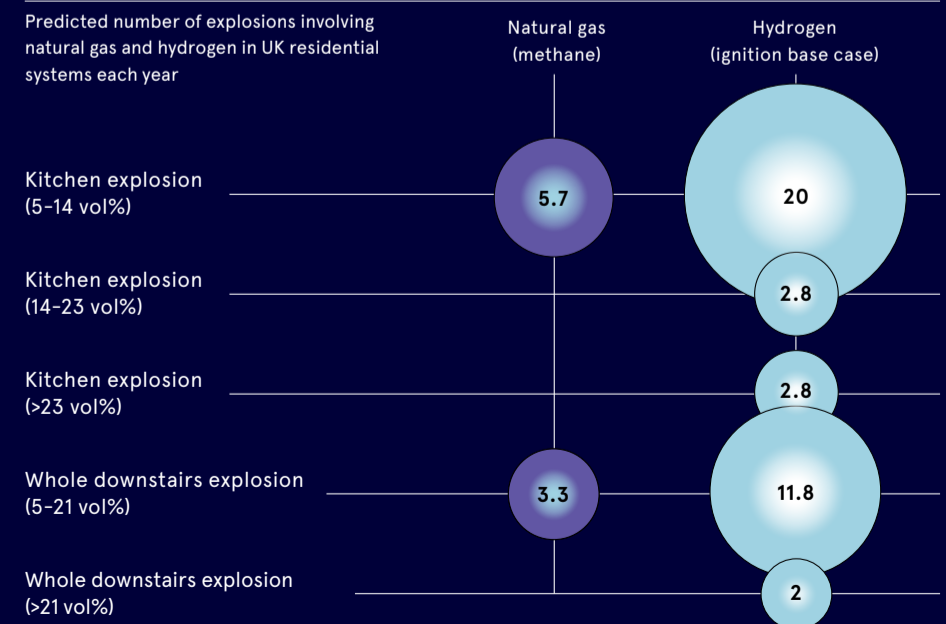
Womble Bond Dickinson, 2021

50% more expensive to store hydrogen than it is to store methane, but storing hydrogen in salt caverns can be... **1%** of the cost of storing electricity

International Renewable Energy Agency, 2021

SAFETY REMAINS A SERIOUS CONCERN

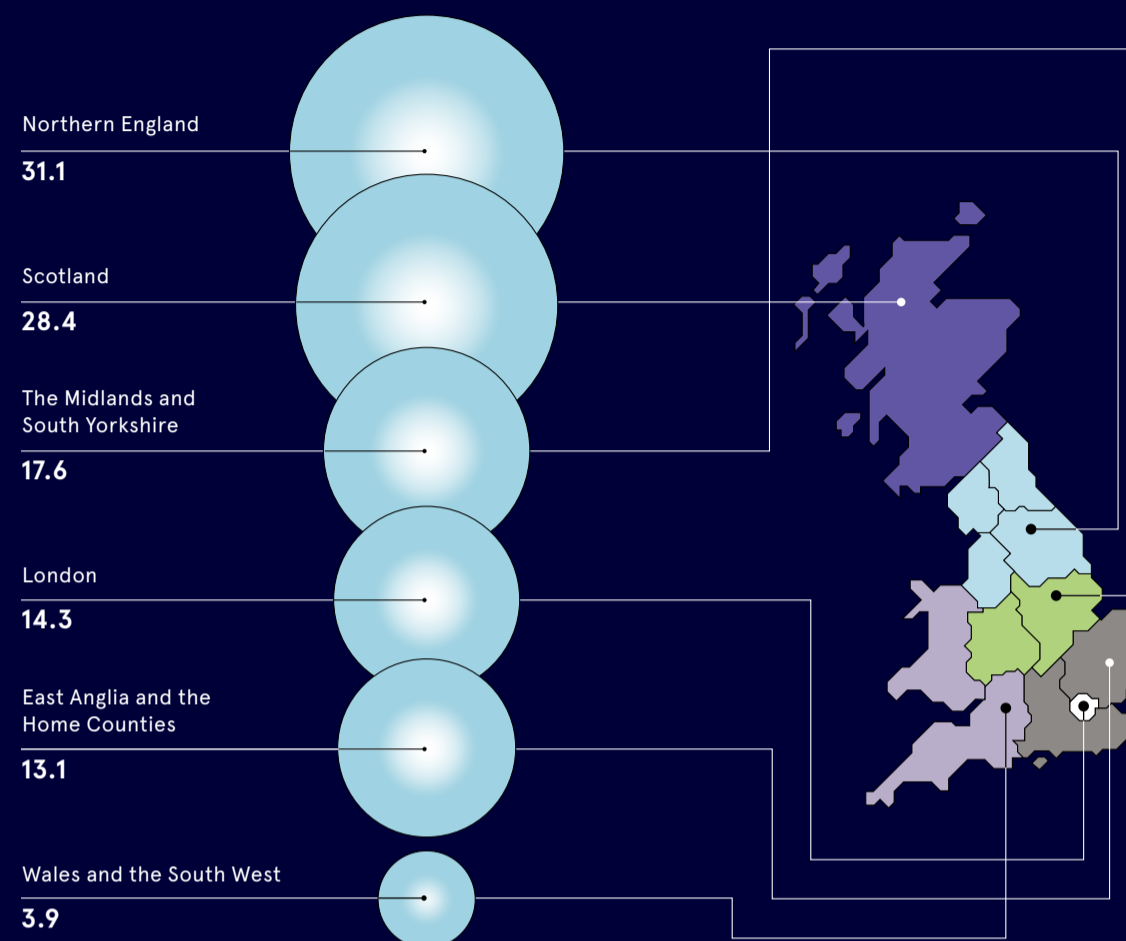
Predicted number of explosions involving natural gas and hydrogen in UK residential systems each year



Arup, Hy4Heat, Department for Business, Energy and Industrial Strategy, 2021

MAKING PROGRESS WITH BLUE HYDROGEN

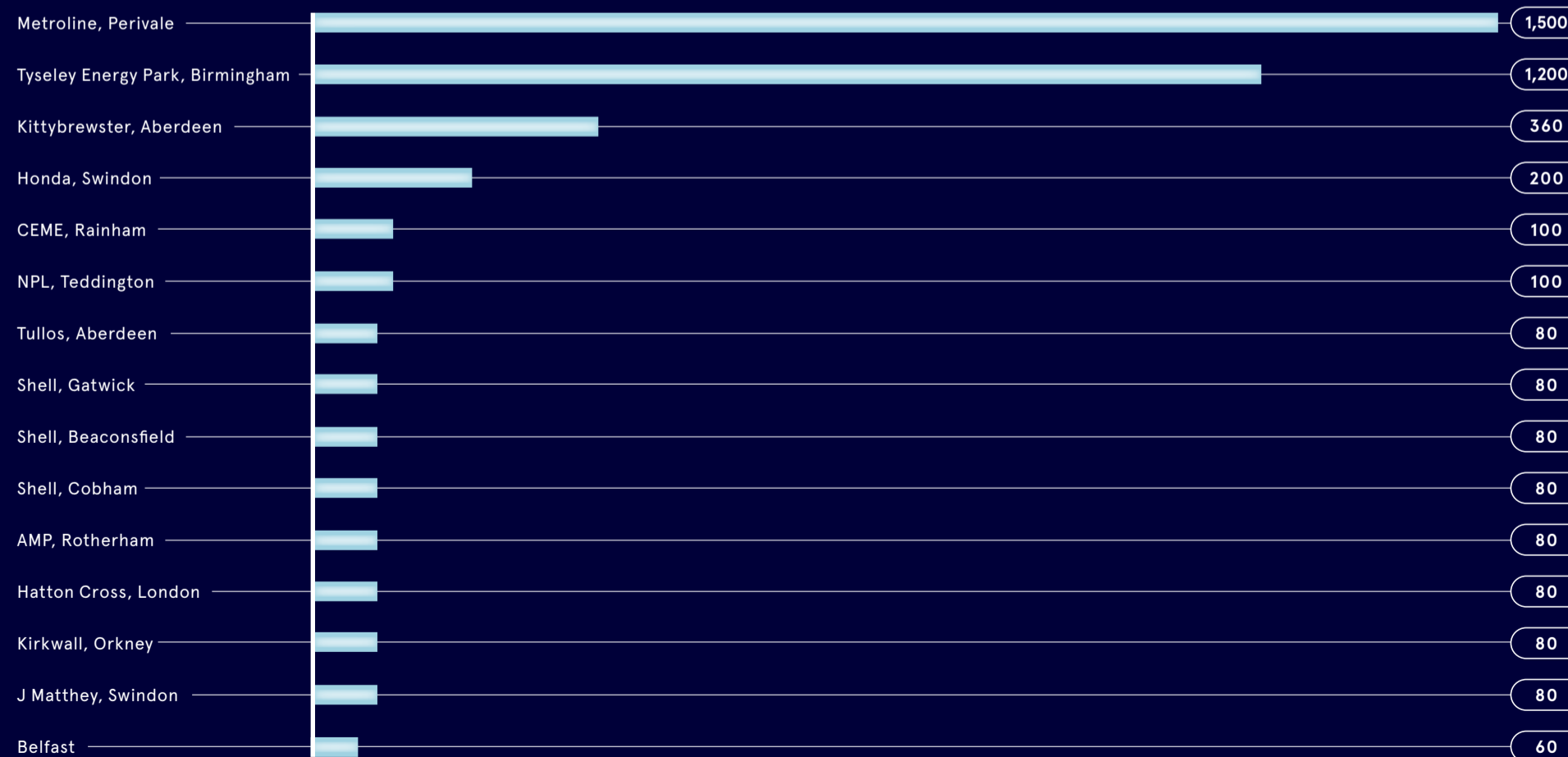
Projected blue hydrogen production capacity installed in the UK in 2050, by region (GW)



