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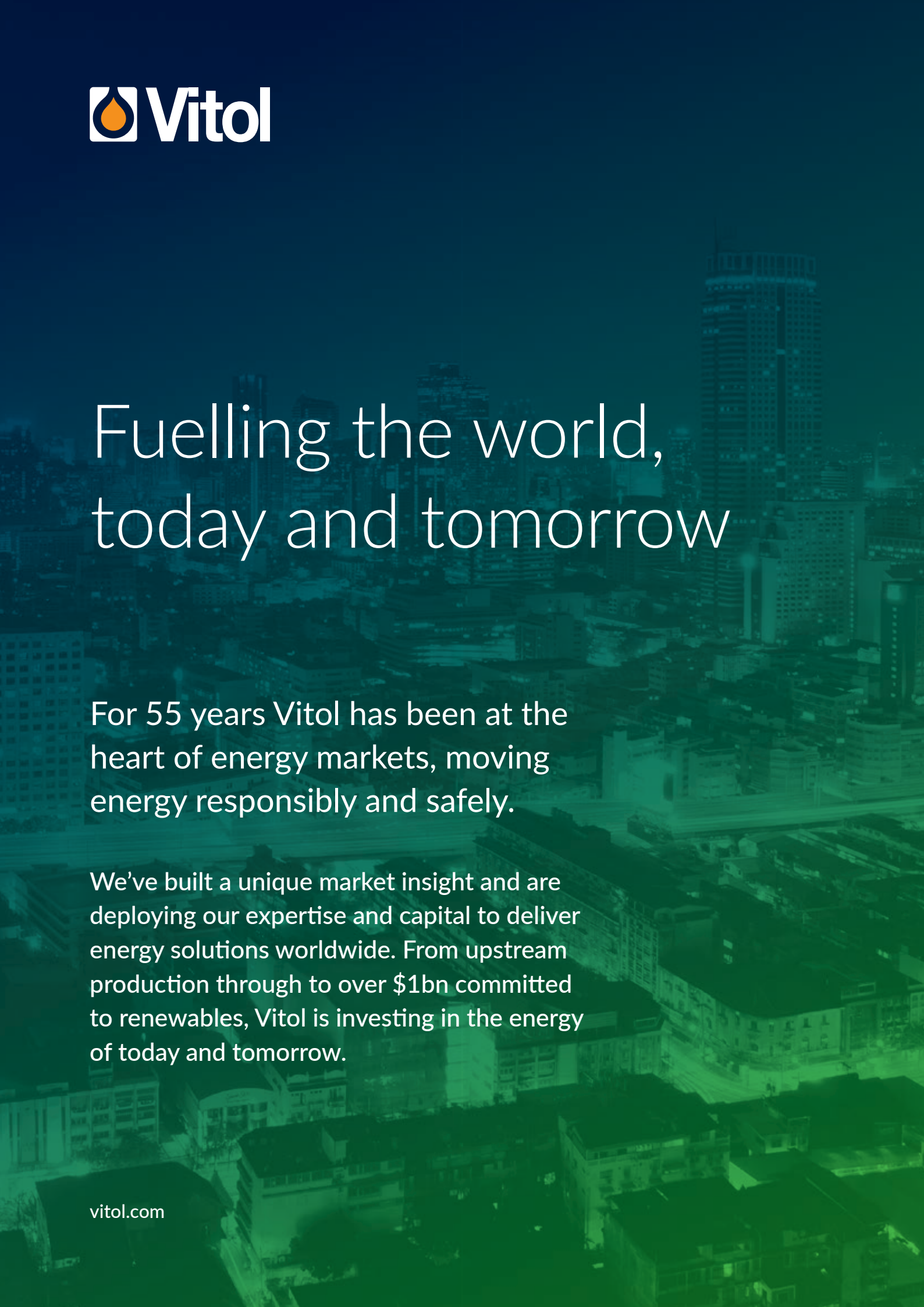
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PETROLEUM REVIEW

VOLUME 75 | NUMBER 893

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Abbreviations
The following are used:

mn = million (10^6)	t/d = tonnes/day
bn = billion (10^9)	kW = kilowatts (10^3)
tn = trillion (10^{12})	MW = megawatts (10^6)
cf = cubic feet	GW = gigawatts (10^9)
m^3 - cubic metres	kWh = kilowatt hour
b/d = barrels/day	km = kilometre
boe = barrels of oil equivalent	sq km = square kilometres
t/y = tonnes/year	

Abbreviations go together
eg 100mn cf/y = 100 million cubic feet per year.

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Magazine of the energy institute

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The civil aviation sector is pushing ahead with deploying sustainable aviation fuel (SAF) across the industry

Photo: Saab AB/ Linus Svensson

Update & regulars

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IN THIS ISSUE...

We begin this month's issue of *Petroleum Review* with a look at how new business strategies, innovation and technologies are driving the transition to net zero, inspired by the recent E.ON Innovation Conference.

With society and the world at large placing more focus on ESG (environmental, social and governance) issues, we highlight some of the key cases and future trends in climate litgation and also ask if there is a role for sustainability-linked loans in the upstream sector.

Meanwhile, Chair of the Energy Institute's International Energy Week 2022 (formerly International Petroleum Week) explains why he sees a bright future ahead for the energy sector as the world transitions to a low carbon future.

Keeping to the energy transition theme, we report on the role that sustainable aviation fuel (SAF) will play on the road to net zero and what needs to be in place to ensure that hydrogen reaches its full potential in helping decarbonise society and industry.

The issue closes with a look at the challenges facing China and other Asia-Pacific nations as they continue to develop their national greenhouse gas emissions reduction strategies in the run-up to the much anticipated COP26 climate change meeting in Glasgow this month.

Kim Jackson, Editor

Features

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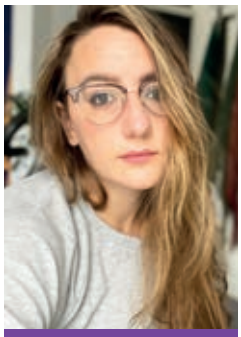
PERSPECTIVE

Carbon intensity awareness is key to net zero



Paula VanLaningham, Global Head of Carbon, S&P Global Platts

Given the urgency to tackle climate change, it is clear that there is no one, single solution to the climate crisis. But in the last several years, it has become increasingly evident that robust measurement and management of the emissions generated from our daily activities – including our continued reliance on hydrocarbons – will play a major role in how we look at commodities from now on.

Global demand for voluntary carbon credits to offset carbon emissions has grown sharply since the start of the COVID-19 pandemic, as the need to pursue aggressive decarbonisation has become ever more urgent. However, how this will happen – and critically, whether it can happen quickly enough to stave off global heating well above the 2°C warming scenario set out in the Paris Climate Agreement – is a question that remains largely unanswered.

Voluntary carbon credit markets (VCM), which have been around since the Kyoto Protocol days, are one of the ways that commodities markets have looked to manage and offset greenhouse gas emissions. Recently, this has led to an increase in 'carbon-neutral' trading – wherein a company or organisation looks to offset the emissions generated across the lifecycle of a fuel with credits sourced from the voluntary markets – first with LNG, but branching out into other fossil fuel commodities including naphtha, LPG and, increasingly, crude oil.