Element Energy, Equinor, 2019

WHERE TO GET YOUR HYDROGEN

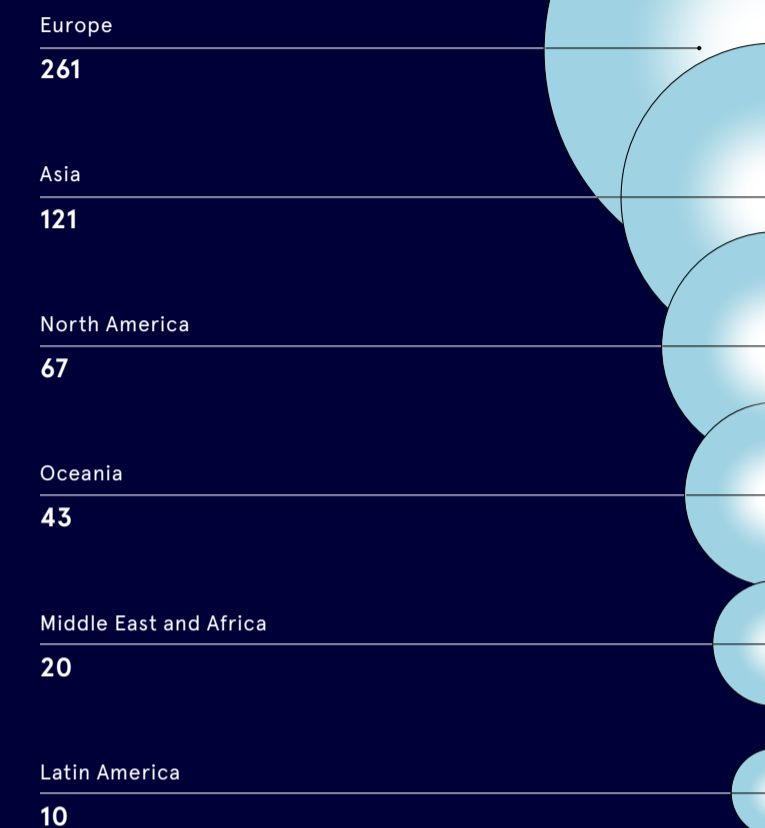
Largest public refueling facilities offering hydrogen in the UK by capacity (kg per day)



H2 Mobility, 2021

WHICH PARTS OF THE WORLD ARE LEADING THE CHARGE?

Number of hydrogen projects announced as of 2021, by region



McKinsey, 2021



INNOVATION

R&D to revive the P&L

Inventive players in all parts of the industry are busy developing new business models and technologies with the potential to reduce fuel bills across the UK

Jonathan Weinberg

The unwelcome return of high inflation to the UK this year has hit everyone in the pocket, but it's presented a stark choice between heating and eating for millions of vulnerable consumers, as increases in the price of essentials such as energy and food show little sign of abating.

To counter the energy industry's significant contribution to the cost-of-living crisis, a growing number of challengers and startups have been working hard to bring prices down over the long term through innovative means.

For many of them, that has meant focusing on green solutions, particularly wind power. For instance, Glasgow-based company Katrick Technologies is trialling a flexible modular system that works with a wider range of wind speeds than conventional turbines can use. Each hexagonal unit features an array of vibrating mini-aerofoils that, the firm says, could generate

22MWh of carbon-free power annually. The system is far smaller than a typical wind farm turbine, which means that units could be mounted in built-up areas and operate effectively and relatively unobtrusively.

This is just one innovation that could provide cheaper renewable energy by tapping into a trend for local microgeneration, with whole communities owning and running some larger installations.

Another option for collective ownership is demonstrated by green power challenger Ripple Energy. Each of its customers buys a tiny stake in a large-scale wind farm. Ripple's supply partners buy the electricity that this generates at its relatively low and stable operating cost, rather than at the high and fluctuating market rate. The saving is passed on to customers in the form of monthly bills that are discounted according to how much electricity their share of the farm generated the previous month.

"Five years ago, onshore wind became the UK's cheapest source of electricity, but people couldn't access it directly. Wind farms were owned by pension funds and utilities," says the company's founder and CEO, Sarah Merrick. "Now that people can see the direct link between owning part of a wind farm and getting cheaper electricity, they are spreading the word. Ownership really helps to protect consumers against price spikes."

Ripple's first wind farm has 900 owners, whose average saving this year is expected to be £350. A much larger facility will start generating from late next year, owned by 5,600 individuals and 19 businesses.

It's not only domestic customers who've been suffering because of the energy crisis, observes Chantel Scheepers, CEO of OakTree Power.

"SMEs have often been ignored in a polarised national conversation about its impact, which has generally involved energy-intensive

industries and households," she argues. "Smaller firms absolutely need to shield themselves from a worsening situation, as the government's handouts simply aren't sustainable and will fall short soon."

Scheepers' company applies what could be classed as a demand-side response to the price problem, modulating energy usage in commercial buildings. The firm's AI-based systems identify when and where consumption can be reduced for short periods without affecting performance, potentially saving users tens of thousands of pounds a year. Commercial partnerships with grid operators are also in place, rewarding firms financially for making up energy shortfalls when supply and demand across the grid are at odds.

"This enables SMEs to tap into the most precious kilowatt there is: the one that you learn to use at a time that's cheaper – or don't use at all," Scheepers says.

New ways to improve energy efficiency are gaining traction on the supply side too. Peter Bance is CEO of Origami Energy, which provides machine learning technology to the owners of energy assets – solar panels turbines and batteries, for example – to help them understand changing market and physical conditions. The information it generates enables them to act swiftly to maximise their savings.

Bance believes that energy firms will depend on such systems for their survival, adding that digital optimisation can reduce prices. "A 'dumb' green transition – one that isn't digitally smart – will simply keep them increasing. For costs to go down for consumers and businesses, costs first need to go down for suppliers," he says.

For its part, Westminster has been pumping public money into the R&D effort. In April it allocated a "wide-ranging £375m package of support for innovative energy technologies", promising that this would "power British homes and businesses for decades to come".