If this trend continues, the VCM could grow even faster than expected, providing not just an opportunity to channel capital and investment towards projects that can make a real difference in the fight against global heating, but also an opportunity to re-think about how we look at the carbon intensity of those things that we rely on every day.

Unlike traditional commodities markets, there is no central hub or repository to trade voluntary carbon credits. Even though the market has been around for 20 years, the vast majority of activity is still conducted on an over-the-counter basis. While this has been an effective way to manage trading up until now, it is unlikely to allow for the scaling up of investment necessary to meet the urgency of the current climate crisis.

Carbon intensity of crude oil

In early 2021, Occidental Petroleum sold the first 'carbon neutral' crude cargo – building on the strategy pioneered by the LNG industry in 2020 – shipping 2mn barrels of crude to Indian refiner Reliance. The emissions generated were offset across the full life cycle of the cargo with voluntary carbon credits certified by the Verified Carbon Standard (VCS).

While there have been more trades of carbon neutral hydrocarbons since, this move towards carbon neutral trading has raised serious questions about how effective carbon offsetting really can be in the absence of emissions savings throughout upstream production and, critically, how to measure those emissions effectively.

Historically, carbon emissions across upstream production have been notoriously difficult to measure, which can often make it easy to over-rely on estimates that can undercount the real environmental impact of upstream activity in the oil and gas sector.

This is where the carbon intensity of the upstream production process can become an attribute of the crude itself, almost like the density of the barrel, or its sulphur content. Carbon intensity is the calculation for how many kilogrammes of carbon is emitted in the production of one barrel of crude.

The industry sees this as the end goal. But getting to a point where carbon intensity is thought of as an attribute of a crude oil cargo will take evolution from the market.

First step to add transparency

As a first step to add transparency to carbon intensities for different crude grades around the world, S&P Global Platts has begun to work on what an upstream calculation will look like and has begun publishing monthly calculations that measure the carbon intensity of the crude produced at 14 different crude fields, many of which make up a large proportion of those used by Asian refiners.

To further increase understanding, the company is now publishing daily carbon intensity premiums – to show how much more a refiner has to pay for a crude with a relatively higher carbon intensity for each one of these 14 fields.

The move towards carbon neutral petroleum fuels, whilst dependent on demand economics within Asia, is only a matter of time, as the city-state's Singapore Green Plan 2030 picks up momentum. The plan aims to strengthen Singapore's climate change commitments under the UN's 2030 Sustainable Development Agenda and Paris Agreement, through activities like using cleaner, lower-carbon energy and increasing energy efficiency.

The bigger picture

When looking at the bigger picture and all that is necessary to become net zero by 2050, being aware of carbon intensity when it comes to existing commodities is just the first step, but one that is absolutely necessary. ●

The views and opinions expressed here are strictly those of the author and are not necessarily given or endorsed by or on the behalf of the Energy Institute.

Need for speed – call for ambition and action

A new energy economy is emerging, but not quickly enough to reach net zero by 2050, says the IEA

A new energy economy is emerging around the world as solar, wind, electric vehicles (EVs) and other low-carbon technologies flourish. However, the International Energy Agency's (IEA) latest *World Energy Outlook* makes it clear that this clean energy progress is still far too slow to put global emissions into sustained decline towards net zero, highlighting the need for an unmistakeable signal of ambition and action from governments at the COP26 meeting in Glasgow.

The *World Energy Outlook 2021* (*WEO2021*) delivers stark warnings about the direction in which today's policy settings are taking the world and notes that even as deployments of solar and wind go from strength to strength, the world's consumption of coal is growing strongly this year, pushing CO_2 emissions towards their second largest annual increase in history.

The report spells out clearly what is at stake and what the pledges to reduce emissions made by governments so far mean for the energy sector and the climate. It sets out what needs to be done to move beyond these announced pledges towards a trajectory that would reach net zero emissions globally by mid-century – the IEA's Net Zero Emissions by 2050 Scenario, which is consistent with limiting global warming to 1.5 °C.

The report also explores two other scenarios to gain insights into how the global energy sector may develop over the next three decades – and what the implications would be. The Stated Policies Scenario represents a path based on the energy and climate measures governments have actually put in place to date, as well as specific policy initiatives that are under development. In this scenario, almost all of the net growth in energy demand through 2050 is met by low-emissions sources, but that leaves annual emissions still around today's levels. As a result, global average temperatures will still be rising when they hit 2.6 °C above pre-industrial levels in 2100.

The Announced Pledges Scenario maps out a path in which the net zero emissions pledges announced by governments so far are implemented in time and in full. In this scenario, demand for fossil fuels peaks by 2025, and global CO_2 emissions fall by 40% by 2050. All sectors see a decline, with the electricity sector delivering by far the largest emissions reduction. The global average temperature rise in 2100 is held to around 2.1 °C.

For the first time in a *WEO*, oil demand goes into eventual decline in all the scenarios examined, although the timing and speed of the drop vary widely. If all today's announced climate pledges are met, the world would still be consuming 75mn boe/d by 2050 – down from around 100mn today – but that plummets to 25mn in the Net Zero Emissions by 2050 Scenario. Natural gas demand increases in all scenarios over the next five years, but there are sharp divergences after this.

The differences between the outcomes in the Announced Pledges Scenario and the Net Zero Emissions by 2050 Scenario are stark, highlighting the need for more ambitious commitments if the world is to reach net zero by mid-century.

'Today's climate pledges would result in only 20% of the emissions reductions by 2030 that are necessary to put the world on a path towards net zero by 2050,' says Fatih Birol, Executive Director, IEA. 'Reaching that path requires investment in clean energy projects and infrastructure to more than triple over the next decade. Some 70% of that additional spending needs to happen in emerging and developing economies, where financing is scarce and capital remains up to seven times more expensive than in advanced economies.'

'There is a looming risk of more turbulence for global energy markets. We are not investing enough to meet future energy needs, and the uncertainties are setting the stage for a volatile period ahead. The way to address this mismatch is clear – a major boost in clean energy investment, across all technologies and all markets. But this needs to happen quickly.'

The report stresses that the extra investment to reach net zero by 2050 is less burdensome than it might appear. More than 40% of the required emissions reductions could come from measures that pay for themselves, such as improving efficiency, limiting gas leakage, or installing wind or solar in places where they are now the most competitive electricity generation technologies, says the IEA.

These investments also create huge economic opportunities. Successfully pursuing net zero would create a market for wind turbines, solar panels, lithium-ion batteries, electrolysers and fuel cells of well over $1tn/y by 2050, comparable in size to the current oil market, suggests the report.

'The world's hugely encouraging clean energy momentum is running up against the stubborn incumbency of fossil fuels in our energy systems. Governments need to resolve this at COP26 by giving a clear and unmistakeable signal that they are committed to rapidly scaling up the clean and resilient technologies of the future. The social and economic benefits of accelerating clean energy transitions are huge, and the costs of inaction are immense.'

Fatih Birol, Executive Director, IEA

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Hydrogen

Large-scale green hydrogen facility planned in Orkney

Offshore Wind Power Limited (OWPL), the consortium formed by Macquarie's Green Investment Group, TotalEnergies and Scottish developer Renewable Infrastructure Development Group (RIDG), is studying the use of offshore wind to power the production of green hydrogen on an industrial scale on the island of Flotta in Orkney, Scotland.