Bance is also a non-executive director at the Energy Systems Catapult, a not-for-profit enterprise focused on bringing government, academia and industry together to accelerate innovation. The group believes that policy-makers should mandate that any new green energy product must have digital systems built into it from the outset to maximise its efficiency.

As part of his role at the Energy Systems Catapult, Bance advises on how digital technologies can best be applied. He argues that another priority for the government should be to engage with the host of innovative startups and

SMEs working in the sector, rather than focusing on big companies.

Another policy idea might come from the US, where President Biden has announced that he will use the Defense Production Act 1950 – normally invoked whenever the country is at war – to mobilise the production of goods ranging from insulation to energy-efficient heat pumps. The chief aim is to push down their prices to encourage greater uptake among businesses and consumers.

In the shorter term, an investment in public education could make a difference in reducing energy consumption and, therefore, costs. Merrick says that there's an important role for "low-tech and not very innovative" solutions, citing a desperate need among vulnerable customers for help to reduce their energy consumption next winter. Relatively cheap, straightforward and effective measures include stopping draughts, insulating lofts and adjusting the flow settings on condensing combination boilers to improve their efficiency.

In the longer term, it's hoped that machine learning systems will assess market prices in real time and create dynamic tariffs, which could benefit all energy consumers.

Adam Ault, technical consultant at IT services company Ailmi, says that such systems could "identify people most at risk of entering fuel poverty and move them to an affordability tariff" before those customers even realise themselves.

Ault, who notes that such tech is already being used in the water industry, believes that utility providers could quickly identify struggling customers and alert each other to potential problems through the greater use of open data.

More cooperation will be needed if the UK is to get through the energy crisis. That's the view of Dhara Vyas, director of advocacy at industry trade body Energy UK, who also believes that it's crucial to leave no one behind.

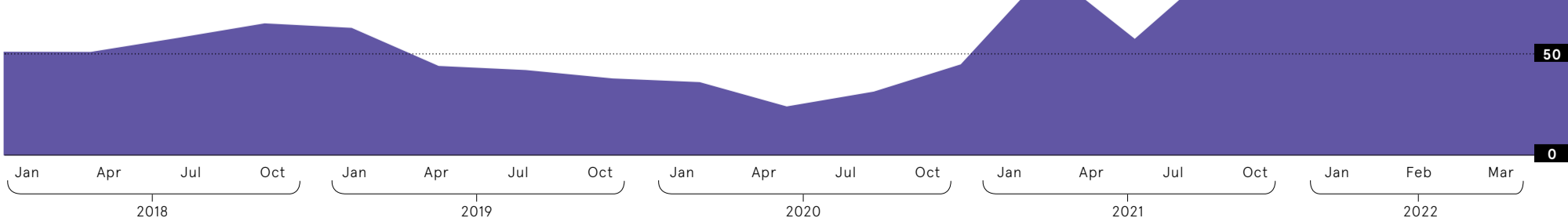
"Government, industry, financial institutions and the regulator need to work together," Vyas stresses.

"We must all ensure that the energy market will work for everyone, not just those most able and willing to adopt new technologies."

What does the North Sea transition deal cover and why is it so significant? Last year the UK's offshore oil and gas sector signed a transformative partnership with the government known as the North Sea transition deal. This agreement, which was the first of its kind sealed by any G7 country, is a tangible example of the nation's commitment to becoming a global leader in tackling climate change. It's crucial to harness the power of offshore oil and gas to help the UK meet its net-zero targets by 2050, affordably and at pace. The deal is a blueprint for cutting emissions, accelerating home-grown greener

SOARING ENERGY PRICES REACH CRISIS LEVELS

Monthly average electricity prices in Great Britain (£ per MWh)



'Our sector is a vital asset in reducing emissions. We mustn't be shy about telling people that'

The CEO of industry body Offshore Energies UK discusses innovation, the North Sea transition deal and the pursuit of a greener future

Q How are your members joining the journey towards a greener future?

A As an industry, it's vital for us to show that we are committed to change and that we are excited about the positive role that we can play – and are already playing – in developing the UK's low-carbon energy future.

Many of our members are already investing and diversifying into the exciting low-carbon technologies of the future, while others need to stay focused on ensuring the production of cleaner oil and gas. Whether it's through the development of new technologies such as carbon capture and storage or hydrogen power, or the billions of pounds of investment into crucial low-carbon solutions, our sector is a vital asset in accelerating the reduction of emissions. We need to make sure we're not shy about telling people that.

Q There is a huge amount of investment and innovation in energy at the moment. Which trends and projects are you most excited about?

A While I'm optimistic about the range of projects transforming our industry – including supply decarbonisation, carbon capture and storage, hydrogen and the transformation of our supply chain – I'm really looking forward to seeing how our people and skills will develop. As our industry evolves, we know that our workforce must do so too.

The North Sea transition deal makes a commitment to aid the reskilling of parts of the oil and gas workforce to ensure that people and skills are transferable across the wider energy sector. It's a real future-proofing of our industry.

As a sector, we need to continue attracting and retaining diverse talent if we're to find the solutions to the challenges facing the industry. Diversity – of thought, of experience and of background – will be crucial in our efforts to navigate the energy transition and unlock the potential of our industry in the journey to net zero.

Q What does the North Sea transition deal cover and why is it so significant?

A Last year the UK's offshore oil and gas sector signed a transformative partnership with the government known as the North Sea transition deal. This agreement, which was the first of its kind sealed by any G7 country, is a tangible example of the nation's commitment to becoming a global leader in tackling climate change. It's crucial to harness the power of offshore oil and gas to help the UK meet its net-zero targets by 2050, affordably and at pace. The deal is a blueprint for cutting emissions, accelerating home-grown greener

energies and creating a new generation of low-carbon jobs. By 2030, the deal seeks to unlock up to £16bn of investment, secure up to 40,000 energy jobs and reduce CO₂ emissions by up to 60 million tonnes.

While our industry is committed to moving to a lower-carbon economy, we must recognise the importance of hydrocarbons in the energy mix of the future, albeit in declining amounts. Continued investment in North Sea oil and gas will enable the industry to make the transition, but in a way that, at a time of great geopolitical unrest, does not compromise our need for secure, reliable and sustainable energy supplies.

Q There is a huge amount of investment and innovation in energy at the moment. Which trends and projects are you most excited about?

A While I'm optimistic about the range of projects transforming our industry – including supply decarbonisation, carbon capture and storage, hydrogen and the transformation of our supply chain – I'm really looking forward to seeing how our people and skills will develop. As our industry evolves, we know that our workforce must do so too.

The North Sea transition deal makes a commitment to aid the reskilling of parts of the oil and gas workforce to ensure that people and skills are transferable across the wider energy sector. It's a real future-proofing of our industry.

As a sector, we need to continue attracting and retaining diverse talent if we're to find the solutions to the challenges facing the industry. Diversity – of thought, of experience and of background – will be crucial in our efforts to navigate the energy transition and unlock the potential of our industry in the journey to net zero.



Deirdre Michie
Chief executive, Offshore Energies UK

Fair wind ahead for sustainable growth

Séverine Baudic, managing director of SBM Offshore's new energies and services division, explains how we can develop sustainable and affordable energy for generations to come

SBM Offshore is optimistic that down in the sparkling seas of Southern France it is working on technology primed to accelerate the global energy transition. The Dutch-based group is currently piloting new floating offshore wind solutions in waters near Marseille and is set to launch fabrication of a wave energy prototype to be deployed offshore Monaco in the future.

"Since Covid and the Russia-Ukraine war, we have seen a stronger drive from governments to accelerate energy transition to renewables," says Séverine Baudic, managing director of SBM Offshore's new energies and services division. "This is only going to increase and one of the keys to getting it right is to be able to provide this energy at an affordable cost. That is something we and other innovative firms are aiming towards."