The OWPL consortium has submitted a proposal to the Crown Estate Scotland's offshore wind leasing round (ScotWind) to develop the N1 plan option area west of Orkney. If successful, the West of Orkney wind farm could deliver renewable power to a green hydrogen production facility at the Flotta terminal.

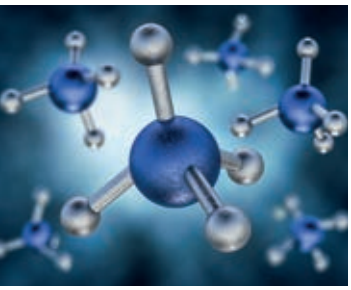
Plans to power the proposed Flotta hydrogen hub are being developed by OWPL in partnership with Flotta Terminal's owner Repsol Sinopec, and energy company Uniper. The proposal is also supported locally by EMEC Hydrogen.

Commenting on the proposal, Edward Northam, Head of Green Investment Group Europe, says: 'We believe that green hydrogen could provide a critical alternative route to market for some of Scotland's largest offshore wind projects and play a significant role in creating wider economic benefits as the North Sea goes through its energy transition.'

José Luis Muñoz, CEO, Repsol Sinopec, adds: 'We fully support our industry's transition to clean, green energy and a secure future for skilled oil and gas workers in Scotland and across the UK... The Flotta terminal has been in operation since 1976 and has made a significant contribution to Orkney's economy and communities for more than 40 years. This project would enable the terminal to be progressively transformed over time into a diversified energy hub where conventional oil and gas operations continue, co-existing alongside the development of a sustainable long-term green future for the facility. The repurposing of Flotta will require local stakeholders' support, retaining and upskilling the current workforce as well as the creation of long-term skilled jobs during both construction and hydrogen operations.'

Artist's impression of the planned Flotta hydrogen hub
Source: OWPL

IN BRIEF



A new Global Methane Pledge is to be formally launched at COP26
Photo: Shutterstock

The European Union (EU) and the US have announced a Global Methane Pledge to deliver a 30% reduction in methane emissions by 2030 (based on 2020 levels). Argentina, Ghana, Indonesia, Iraq, Italy, Mexico and the UK have indicated their support for the Pledge, which is due to be formally launched at COP26 in Glasgow this month. Countries signalling their support include six of the top 15 methane emitters globally, which together account for over one-fifth of global methane emissions and nearly half of the global economy.

The UK government plans to decarbonise the UK's electricity system by 2035
Photo: Shutterstock

The UK government has unveiled plans to decarbonise the UK's electricity system by 2035, in a bid to help boost the country's efforts in achieving its net zero ambitions. The announcement brings forward by 15 years the government's commitment to a fully decarbonised power system by 2050, set out in its Energy White Paper, and builds on the Prime Minister's 10-point plan for a green industrial revolution, to secure a 'future clean electricity supply that is generated in the UK, for the UK'. To ensure this ambition becomes a reality, the government says it will double down on efforts to deploy a new generation of home-grown technologies – from offshore wind, hydrogen and solar, to nuclear, onshore wind, and carbon capture and storage (CCS) – reducing reliance on fossil fuels and exposure to volatile global wholesale energy prices.

Chevron has published an updated climate change resilience report that further details the company's low-carbon ambitions. The report comes after the company unveiled plans in September to invest more capital to grow lower carbon energy businesses, more than tripling its planned total capital investment to $10bn through to 2028. In its latest update, Chevron has adopted a 2050 net zero goal for equity upstream Scope 1 and 2 emissions. It also plans to incorporate Scope 3 emissions into its greenhouse gas emission targets by establishing a portfolio carbon intensity (PCI) target that covers the full value chain. The company has set a >5% carbon emissions intensity reduction target from 2016 levels by 2028.

The US Energy Information Administration (EIA) has reported that without significant changes in policy or technology, world energy consumption will grow by nearly 50% between 2020 and 2050. In its *International Energy Outlook 2021* report, the EIA projects that strong economic growth, particularly with developing economies in Asia, will drive global increases in energy consumption despite pandemic-related declines and long-term improvements in energy efficiency. See **www.bit.ly/PRNov2021EIA**

An urgent change of mindset and a massive redirection of spending from carbon-heavy investment into clean energy is needed if an affordable transition that meets the Paris Agreement is to be achieved, says DNV in its latest report. The company forecasts that the percentage of world GDP that will be spent on energy will halve from 3.2% in 2019 to 1.6% in 2050. However, if the current fraction of GDP devoted to energy expenditure remained constant, the surplus funds to spend on clean energy would grow by around $2tn each year, reaching close to $63tn by 2050 – more than enough to finance a transition compliant with the Paris Agreement. See **www.bit.ly/PRNov2021DNV**

New UK gas storage project gets green light

Islandmagee Energy's gas storage project will hold 500mn m³ of natural gas, providing security of supply and protecting against extreme volatility in gas and power prices in the UK

A gas storage project located off the coast of Northern Ireland has been awarded a marine construction licence, giving it the green light to proceed towards construction.

Islandmagee Energy's gas storage project will initially unlock seven gas storage caverns. Once constructed and fully operational, these caverns will hold around 500mn m³ of natural gas and provide security of supply during peak demand for up to 14 days for Northern Ireland.

The UK has one of Europe's lowest gas storage capacities at just 1% of its annual demand in storage, leaving it much less resilient to supply issues than other European countries which hold as much as 20–30% of annual demand in storage. Once fully developed, the Islandmagee gas storage project will hold over 25% of the UK's storage capacity.

John Wood, Group CEO, Harland & Wolff, Islandmagee Energy's parent company, comments: 'This is good news for consumers and businesses in the UK who are currently experiencing distressing hikes in energy prices and fears of potential blackouts as gas and power grids face peak demand stresses during the winter months. With the current energy supply crisis, everyone now understands just how important gas storage is to secure supply and protect against extreme volatility in gas and power prices in the UK.'

Islandmagee Energy also has longer term ambitions to store hydrogen. Wood explains: 'Large-scale hydrogen storage will enable the UK to make the most of excess renewable energy as it transitions to net zero. The existing power grid cannot always accept all of the electricity generated from wind farms during periods of surplus wind power generation. It is during these frequently occurring periods that wind farms are temporarily scaled back as there is no way to store the excess electricity produced. Large-scale production of hydrogen and its storage is the long-term solution to this. Excess wind generated power can be used to produce green hydrogen which can then be stored in salt caverns for future use during peak demand periods.'

Once constructed, Islandmagee Energy's gas storage project will hold over 25% of the UK's gas storage capacity

Photo: Shutterstock

Refining

BP to invest $269mn in Cherry Point refinery

Cherry Point refinery
Photo: BP

BP has unveiled plans for a $269mn investment in three projects at its Cherry Point refinery in Washington state, US, aimed at improving the refinery's efficiency, reducing its CO_2 emissions and increasing its renewable diesel production capability. The investment is aligned with BP's aims to be net zero across its operations by 2050 or sooner, and to reduce the carbon intensity of the products it sells by 50% by 2050 or sooner.

The $169mn hydrocracker improvement project (HIP) and $55mn cooling water infrastructure project are both due to complete in 2023 and together are estimated to reduce CO_2 emissions by approximately 160,000 t/y.