SBM Offshore is most commonly associated with serving oil and gas energy giants such as Exxon Mobil with its 15-strong fleet of floating production, storage and offloading vessels (FPSOs). It currently has five FPSOs under construction and it remains the company's main revenue generator.

For around a decade, the company has strived to utilise its offshore technological experience in the renewable energy market. The main area of focus is floating offshore wind – essentially an offshore wind turbine erected on a floating structure. It is ideal technology for areas off a coast or further out to sea where fixed offshore wind platforms are not tenable because of depth or weather impact.

"At the time there really wasn't a floating wind market at all but we believed we could use our existing knowledge of the tension leg platform (TLP) technology as a solution," explains Baudic.

In 2016, SBM Offshore was selected by French energy group EDF to work on



the pilot Provence Grand Large floating offshore wind project 17km offshore Marseille. SBM Offshore designed three offshore wind floaters – vertically moored with low motion – based on a TLP design, which will each hold 8.4MW Siemens turbines. It is now assembling the floaters which are expected to be operational in the water by the end of next year.

SBM Offshore has also designed a second-generation floater called Float4Wind which is suitable for ultradeep water of 2,000 metres, harsher conditions and the world's biggest turbines. It can also be fabricated and assembled more quickly. The design is simpler and ready for industrialisation, with the aim to be cost competitive.

"The floating wind market is now real, with two competitor technologies already in the water," says Baudic. "But we, and the other up to 80 different floater concepts in this industry, need to prove first that the technology works."

SBM Offshore is confidently targeting over two gigawatt of installed or under construction floating wind capacity by 2030. "And looking at our potential clients, they are not just renewable utility companies; we see more oil and gas players investing in the energy transition. That is making a difference to the size of the overall market and our business as they recognise our experience," Baudic explains.

The company is eyeing up opportunities in key markets such as France, West Coast USA, the UK, South Korea and Japan to drive its growth. "In these markets, the only solution is floating wind," Baudic says. "We are already working on other future test and demonstration projects including in the Celtic Sea."

It is not just a solution for the environment but also for the economy and local jobs, with assembly of floating wind components taking place in factories and harbours close to project sites. However, despite these benefits, Baudic believes project development is still too lengthy, not helped by permitting delays. The recent rise in inflation is also hiking supply chain costs such as steel. It means that the search for alternative renewable solutions needs to continue, for instance wave energy. "We want to harness the power of the ocean," she says. "There is no wave energy market at the moment, but the long-term potential is huge."

Given the timescale and nascent nature of both floating wind and wave energy, SBM Offshore is realistic that energy transition will take time. With the recent hike in oil prices and governments realising that fossil fuels can play a crucial role in reducing dependence on Russian energy, there is still life left in SBM's traditional oil and gas division. But it must continue to change.

To help the oil and gas sector take green steps SBM Offshore has an emissionZERO programme reducing emissions from FPSOs. Baudic explains: "We are an energy transition company. We see the future of energy centred on decarbonising fossil fuel energy and developing renewable solutions."

“We are an energy transition company. We see the future of energy centred on decarbonising fossil fuel energy and developing renewable solutions

To find out more, visit sbmoffshore.com



The carbon-neutral future is electric

Gerhard Salge, CTO of Hitachi Energy – an innovation-driven technology leader in power grids which is advancing a sustainable energy future for all – explains why electricity will be the backbone of the entire energy system

Electricity has improved our standard of living since its invention more than 200 years ago. However, over the next 30 years, the changes that will deepen electrification in the name of sustainability will go beyond anything we have seen before. The evolution of the total world energy system shows that global electricity consumption will more than double from around 20% (today) to significantly more than 40% of total energy demand by 2050. Certain regions of the world – like Europe – will go far beyond this.

Three building blocks are stacking up to deliver this carbon-neutral electric future: connecting larger volumes of wind, solar and hydro to the grids; electrifying the world's transportation, building and industrial sectors; and, where direct electrification is either not efficient or impossible, introducing complementary and sustainable energy carriers. Combined, these blocks will give us the foundation upon which electricity will become the backbone of the entire energy system and on which sustainable societies can progress.

The most efficient, cleanest and cost-effective way to electrify the world is to build renewable energy capacity and harness energy from wind, sunshine and water that nature provides in practically unlimited reserves. As a result, we estimate that global renewable energy capacity will grow by much more than a factor of ten until 2050.

Electrification, powered by this huge growth in variable renewable power generation, brings a host of new challenges – but two stand out most. The first is tackling the complexity arising from a greater number of widely distributed and less predictable power generation sites. The second is the need to significantly upgrade and expand grid capacity to accommodate the rapid growth in demand.

In order to manage fluctuating electricity production and new consumption patterns, our energy system needs to become more flexible, and new tools are required to deliver this. Innovative grid components using

power electronics will provide the operational flexibility needed to enable grids to become more efficient. Sensors will provide the necessary information, and digital solutions will process the huge amount of information in intelligent grid control centres. This will enable faster decision making in a much more dynamic and complex environment, without compromising on reliability of the electricity supply.

The second challenge, expanding grid capacity, can be tackled in two ways: optimising the utilisation of current networks and upgrading and extending power systems. Here, we can rely on clever combinations of power electronics and digital technologies to optimise copper and iron efficiencies on existing power grids, and also on all new additional capacity installations.

One recent example is in Scotland, where a high-voltage direct current (HVDC) link is being built to connect Shetland to the Scottish mainland. The Shetland link will allow efficient transmission of renewable wind energy, increase reliability in the mainland grid and enhance the security of supply for Shetland. The link will contribute to the UK's decarbonisation target of bringing all greenhouse gas emissions to net zero by 2050. Hitachi Energy is also connecting the world's largest offshore wind farm at Dogger Bank, located 130-190km off the North East coast of England, to the mainland transmission network at Teesside and Croyke Beck. These installations and others will significantly contribute towards the UK government's goals of sourcing up to a third of its electricity from offshore wind by 2030.

Grid capacity will need to cope with more than twice the electrical energy of today. This includes the expansion of high-voltage networks and interconnections across regions, linking renewable energy generated in remote places, such as offshore wind farms.

From a demand-side perspective, this huge expansion will enable electrification to significantly rise in areas that have so far been low load regions – away from densely populated cities where demand is high. For example,



through electrification, it will become easier to locate a growing number of data centres in secluded areas. And we can expect to see more industrial sites, such as steel plants and mining operations, turn to electrification in a move to convert away from carbon-intensive processes whilst simultaneously, increasing efficiency. Over the next thirty years, we are likely to see power systems also growing into geographical areas that, up to now, have rarely been taken into account in grid expansion planning.

The journey towards a carbon-neutral energy system is dependent upon future power systems that are extremely flexible. They will need to cope with increased complexity, brought about by the need to integrate bulk and distributed variable power generated from renewable sources.

Whenever grid flexibility is required, the first and most proven technical solution is grid expansion and

interconnection. Once this reaches its limit, energy storage starts to play an important role in the pathway towards a carbon-neutral energy system. Battery storage for electricity has already made impressive strides over the past years. With the rise of variable renewable power production comes a greater need for short-term electricity storage to ensure the reliability of the power system. Battery technology is on its way to becoming the dominant solution for meeting short-term needs. It offers the highest flexibility and the most attractive cost-benefit ratio.

When planning and designing the future energy market, an important aspect that decision-makers should consider is not to overly rely upon one direction only. Power system expansion and interconnection offers opportunities to link time zones and even climatic zones instantaneously. Nevertheless, the future energy system needs both interconnections and energy storage. It should never be a question of building one or the other – because they are complementary.

Time is of the essence in the move towards a carbon-neutral energy system. There have been several welcome policy announcements and initiatives of late, setting ambitious targets. This includes the stimulus initiatives and goals to accelerate the European Union's way forward, but also targets set by several further countries including the UK, Japan, China, India and South Korea.