Meanwhile, the $45mn renewable diesel optimisation (RDO) project will more than double the refinery's renewable diesel production capability to an estimated 2.6mn b/y and is expected to reduce the CO_2 emissions by approximately 400,000–600,000 t/y. The additional renewable diesel production is expected to be available in 2022.

In this month's *Energy World*:

- COP26 – negotiations begin in Glasgow
- Developing small-scale renewables projects in Africa
- Innovation in electricity systems throughout Europe
- Energy in transport – shipping, aviation and policy

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Carbon capture and storage

CCS gathers momentum in response to rising climate ambitions

A new climate report released by the Global CCS Institute (GCCSI) has highlighted the continuing growth of carbon capture and storage (CCS) worldwide. In 2021, the total capacity of the CCS project pipeline increased for the fourth year in a row, by almost one third over the previous year.

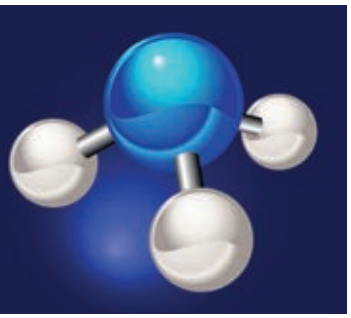
According to Jarad Daniels, CEO, GCCSI, the dramatic increase in projects in development reinforces the critical role of CCS in reaching global climate goals within the short timeframe required. 'As we accelerate toward net zero emissions by mid-century and establish clearer interim targets, CCS will be integral to the decarbonisation of energy and industrial sectors such as cement, fertilisers and chemicals, and will open new opportunities in areas including clean hydrogen and carbon dioxide removal,' he says.

The *Global Status of CCS* report provides a snapshot of CCS progress around the world. The 2021 report shows:

- Of the 135 commercial CCS facilities in the project pipeline, 27 are fully operating, four are under construction, and 102 are under development.
- A total of 71 new CCS facilities were added to the project pipeline in 2021.
- As of September 2021, the CO2 capture capacity of all CCS facilities under development has grown from 73mn t/y to 111mn t/y – a 48% increase over 2020.
- North America continues to be the global front runner in CCS deployment, with over 40 new CCS projects announced in 2021. This can largely be attributed to CCS tax credits, stronger climate commitments under President Joe Biden – including the US re-joining the Paris Agreement – and anticipated rise in demand for low-carbon energy products.
- CCS projects are becoming increasingly diverse, with facilities in development in a broad range of sectors including power generation, LNG, cement, steel, waste-to-energy, direct air capture and storage, and hydrogen production.
- Several new countries now have commercial CCS facilities under development, including Belgium, Denmark, Hungary, Indonesia, Italy, Malaysia and Sweden.
- CCS networks – in which multiple emissions sources share transport and storage infrastructure – are increasingly becoming the dominant operating model, incorporating ever-larger volumes of CO_2.

'The International Energy Agency's Sustainable Development Scenario foresees 15% of emissions reductions to come from CCS, requiring a 100-fold increase in the capacity of operational facilities by 2050. While the acceleration of CCS adoption is promising, more urgency in the deployment of the technology is needed to reach 2050 climate goals,' notes Guloren Turan, General Manager of Advocacy and Communication, GCCSI.

> ***'While the acceleration of CCS adoption is promising, more urgency in the deployment of the technology is needed to reach 2050 climate goals.'***
>
> **Guloren Turan, General Manager of Advocacy and Communication, Global CCS Institute**



As a fuel, ammonia has the potential to drastically reduce emissions of CO_2, supporting the shipping industry's efforts to decarbonise operations

Photo: Shutterstock

IN BRIEF

The Chairman of the Petrol Retailers Association (PRA), Brian Madderson, has called for an independent inquiry into the UK government's handling of the recent road transport fuel crisis, so that motorists are protected from acute fuel shortages in the future. See **www.bit.ly/PRNov2021Fuel**

Technology group Wärtsilä and Norwegian ship owner Eidesvik Offshore have unveiled plans to convert an offshore supply vessel (OSV) to operate with an ammonia-fuelled combustion engine. The project is reportedly the first of its kind in the world and has a provisional completion target of end-2023. The OSV under consideration for a retrofit currently has Wärtsilä dual-fuel engines operating primarily with LNG fuel. The conversion will allow the vessel to operate with a 70% ammonia blend. The ultimate goal is to achieve operation with 100% ammonia and with a minimum ignition fuel requirement.

Octopus Hydrogen has entered a strategic partnership with Innova Renewables and Novus to build green hydrogen production facilities alongside their 4 GW of solar, wind and battery projects currently under development in the UK. The combined renewable energy and hydrogen sites are thought to be among the first co-located green hydrogen projects in the country.

ENN, a major player in China's rapidly growing natural gas market, is to purchase some 0.9mn t/y of LNG from US company Cheniere Energy on a free-on-board basis for 13 years, beginning in July 2022. The purchase price for LNG under the long-term sale and purchase agreement (SPA) is indexed to the Henry Hub price, plus a fixed liquefaction fee.

ExxonMobil has increased its participation in the proposed Acorn carbon capture project in Scotland by signing an expression of interest to capture, transport and store CO_2 from its Fife ethylene plant. The agreement to include the ethylene plant is in addition to an earlier announced memorandum of understanding to capture and store emissions from gas terminals at the St Fergus complex in Scotland, which includes ExxonMobil's joint venture gas terminal.

BP has acquired Blueprint Power, a US-based technology company whose technology can help turn buildings into a flexible power network by connecting them to energy markets through cloud-based software. Founded in response to new energy regulations after the Hurricane Sandy black-out in New York in 2012, Blueprint uses bespoke algorithms to optimise the energy efficiency of buildings and connect them to power markets. This allows commercial building owners to sell surplus energy stored in batteries or power generated on site from equipment such as solar panels.

Vitol has acquired a majority share in Liquind, a supplier of gas-for-transport in north-west Europe. Liquind currently has a network of 15 outlets providing LNG fuel to the trucking industry in Germany. The company plans to grow its network regionally and extend its offering to biogas for transport.

Oilfield services sector moving to net zero

The oilfield sevices sector is undergoing a radical restructuring in response to the energy transition

The oilfield services sector is radically restructuring to survive in a world moving towards net zero carbon emissions, according to a new study by Protolabs. The *Decision Time* report, which explores the challenges and opportunities for Europe's oilfield services sector, found that 73% of UK respondents are already redefining what their core business should be due to the energy transition.

The majority of business leaders in the sector who took part in the research see sustainability as an opportunity, with 77% saying it is a way to differentiate and grow their business, and 80% saying that experience in sustainability gives European businesses an edge in global markets.

The research found that most highlighted the need to innovate in order to survive. Within the next 12 months, 87% of UK respondents plan to implement robotics and automation and 83% plan to engage in manufacturing-as-a-service (MaaS) – 3D printing and on-demand manufacturing to streamline component production.

The results from the survey also indicate a clear departure from fossil fuels, with respondents expecting the majority of their future portfolio to be non-oil and gas business. According to Bjoern Klaas, Vice President and Managing Director of Protolabs Europe, respondents expect to have shifted 64% of their projects to new energy or non-energy business within the next five years, compared with 56% of projects today. 'This is testament to the willingness to meet the challenges faced by the sector,' he says.