While this is laudable, it is imperative that planning and execution cycles are accelerated to unlock the necessary investments in our energy infrastructure. Policymakers need to set a clear agenda and enable this to happen, which includes putting in place the right regulatory framework and ensuring a degree of collaboration in key areas such as grid codes and market mechanisms. The area of interconnected electricity networks is also becoming increasingly important to maximise the penetration of renewables. Collaboration will clearly be a key success factor.

Be it North Sea winds powering electric vehicles or solar power feeding air conditioning systems, a carbon-neutral energy system will reshape the world. The challenge is so big that there is no room for picking winners – we need all sustainable solutions, current and future. We should not waste our energy and time arguing about which is the most optimised option, but instead focus on building sustainable partnerships and accelerating implementation, only then we will make a real and timely impact.

For more information, visit [hitachienergy.com](https://www.hitachienergy.com)

Hitachi Energy

DECARBONISATION

Green energy sector looks to its laurels

Renewable suppliers are striving to make their own supply chains more sustainable

David Stirling

The race to achieve net-zero carbon emissions targets is intensifying as concerns about global warming and climate change deepen. Although wind and solar plants are easing the world's reliance on fossil fuels, renewable energy companies are well aware that they have emissions problems of their own to solve, largely from within their supply chains.

Take wind power: most turbine blades contain petrochemical-based resins. The production of these and other materials that go into them – steel, for instance – emits a lot of CO₂, as does transporting them.

In the solar industry, meanwhile, polysilicon is a key constituent of panels. Three-quarters of the global manufacturing capacity resides in China, but there have been worrying reports about the use of coal power – and even forced labour – in the material's production.

Consequently, there is growing pressure on renewable energy players to do more to ensure that their supply chains are sustainable and ethically sound. At the end of the United Nations' COP26 climate conference in Glasgow, the summit's president, Alok Sharma, urged the sector to “encourage your suppliers to commit to net zero and work with them to reduce emissions”.

In March, the Clean Energy Buyers Institute set up the Decarbonizing Industrial Supply Chain Energy initiative, which aims to increase awareness and develop tools to decarbonise the solar supply chain. It encourages energy customers and developers to collaborate on clean

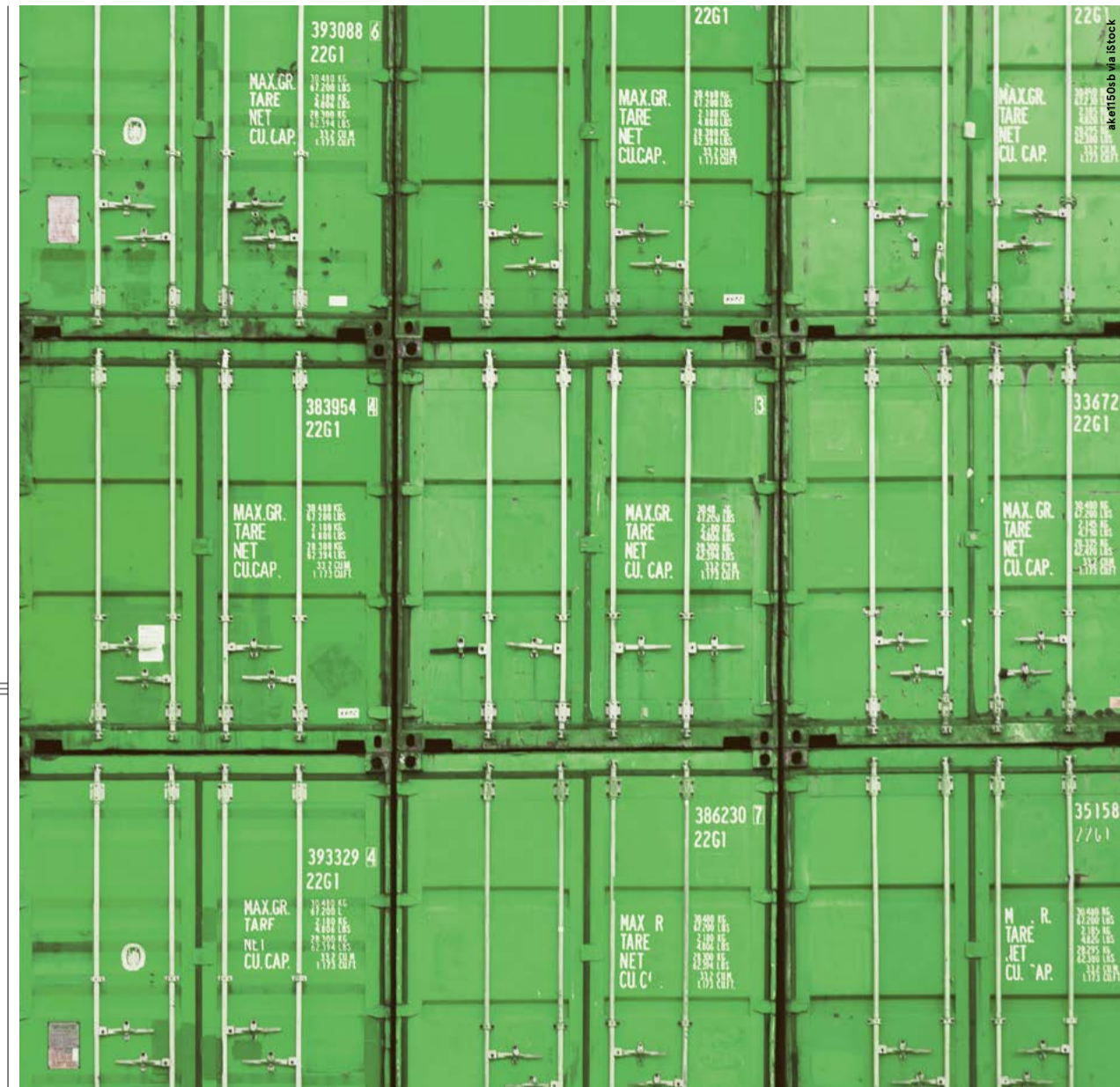
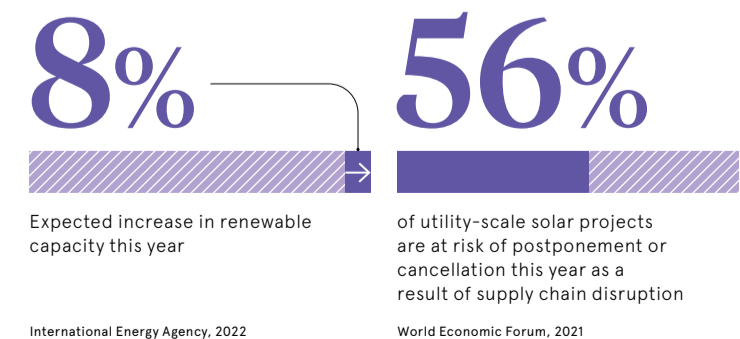
energy procurement and decarbonise building materials.

Trade association RenewableUK has been encouraging its members for some time to think sustainably. In 2020, it created the member values charter, which committed signatories to reducing emissions from operations and products.

“Renewable energy developers are, rightly, held up to even greater scrutiny than those in any other sector. It is no longer enough to generate green power,” says RenewableUK's head of communications, Robert Norris. “You need to look at every part of your supply chain to ensure that it's as green as possible.”

Companies are answering the call. Siemens Gamesa plans to make the wind turbines it manufactures fully recyclable by 2040. The towers and electrical components made of copper can be reused but the blades are trickier, as they're made of composite materials. These are usually sent to landfill or incinerated at the end of their working lives. Now, though, new tech enables these materials to be separated, so that the blades can be recycled for other applications. In the Danish city of Aalborg, home to one of Siemens Gamesa's plants, the local authority has repurposed used blades as bike shelters.

Vestas Wind Systems, which also makes turbines, is developing recyclable blades as part of its sustainability strategy. It's focused on cutting CO₂ emissions from its supply chain by 45% per MWh generated before 2030. As part of the plan, the company is asking 27 key suppliers to set emission-reduction targets, measure



“The biggest carbon footprint is rarely with our direct suppliers. It usually lies much further along the supply chain

production waste and commit to using 100% renewable energy.