The report found that 42% of respondents across Europe see new renewable energy technology as the greatest energy transition opportunity for their business over the next two to three years, and 22% consider CO_2 management as the greatest energy transition opportunity over the same timeframe. In addition, 31% consider innovation in enhanced oil recovery to be key to growth over the next 12 months.

The oilfield services sector is restructuring to survive in a world moving towards net-zero carbon emissions

Photo: Protolabs Oilfield services sector

Klaas concludes: 'That the oilfield services sector, and the wider energy sector, will transition to renewable energy is well understood. But this report makes clear the transition already being undertaken along the supply chain. Companies in the sector appreciate the value of environmental credibility, not only to secure their own reputation and funding, but also in response to the legislative need to cut down on emissions and the competitive need to be sustainable within the global marketplace.'

North Sea

UK gas output could fall 75% by 2030 without new investment

The global gas shortage that sent prices surging again in early October is a powerful reminder of the UK's need to maintain its own North Sea supplies, according to OGUK.

On 5 October, wholesale gas prices soared 37% in just one day, hitting £4 per therm in short-term global markets (equivalent to £1.41/m³) – a 700% increase compared with more typical levels at the start of 2021.

Factors causing the latest surge include Russia making a 70% reduction in the amount of gas delivered to the EU via its Belarussian pipelines, plus surging global demand for LNG shipments, especially from Asia.

The UK's own gas fields in the North Sea and Irish Sea have served the nation well – but their output is falling, partly because too few new fields have been developed, says OGUK, noting that from self-sufficiency in 2004 the UK can now meet only half its own gas needs. This means the UK is increasingly reliant on imports. In 2020 the UK consumed 74bn m³ of gas – about 1,100 m³ per person. Half had to be imported from other countries, including Norway, Qatar Russia, Trinidad and Tobago, Egypt and Nigeria.

OGUK's soon to be published *Energy Transition Outlook* will warn that such reliance will increase – unless the UK invests in the new resources known to lie under its continental shelf. Without such investment UK gas output will plummet another 75% by 2030, states OGUK.

Deirdre Michie, CEO, OGUK says: 'The gas resources off our own shores can boost our energy security and protect jobs. The UK industry's own greenhouse gas emissions, generated during production from these new fields, would also be a lot lower than those generated by LNG imports. The UK and our industry are on a journey to achieve net zero emissions by 2050. We fully support this goal but 23mn UK homes are still heated by gas, which also generates 40% of our electricity, so we will need gas to power us through this green transition. It would be far better to get as much of that gas as possible from sources we can control rather than rely on other countries.'

OGUK notes that from self-sufficiency in 2004 the UK can now meet only half its own gas needs

Photo: Harbour Energy

North America

US Lower 48 production set to exceed pre-pandemic levels

The oil production outlook for the US is set to grow over the next five years, from 10.96mn b/d at the beginning of 2021 to more than 12.9mn b/d by 2030, according to a new report from GlobalData. The biggest growth is expected in the Permian Basin, where crude oil and condensate supply is projected to increase by almost 0.90mn b/d, up from 4.5mn b/d in 2021 to 5.4mn b/d by the end of the outlook period.

According to the market analyst, US Lower 48 operators were able to make significant drilling and completion improvements in the past year, lowering the break-even price of unconventional projects to as low as $35/b, while will allow shale production in the country to rebound to pre-pandemic levels by 2024.

Svetlana Doh, Oil & Gas Analyst at GlobalData, comments: 'Despite the significant increase in oil prices, operators have been quite prudent in their capital spending and started building their strategies around high-return core assets. As a result, total rig count in the US has been quite sluggish in response to an increase in WTI price and is still at a 63% level compared to the number of rigs before the pandemic started.'

The US oil and gas rig count has been growing steadily during 1H2021, but it is down by 29% annually, the report notes. An average of 327 rigs were active across the US shale plays during 1H2021, which is 132 rigs lower compared to 1H2020. However, the recent oil price recovery has facilitated the improvement in rig activity and, in January, 332 rigs were operational across major shale plays, rising to 418 in June 2021.

Doh adds: 'Future production in the US Lower 48 is also likely to be affected by the fact that President Biden's administration will try to constrain leasing on the federal land, even though the drilling freeze was lifted by the court's ruling earlier this year. Such a measure is making the process of leasing time-consuming and this alone could hurt operators with significant acreage on federal land in the long run. However, the overall effect on production is not expected to be immediate. Operators have been stocking up drilling permits in advance, and drilling will still be allowed on active but not expired federal leases.'

Crude oil and condensate production from the US Permian Basin is forecast to rise from 4.5mn b/d in 2021 to 5.4mn b/d by the end of 2030

Photo: Chevron

IN BRIEF

Equinor and Rosneft are to join forces to develop low carbon solutions and reduce the carbon footprint from joint upstream projects in Russia. The companies plan to explore opportunities within such areas as reduction in flaring and methane emissions, energy efficiency and reporting of greenhouse gas emissions. They will also evaluate joint opportunities for the use of renewables, carbon capture, utilisation and storage (CCUS) and low carbon hydrogen solutions.

Lundin Energy has produced first oil from the Solveig field, a subsea tie-back development to the Edvard Grieg platform in the Norwegian sector of the North Sea. Phase 1 development of Solveig has gross proved plus probable (2P) reserves put at 57mn boe, with a peak plateau production of 30,000 boe/d, significantly contributing to the extension of the plateau production period at Edvard Grieg, which has already been extended by five years to the end of 2023. A plan for development and operation for a phase 2 development could be submitted by the end of 2022.