Swedish renewable energy developer Vattenfall has also vowed to reduce its supply chain emissions from goods and services – by half, by 2030. Its main emissions drivers are the extraction and production of raw materials and transport. Part of its attempt to tackle the problem, it says, is making “climate-smart” design choices. This includes developing concrete with a lower cement content for a new hydropower dam.

During the construction of an on-shore wind farm in the Netherlands, it has also introduced the environmental cost indicator (ECI) in its procurement process. This assessment involves asking suppliers how they would improve their ECI value by various means. Those with a high expected reduction gained an advantage in the selection process, leading to reduced CO₂ emissions on the project relative to those of comparable builds.

“We have had a focus on reducing emissions for some time, but we

wanted to create a firm target for suppliers,” says Vattenfall's head of sustainability, Annika Ramsköld. “But the biggest carbon footprint is rarely with our direct suppliers. It usually lies much further along the supply chain with the production of steel, aluminium and cement, which we don't buy directly.”

The embryonic nature of parts of the sector can be a barrier to finding good suppliers. Ian Johnston, CEO of the Osprey Charging Network for electric vehicles, says the firm has had a sustainable supplier framework in place since 2020, but adds: “The challenge for a business in a relatively nascent market like ours is that we don't yet have a wide range of hardware suppliers to select from. The ease of use of the hardware we install is key to driver satisfaction, but we are fortunate that sustainability is such an important factor in our industry that our hardware partners are making strong strides.”

Meanwhile, supply chain expert Achilles has been working to make the sector more visible for other new entrants, such as legacy oil and gas firms. It provides pre-qualification services and ESG scores for potential renewable suppliers to help developers build new supply chains. “There is a massive opportunity as the industry ramps up, but it is creating growing pains,” notes its chief product officer, Katie Tamblin. A lot of swift supply chain building is needed. When so many suppliers are entering the market, it is difficult to ensure that the supply chain is

ethical and sustainable. The carbon footprint across the supply chain has to be fully visible – as do issues such as governance and labour rights. There are lots of risks.”

One potential answer – driven by the Russo-Ukrainian war and the need for energy security – is the localisation of supply. Aiming to reduce its exposure to steel, Vattenfall has joined the Hydrogen Breakthrough Iron-making Technology (Hybrit) project alongside Swedish steel maker SSAB and mining group LKAB. Their purpose is to create fossil-free steel using hydrogen.

The US has barred imports of Chinese polysilicon and, as part of its campaign to stimulate offshore wind production, has asked bidders to include plans to support port development and the supply chain.

In the UK, developers of projects with a capacity exceeding 300MW must include supply chain plans in their bids. The government has also funded a new turbine tower factory at the Port of Nigg in Ross-shire to increase local production.

“The government is keen on creating these hubs for offshore wind,” Norris says. “This leads to a smaller carbon footprint than getting materials from elsewhere. It is an interesting blueprint for the future and another example of our industry walking the walk on sustainability.”

Such initiatives will surely help to ease the climate crisis. But there will always be room for further innovative thinking in the bid to decarbonise industrial supply chains. ●



If you're looking at this advert, then your prospects are too.

Advertise with Raconteur in *The Times* and reach more senior business decision makers than any other national title.

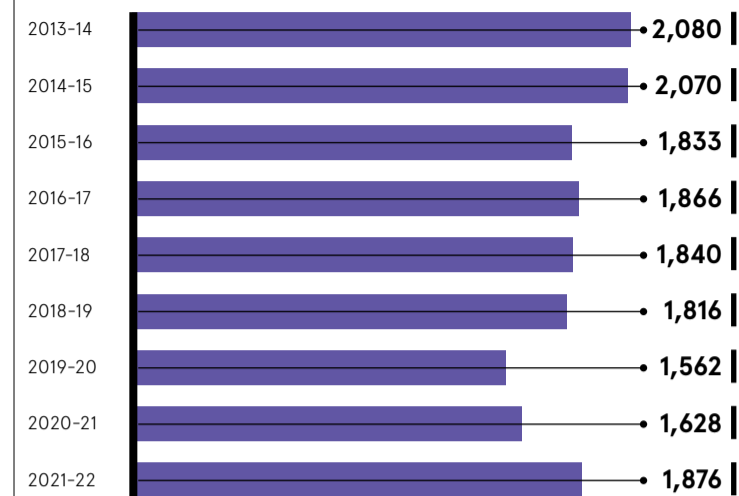
Email enquiries@raconteur.net to learn more about our calendar of over 80 reports in *The Times*.

RACONTEUR



WILL SMALL SCALE SOLAR COSTS CONTINUE TO FALL?

Annual trend comparison in the mean cost of ≤4kW installations (£ per kW)



Department for Business, Energy and Industrial Strategy, 2022

SOLAR

Astronomical? The true cost of a home solar system

As energy price inflation looks unlikely to ease any time soon, the idea of generating electricity on your own property seems ever more appealing. But how do the numbers stack up?

Charles Orton-Jones

Is it worth installing solar panels at home? This is a question that more and more UK households are considering as their electricity bills go through the roof. Yet finding a definitive answer is not easy. If you visit the websites of energy majors and installation firms, you'll tend to see plenty of vague phrases, such as "long-term investment" and "price on application". The only thing you can infer from this is that solar is unlikely to be cheap. So how much will a new system typically

cost to purchase and install? And when is a buyer likely to break even on this "long-term investment"? A good person to ask such questions is Lee Chambers, chief commercial officer of the Active Building Centre. Conceived by experts from the University of Swansea, his organisation advises governments, developers, energy firms and homeowners on green technologies for buildings. Having been in the industry for the best part of two decades, he's worked on well over 100 large solar plants around the world and

built an encyclopaedic knowledge of solar economics in the process.

Over the 15 years to 2021, he saw a dramatic fall in the cost of panels. Back in the mid-noughties, "you'd have paid £3 per watt of capacity. Today, it's about 15 pence," he says. "You're looking at £6,000 to £8,000 for a standard 4kW set and inverter, including installation."

At the start of last year, it was more like £4,000. Blame soaring demand for the hike.

The panels are categorised by their maximum power output. For a single solar module, that's likely to be 350W. A standard household array comprises 10 to 12 modules, so the total output in perfect conditions will be 3.5kW or 4.2kW. Installers round to the nearest integer, so 4kW systems are among the most common ones on the market.

How far does 4kW go? The average UK household uses about 10kWh of electricity a day, according to government estimates. In theory, then, a 4kW array could generate enough energy in two-and-a-half hours to cover that home's daily consumption. The surplus energy generated can then either be stored in a battery for later use or sold back to the grid.

“Payback periods on solar are now somewhere between five and seven years

Eugene Lucarelli is a marketing manager at GoodWe, a manufacturer of inverters, which convert solar energy to usable alternating current. He says that the "payback periods on solar are now somewhere between five and seven years as a result of the electricity price spike and the cut in VAT on solar installations".

Lucarelli's estimate is based on the following approximations: at the time of writing, electricity is being sold to consumers at 28p per unit and a 4kW system costing £6,000 should generate 3,600 units a year. So, if every unit produced by that system equates to a unit not bought from the grid, the household's saving on its annual electricity bill will be 3,600 units x £0.28 per unit = £1,008. This assumes that all energy produced reduces grid reliance and none is wasted. If the home's occupants are away in the daytime and use power at night, the cost savings will be lower, unless a battery has been installed to store the electricity.

Solar kit has a long life, so it could realistically pay back £20,000 over two decades of operation – more, if energy prices continue rising. It's a return on investment that would be hard to match elsewhere.

There are six big panel producers, collectively known in the trade as the silicon module super league: Canadian Solar, Hanwha Q Cells, JA Solar Holdings, JinkoSolar, Longi Green Energy Technology and Trina Solar. Does it matter which brand you buy? Not really – they're pretty similar, according to Chambers.