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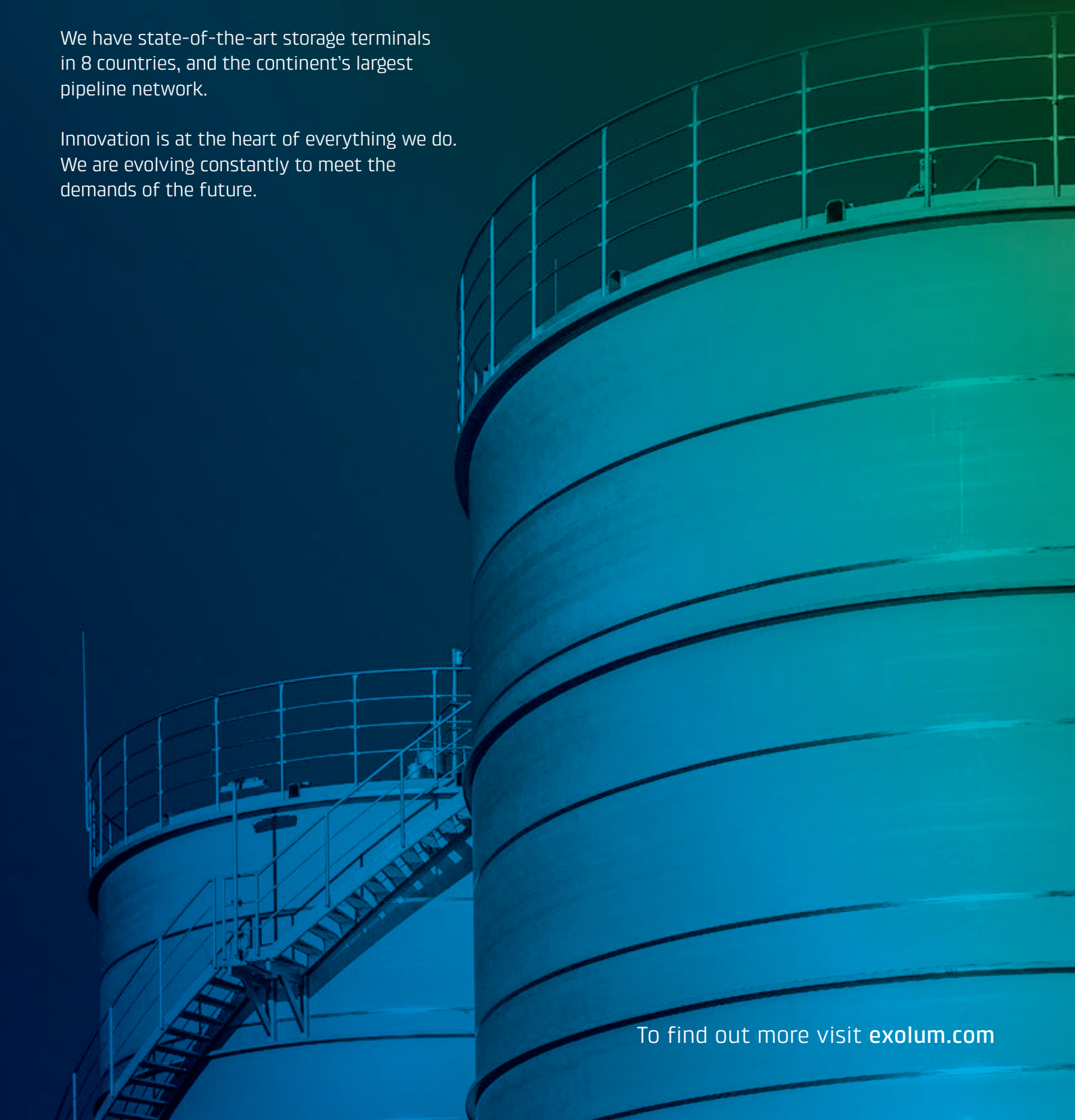

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Generation 2050 initiative sparks international intergenerational discussions

Ahead of COP26, the Energy Institute's Generation 2050 initiative held a series of round tables aimed at providing a platform for young professionals in energy to have their voices heard. Led by young professionals from different international regions, the round tables highlighted the strength of opinion about climate change among young people working in energy and debated with senior industry leaders some of the most pressing global energy issues we face today.

Providing intergenerational dialogue on how responding to the climate crisis looks in different parts of the world, the first round table in September 2021 asked 'Can the Middle East deliver on net zero?'. Young professionals from the Energy Institute's Middle East branch were in discussion with Tim Gould, Chief Energy Economist at the International Energy Agency; His Excellency Dr Abdul Hussain Bin Ali Mirza HonFEI, President of Bahrain's Sustainable Energy Authority; Jasim Husain Thabet, Group Chief Executive Officer and Managing Director of TAQA; and Binu Parthan, Head of Regions at IRENA. The discussion examined the risks and opportunities to Middle East economies of the need to act on global climate change, in particular whether the necessary public policy and investment commitments are in place in the region to bring about change at the pace required.

The second international round table asked 'Is the rise of Asia-Pacific the world's biggest climate conundrum?', and brought together young professionals from the Malaysia, Hong Kong and Singapore branches. Speakers offering their expert opinions included Professor PS Lee FEI, Executive Director of the National University Singapore Energy Studies Institute; Professor Christine Loh, Chief Development Strategist at The Hong Kong University of Science and Technology; Kevin Liu, Regional Representative & Head of Energy Asia Pacific at Scottish Development International; and Lucy Cullen, Principal Analyst of APAC Gas & LNG Research at Wood Mackenzie. The session examined the delicate balance between the rise in energy demand forecast in the region and how growth economies industrialise to meet the needs of emerging urbanised middle classes. In addition, the challenges posed by the energy transition and meeting the region's contribution to the global net zero target were also considered.

The third and final international round table of this series brought together the young professionals from the London and Nigeria branches and speakers Mervin Azeta, Product and Service Delivery Manager at Schlumberger, West Africa; Samuel Adunreke, Founder at Innovea Hubs, Nigeria; Demi Edosomwan, Managing Director of Emerging Markets at TotalEnergies Ventures; and Dr Musonda Mumba, Director of The Rome Centre for Sustainable Development. Asking 'Does UK energy investment help or hinder SDGs in the Global South?', the session examined whether the integration of the UN's Sustainable Development Goals, as the main framework to support the decision-making process of foreign energy investment, can help Global South nations to become more sustainable.

Catch up on all the roundtables now at: **www.energy-inst.org/gen-2050-roundtables**

EI publishes new resources to aid industry

As part of our aim to provide industry with cost-effective, value-adding knowledge to support the safe and responsible generation of energy, the EI's technical team has recently published several new resources to aid industry professionals. The third edition of the HM31 *Guide to refinery hydrocarbon management* is out now, summarising what is considered to be best practice in the areas of operation, accounting, hydrocarbon measurement and loss control. As well as aiding significant operational cost savings, the guidance assists oil and gas operators in reducing their environmental impact.

Also out now is our good practice animation aimed at helping petroleum road tanker drivers loading at fuel storage terminals. Demonstrating the correct methodology and driver placement for loading processes, the animation can be used by terminal operators during their driver induction sessions or safety briefings.

Finally, the third edition of the EI's *Guidelines for management of integrity of bolted joints in pressurised systems* describes the principles and good practice for the establishment of a management system for bolted joints in pressurised systems.

EI Enable – help and advice when you really need it

One of the greatest difficulties of the pandemic has been getting access to services and support, particularly in relation to support for mental health. We have had so many adjustments to make, new things to deal with and many of us have faced new stresses, illness or personal loss.

Did you know **EI Enable** can help? Free to EI members, this confidential service can provide up to four counselling sessions from trained clinicians to those who need it. Call 0300 303 4331 or visit the website to access the service online at **www.energyinst.org/membership-and-careers/ei-enable**

Why energy has never felt so important – a viewpoint from EI CEO Nick Wayth

I'm now five months into my journey at the EI and I thought it timely to share some perspectives. It's been a whirlwind of meetings – with staff, volunteers, trustees, industry partners, other professional engineering institutions, government and many others. It's been wonderful to meet so many amazing, professional and dedicated people. I am also very lucky to be part of such a fantastic team at the EI.

The world of energy has never felt as important or as fast moving. And once again energy is grabbing the headlines, all for the wrong reasons: fuel supplies drying up on UK forecourts and natural gas at record high prices, with knock-on effects from retail energy providers going out of business to issues in the food supply chain. How many of us understood the linkage between gas price and chicken supply? (Find out more on the links between food and energy on our podcast: *Energy in Conversation* Series 1, Episode 1 – Food waste? Not cool).

We are living through a seemingly huge paradox of the need to urgently decarbonise society due to the climate crisis, whilst at the same time we see the panic, fear and real-life impacts on people when energy supplies fail. So, as we approach COP26, how do we reconcile this need to accelerate the pace of decarbonisation and keep the lights on and people moving?

I fundamentally believe we can do both and ultimately transition to an energy system without carbon. And not only that but one that will be more affordable, more democratic and more equitable – if we do it right. The EI is committed to supporting society to deliver this. We have set our own target to reach net zero well before 2050 and plan to nearly halve our carbon impact by 2030. More importantly, we are helping the energy sector work towards net zero at pace, as we continue to ensure that energy is better managed and understood. Let me share some examples.

First, we have a critical role in developing the energy workforce of the future, ensuring energy professionals have the skills required to deliver the massive challenge in front of us. Qualifications, such as our Chartered Energy Manager, are playing a critical role in equipping individuals with the knowledge to better manage energy. We also need to build a workforce that far better represents society – not just because it is the right thing to do, but because it is the only way we bring the breadth of perspectives, experience and knowledge to tackle this crisis. Our Young Professionals Networks across the world are shining examples of developing the brightest new talent into the energy leaders of tomorrow.

Second, we are working with many of the largest companies across energy, from renewable players to integrated oil and gas companies, to develop the technical practices required to make energy cleaner, safer and more efficient. We are already active in everything from offshore wind to hydrogen to sustainable aviation fuels. And as always, there is much more to do as we think about integrated power systems and the role of digitalisation in the energy system. Our dedicated Technical Team will continue to collaborate with industry to develop good practice across these innovative new areas.

And third, we have an important role in using our trusted and unbiased role as a chartered membership body to convene our Fellows, members and experts from across the energy sector to help debate and inform society on how we tackle the biggest energy challenges. The recent discourse around hydrogen colours or the role of heat pumps has become emotional and divisive. Whilst people may not always agree, our role is to help convene that discussion in a constructive manner, relying on science to help inform better decisions.

EI CEO Nick Wayth

I, for one, don't have the answers but what I do know is that if we come together as an industry and as energy professionals, we are going to be much better placed to help solve the biggest challenge humanity has ever faced. Our role has never been more important as society looks at our sector to keep the lights on and to deliver the energy transition at pace.

As the Energy Institute prepares for several events before, during and after COP26 I'd love to hear your thoughts on what more we should do.

As the Energy Institute prepares for several events before, during and after COP26 I'd love to hear your thoughts on what more we should do at **CEO@energyinst.org.**

New professional members

The EI provides a range of professional membership grades and chartered titles. Achieving these higher levels of recognition supports your career development and demonstrates your commitment to the industry. Congratulations to the individuals who have achieved professional recognition and/or have acquired registration in the last few months.

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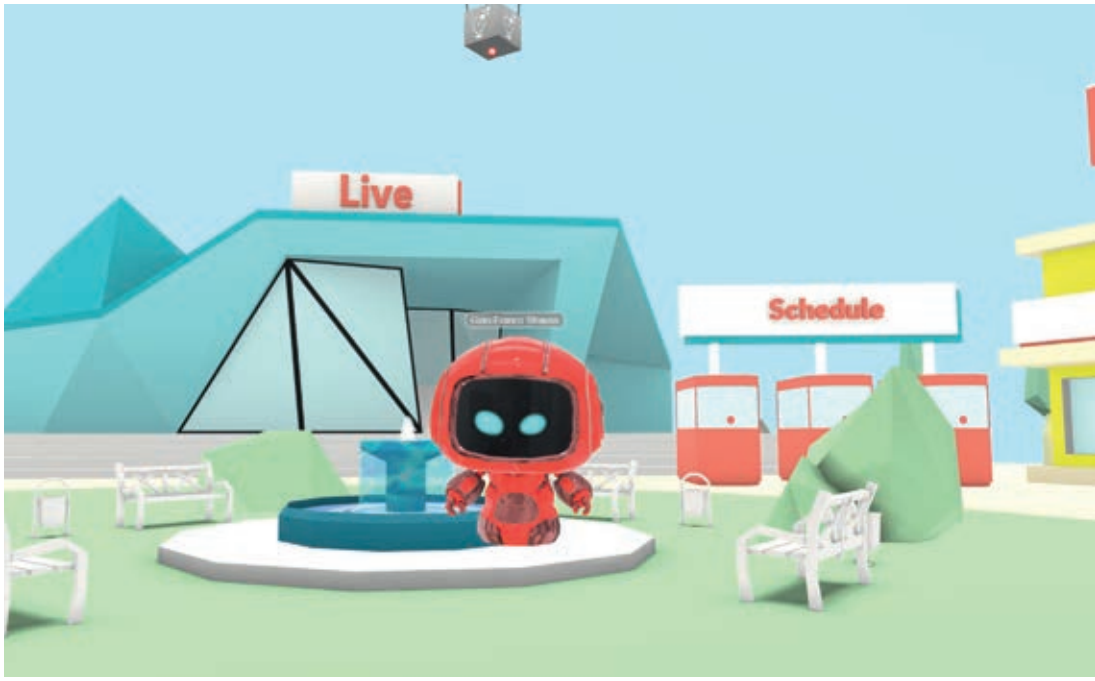
Contact the EI Membership team on t: +44 (0)20 7467 7100 or **membership@energyinst.org** for details of upgrading your membership, applying for registration or for any other queries about your EI membership.

TECHNOLOGY



Innovation is key

The three-day E.ON Innovation conference highlighted a plethora of comment and strategies for transforming the energy market, from distributed power and renewables to new hydrogen developments and regulatory challenges. *Brian Davis* reports.

Every aspect of the energy spectrum is changing in the drive for a more sustainable future. The energy market is being transformed, with the move to distributed power, new sources of energy like blue and green hydrogen, decarbonisation and digitalisation. Innovation is key.

So, it was with eager anticipation that I attended the E.ON Innovation conference in early October, in the guise of a little robot avatar at a three-day virtual event, rather than winging my way to Dortmund, Germany. Given there were 83 speakers and 1,250 minutes of live streaming of Europe's largest virtual energy event, this report focuses on some of the key themes, although there was food for thought in nearly every session.

Leonhard Birnbaum, CEO of E.ON set the picture. 'The biggest challenge today is the energy transition. There are big and small innovations in every area, which by definition require small steps every day. Innovation also leads to more CO_2 reduction and the key area of innovation will be to digitise our full eco-systems.'

Birnbaum emphasised that 'sustainability means electrification, and particularly renewable electrification with hydrogen development from renewable sources at scale'. However, 'building this eco-system will require significant finance and demographics, which is a major challenge to reach E.ON's target of net zero by 2045 or sooner', he noted.

Interconnection is about sustainability

'E.ON has completely transformed its business to prepare for a carbon neutral world,' explained Thomas König, Chief Operating Officer for Networks at E.ON.

But how are connectivity and sustainability linked?

König drew attention to the extreme heat and floods that hit many countries across the globe this summer and reflected: 'There's no doubt these disasters are man-made. It has become more critical than ever to drastically reduce our CO_2 emissions and live sustainably. At the same time, the flood disaster in Germany showed the importance of connectivity, as 200,000 people were temporarily without power. Fortunately, customers were reconnected in record time, due to collaboration, creating new solutions and support from other countries.'