But your location does matter: the further north you are, the less viable an investment in solar becomes. Cornwall receives 1,200kWh per m² of light each year, whereas Scotland gets only 800kWh per m². An irradiance map will provide the precise figures for your area.

The site's dimensions matter too, Chambers notes. "It is quite common to struggle for space. Most houses are 5m wide and you lose 50cm either side, giving you only 4m of roof to install on. The most you'd be able to fit in that space is eight standard modules – and only if the shape of the roof permits it."

It is possible to install modules on a vertical surface, but this will

typically incur an efficiency loss of about 20%.

And then there's the battery. It's not essential, but going without one means relying on the grid at night and periods of high consumption. A battery that can handle a 4kW system will cost approximately £5,000. The cheapest solar battery from E.ON is priced at £2,574, but that's a relatively lightweight spec. Tesla's premium-grade Powerwall 2 can store 13.4kWh, but such a whopping capacity will set you back £8,600 to £10,500, depending on the complexity of the installation.

On the plus side, a battery will typically enable a home to run between 80% and 100% grid-free. This is a superior economic model to that of exporting and importing your electricity each day. The UK's so-called smart export guarantee means that energy firms pay households for any electricity they send to the grid. The amount varies from firm to firm, but it's far less than the price they're currently charging to supply it (28p per kWh). SSE offers 3.5p per kWh, for instance, whereas E.ON offers 2p, or 5.5p for customers who acquired a system from it after 2020.

Nonetheless, the overall return on investment in a battery is relatively hard to calculate. It depends on factors including the smart export guarantee, the time electricity is used and the future cost of energy from the grid. Chambers advises contacting three certified installers from the database run by the Micro-generation Certification Scheme. Ask each to visit your property and provide a detailed quotation, including a hardware recommendation, a cost breakdown and an estimated payback period. This should give a reasonable idea of whether a battery is worth installing or not.

"Solar really is an easy win," Chambers says. "It is easy to install, requires little maintenance and saves you from buying electricity at huge prices. It will pay back your investment and there's a definite environmental benefit."

Since the UK energy crisis started in Q3 2021, demand for panels has risen by 65%. As electricity bills continue to spiral, interest in solar is only going to increase further. ●

NUCLEAR

Atomic booster: the rise of small reactors



As the UK seeks ways to improve its energy security while weaning itself off fossil-fuel imports, small modular reactors could be the key to filling the nuclear generation gap

Rich McEachran

Although all but one of the UK's operational nuclear power stations are due for retirement before the end of this decade, Westminster is not planning to phase out atomic energy – far from it, in fact. The prime minister has said that the Putin regime's war on Ukraine has highlighted the UK's overreliance on Russian oil and that now is the time "to make a series of big new bets" on nuclear. The government has therefore set an ambitious target of obtaining a quarter of the

UK's electricity from atomic power by 2050 as part of its drive towards net-zero greenhouse gas emissions. The UK generates about 15% of its electricity from about 7GW of nuclear capacity. That is likely to fall to 3.6GW by as soon as 2024 as ageing reactors are taken offline as scheduled. The government's plan is for this figure to be 24GW by 2050, which naturally raises questions as to how such a substantial increase can be achieved. The forthcoming Hinkley Point C plant on the Somerset coast should

account for 3.2GW of the targeted total, although its expected completion date has been pushed back to mid-2026. "If we're to get anywhere close to net zero by 2050, we can't restrict our focus to large new reactors such as Hinkley Point C," says Adrian Bull, chair in nuclear energy and society at the University of Manchester's Dalton Nuclear Institute. "These are slow to build and incredibly expensive for investors. And there are limits to where they can be located, because of their need

for vast amounts of cooling water. Future nuclear power has to be deployed much more flexibly." One solution that's been touted as the future of nuclear generation in the UK is the small modular reactor (SMR), a factory-built power plant. Leading the way in this field is a consortium led by Rolls-Royce, which has secured more than £450m in R&D funding, including a £210m injection from the government.

The venture hopes to receive regulatory approval by Q3 2024 with the aim of bringing the first of its SMRs online from 2029. Each reactor would be able to generate 470MW – equivalent to more than 150 offshore wind turbines. That would be enough to power about 1.3 million homes, according to Ofgem data.

Each SMR would occupy an area of no more than 4ha – a far smaller footprint than that of a conventional power station – and cost a mere £1.8bn to build.

According to Tom Samson, CEO of Rolls-Royce SMR, 90% of the manufacturing and assembly activities would take place in factory conditions. This is "a low-risk construction method" that should ensure a relatively fast build.

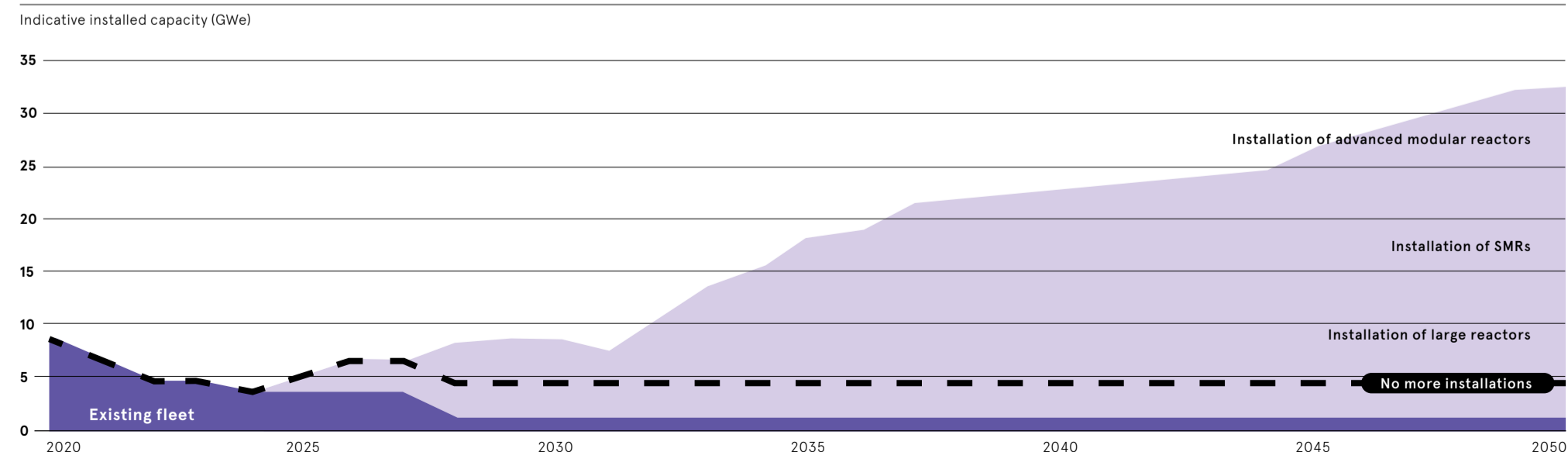
SMRs are designed in such a way that their need for cooling water is far less than that of a conventional

An artist's rendering of an SMR design by the Rolls-Royce-led consortium

"If we're to get anywhere close to net zero by 2050, we can't restrict our focus to large new reactors"

POTENTIAL SCENARIOS FOR THE UK'S NUCLEAR GENERATION CAPACITY TO 2050

Nuclear Industry Association, 2020



plant, he notes. This means that they won't necessarily need to be located on the coast, which is where almost all atomic power stations in the UK have been built so far.

SMRs make nuclear a more attractive proposition for the investment community, which may have been deterred from the segment because of the high capital expenditure and risky construction environment associated with traditional reactors, Samson argues. Securing long-term private capital will be crucial if his consortium is to achieve its long-term goal of having 16 reactors in place nationwide.

The modular nature of SMRs also lends them "great export potential," he says. Components could be made in the UK by a local manufacturer and then easily be transported overseas.

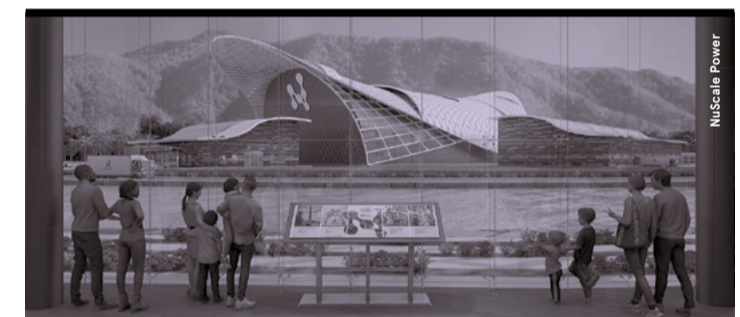
Rolls-Royce's consortium will be the bellwether for SMR development in the UK, but other players will surely need to be involved. After all, even if it were to get all 16 of its planned 470MW reactors up and running on schedule, they would collectively account for just

"Future nuclear power needs to be deployed much more flexibly"

under a third of the government's targeted capacity for 2050.

Bull believes that the government could and should play a bigger role in "helping to build confidence and surmount that initial hump of first-of-a-kind risk". Putting more public money into the SMR drive would help to reduce the payback time for all investors and boost the domestic supply chain, he argues.

"SMRs will never be cheap", Bull says, "but government support to rapidly establish a viable fleet of them – based on a UK supply chain – could be one of its best decisions, especially given the growing international interest in them."



How other countries are investing in SMRs

US
The nation's first SMRs are on track to be deployed in about 2030.

The domestic leader in the field is NuScale Power, based in Portland, Oregon. It received approval from the US Nuclear Regulatory Commission on its first design for a relatively small-scale (60MW) reactor in 2020.

Unlike Rolls-Royce, NuScale is looking to outsource the manufacturing of its technology. It has signed deals with South Korean conglomerates Samsung and Doosan to explore the potential use of its SMRs in Asia.

Japan
Most nuclear plants in the country were closed after the Tohoku earthquake and tsunami of 2011 caused the catastrophic meltdown of the Fukushima Daiichi reactor, but the government is planning to partner with US businesses to develop SMR technology.

SMRs can be partially buried, which makes them safer than traditional reactors and therefore more appealing to a nation that's suffered far more than any other at the hands of atomic power.

In January, Japan's minister of industry, Koichi Haguda, said that he would encourage local energy companies to test SMRs.

China
The urgent need for nuclear power in China has increased at an alarming rate owing to the sheer volume of greenhouse gas and other pollution emitted by the nation's coal-fuelled plants.

At the end of last year, the country duly fired up the world's first SMR. This 200MW reactor powers the grid in the east-coast province of Shandong. It is reportedly a fifth of the size of Hualong One, a new type of pressurised water reactor that's entered use in China and Pakistan.

The design for Hualong One recently received approval from both the Office for Nuclear Regulation and the Environment Agency in the UK, meaning that it could form part of the next generation of larger reactors to be built on British soil.

Belgium
Spiralling energy prices have caused the Belgian government to defer its planned phasing-out of nuclear power plants by a decade to 2035. In May, it was announced that the national nuclear research centre, SCK CEN, would receive €100m (£86m) over four years to research SMRs. The prerequisite is that reactors should use a liquid metal or gas instead of water for cooling the core.



Sustainable jobs and an economic boost for the Humber

An innovative carbon capture project has the potential to truly level up this important industrial area, create jobs and reduce emissions

The Humber region's proud history of innovation includes inventions as diverse as the liquid crystal display, bone density scanners and boiled sweets. Today, the region generates 20% of the UK's electricity and produces a third of the UK's fuel. Now, two companies have joined forces to ensure the Humber region plays an important role in a green economy.

Humber Zero is a set of large-scale carbon reduction projects with the potential to prevent up to 8 million tonnes of CO₂ entering the region's atmosphere annually by 2030. Phillips 66 Limited and VPI Immingham LLP are consulting on introducing new post-combustion carbon capture technology and infrastructure at their Humber refining and power generation facilities. With an initial partner funding investment of £1.2 billion, including £12.5 million from UKRI's Industrial Strategy Challenge Fund, this is the first phase of Humber Zero. Collectively preventing up to 3.8 million tonnes of CO₂ entering the atmosphere each year by 2028 is the ambition.

Transformative technology
The plan is to retro-fit carbon capture and compression technology at the Phillips 66 Humber Refinery and VPI Immingham Combined Heat and Power Plant (CHP). Put simply, CO₂ emissions

from some processes will be captured at the source and compressed, rather than released into the atmosphere.

Compressed CO₂ will be transported via pipelines for storage under the North Sea bed. Carbon will be captured from the fluid catalytic converter at the Phillips 66 Humber Refinery, and from two gas turbines and auxiliary boilers at the VPI Immingham CHP.

James Beresford-Lambert, VPI's engineering manager for Humber Zero, explained that solvents absorb CO₂ from the flue gas, then CO₂ is removed from the solvent in a regenerator which is then compressed and exported, while the solvent is reused.

These solutions have been effective at a range of facilities around the world. On a small scale many CO₂ capture plants have been deployed in various industries capturing CO₂ in excess of 90 per cent of emissions.

At the other end of the spectrum, successful projects demonstrate how the technology can be scaled up, including coal fired power stations in the US and Canada that capture in excess of 1 million tonnes of CO₂ per year.

The Humber project's risk mitigation involves seeing how the carbon capture technology can be scaled up to meet the environmental ambitions of the two companies.

"We undertook a rigorous evaluation of the technology for the post-combustion carbon capture processes we need to be able to master the absorption process at scale," said Beresford-Lambert. "A lot of investigation was needed to ensure we can work with the different gases produced by the plants."

"There was a great deal of collaboration between technical partners, and we learned a lot of lessons from previous installations. The knowledge gained from the Humber Zero project could support change across

industry, within the Humber region and globally," said Chris Gilbert, technical manager and UK decarbonisation lead, Phillips 66 Limited.

Levelling up in the Humber

As well as meeting environmental targets in line with the government's net zero by 2050 aim, the Humber Zero project seeks to fulfil economic and social goals to benefit people in the region, as well as the broader UK.

Job creation is a special focus during the construction phase of the carbon capture facilities, and once the technology is operational. Phillips 66 Limited and VPI Immingham LLP seek to create around 2,500 construction jobs, and around 200 permanent jobs. The permanent jobs will include operations, engineering, maintenance and support staff. These two facilities are expected to safeguard up to 20,000 existing direct and indirect jobs in the Humber region.

Emission reduction in the refinery, heat and power generation sectors is essential for a greener Humber economy – 20% of the region's economy derives from energy-intensive industries, such as manufacturing. With manufacturing accounting for 55,000 jobs in the region – or 15% of local jobs – decarbonising energy facilities is an economic as well as an environmental necessity.

"These infrastructure projects are vital for underpinning the local economy – we need to future-proof industry in this area," said Chris. "It is an economically disadvantaged area and levelling up can only happen if we shore up the industrial base, for a real future."

"These infrastructure projects are vital for underpinning the local economy"

To find out more, visit humberzero.co.uk





Let us meet your boldest energy challenge

Nobel Energy's integrated services model allows to meet your end-to-end needs in an efficient and sustainable way.

With the tested expertise and experience – in field operations and equipment maintenance, integrated drilling and well services, construction and project management, engineering and fabrication – we have provided safe, agile and cost-effective solutions to our customers for more than 16 years.

Nobel Energy's wide and reliable network has allowed it to build a robust energy projects pipeline that has gone beyond borders and gained access to the markets of Georgia, Ukraine, Kazakhstan, UK, USA, and Turkey where the company has had the presence through the strong relationships with Nobel Energy's local and globally operating business partners.

Nobel Energy is now transforming to become an Integrated Energy Production, Development and Services company to meet the changing energy needs of our world, by pulling together all its resources and expertise to deliver overarching and agile solutions for customers.

For more information

contact@nobelenergy.com
nobelenergy.com/en/ourstrategy