König sees networks as the common denominator today, connecting wind turbines, solar panels, electric vehicles (EVs), etc to support the environment. 'Every new connection of renewable energy sources replacing fossil fuel brings us closer to the Paris Agreement goals,' he commented.

The traditional relationship between energy suppliers and users is changing. With more and more people producing their own green electricity, using solar panels and onsite storage, E.ON has coined the name for these flexible consumers as 'flexsumers'. Orchestrating interconnection of flexsumers with the grid requires a high degree of coordination and automation. The number of connected devices is forecast to increase to 500bn by 2030. 'The system can no longer be controlled by humans. Digitalisation is key to our future – optimising the capacity of distribution systems to ensure energy supply security and make power distribution observable and steerable across all voltage levels over coming years,' he said.

Numerous opportunities are offered by digitalisation throughout the entire value chain, from intelligent network planning and efficient operation of energy networks to new digital solutions for customers. E.ON is focused on building a single digital platform for its entire network business across Europe, linking all its efforts and bundling solutions for customers and network businesses.

'You can no longer talk about the distributed grid without talking about renewable energy systems and all the regulations coming,' remarked Benjamin Jambor, Director of Regional Grids at Westnetz and CEO/Founder of grid solution provider Digikoo. 'The grid is no longer linear but raises increasing questions about the connection of PV [photovoltaics], wind turbines, etc. It's about balancing and looking towards sustainability goals.'

The virtual world of the E.ON Innovation event was a gateway to discussions on every aspect of energy market transformation

Photo: E.ON Innovation

'This is the era of electrification, with a significant increase of customers wanting to connect to the grid, increasing capacity. Industries also want to electrify and decarbonise, with new customers coming like datacentres and battery factories consuming a vast amount of electricity, along with electrification of transport,' added Johan Mörnstam., Senior Vice President of E.ON Energy Networks in Europe. He mentioned that Volvo and other truck manufacturers predict that 50% of new truck sales globally will be EVs by 2030.

'Everything is about innovation,' continued Mörnstam. Examples of new E.ON innovation include a large-scale battery solution in Hungary; the introduction of a new digital trading platform in Sweden, to increase the utilisation factor on the grid; and the use of drones to survey the grid more efficiently. E.ON is also looking to use data and artificial intelligence (AI) to create self-healing grids.

So, what's the scale of the challenge? E.ON has over 50mn customers and operates a 1.4mn km electricity grid with over 800,000 distributed energy producing assets connected to this grid. 'Billions more assets will be joining the grid,' explained Sebastian Weber, Chief Technology Officer, E.ON. 'Managing this complexity is where innovation will happen. Quantum computing, for example, will be utilised in the future, given the number of parameters. But it's just the beginning of the journey and digitalisation will be speeded up over the coming year.'

There is a fundamental drive towards harmonisation on the application landscape, with a move to put all datacentres on the cloud by 2023, to drive flexibility and scalability as well as reducing CO_2 emissions. Smart meters are also being rolled out across Europe. E.ON recently invested in a majority stake in gridX, an AI-based energy load management start-up focused on the micro-grid level.

'I think a world without fossil energy is the wrong direction. It should be a world where we extract CO_2 from fossil energy, but somehow use gas and oil for blue hydrogen and other purposes. Though we must stop burning oil and gas from the 2040s to achieve our net zero target ambition.'

Clemens Hecker, Managing Director of AFRY Management Consulting

Decarbonisation – are we on track?

'Decarbonising energy is at the core of fighting climate change,' noted Dirk Swider, VP of Group Strategy at E.ON. 'Three quarters of global greenhouse gas emissions come from one [hydrocarbon-based] energy or the other. But reducing that is not an easy task and will require substantial changes in how energy is produced, transported and consumed.'

The European Union estimates that additional investment of €200bn/y will be required in coming years. 'That is a massive challenge and most of that money needs to come from private hands. But this indicates the great opportunities we have for society, customers and companies,' continued Swider.

Patrick Grachan, Director of climate policy thinktank Agora Energiewende, feels the energy industry is 'on track' when it comes to direction of moving towards climate neutrality and renewables. However, when it comes to scale and speed, 'we're not on track to reaching greenhouse gas neutrality by 2045,' he stated. 'This requires a lot more renewables and increasing electricity demand in Germany by 50–60%, for example, with more onshore and offshore wind. This is a matter of [government] policy and companies speeding up.'

'We totally lack consciousness of time and ambition,' remarked Susanne Nies, General Manager of grid optimisation company Smart Wires. 'Although we have all the ingredients with leading technology innovation, the mindset of some people lacks speed and commitment.'

'The speed of transition is actually lowering when we look at permitting to get new renewables on the grid,' complained Clemens Hecker, Managing Director of AFRY Management Consulting.

The International Energy Agency's (IEA) recently published a report *Net Zero by 2050* which suggested no new oil and gas fields should be approved from now on. However, the panelists felt fossil energy still had an important role to play in developing countries in Africa and Asia, for example. 'I think a world without fossil energy is the wrong direction. It should be a world where we extract CO_2 from fossil energy, but somehow use gas and oil for blue hydrogen and other purposes. Though we must stop burning oil and gas from the 2040s to achieve our net zero target ambition,' said Hecker.

Nies interjected: 'I was surprised the IEA report only went for 50% electrification, which lacks ambition. The 2040s is too late. We need to phase out oil and gas and have lots of examples of companies reinventing themselves.' But Grachan considered the IEA report 'ground-breaking' because it showed a global pathway towards this challenging goal.

Jöng Bergmann of transmission operator Open Grid Europe (OGE) pointed out that 80% of our energy system currently consists of molecules, but there will be significant adjustment over time as we decarbonise. He sees hydrogen as one of the potentially 'cost efficient' solutions to meet climate goals, supporting security of supply and resilience of the energy system. He also mentioned recent discussions in the Hydrogen Council and the German government's hydrogen strategy that suggest the best sectors in which to deploy hydrogen would be industry and heavy-duty transport. However, he recognised that the most challenging issue would be dealing with the heating sector. OGE has many projects underway and is working on making its network hydrogen ready.

H2Global also has initiatives to support ramp-up of the market for green hydrogen and its products, explained CEO Markus Exenberger. 'The core problem is the price difference between product costs of clean hydrogen and its derivatives,

Interconnection panel (left to right): Johan Mörnstam, Senior Vice President, E.ON Energy Networks in Europe; Sebastian Weber, Chief Technology Officer, E.ON; Benjamin Jambor, CEO, Founder Digikoo; and moderator Christoph Burkhardt, journalist

Photo: Sven Adrian/E.ON Innovation

'We are living in the Age of Zero. It is an era of exponential development, disruption and new interconnections, where we need to think differently about people, power and platforms.'

Kristian Ruby, Secretary General, Eurelectric

such as ammonia, e-kerosene and methanol. Currently, these derivatives can't be produced economically by this route, so state support is needed to address demand for very large projects.' Initially, the German government has provided €90mn to H2Global in the first round of funding. 'Although we have very ambitious targets and the technology is well known, what is missing is the legal and regulatory frameworks,' he remarked.

'Speed is of the essence', said Valborg Lundegaard, CEO of Aker Carbon Capture, which has been awarded a major carbon capture and storage (CCS) contract for Heidelberg Cement, as part of the Norwegian full-value-chain Longship CCS project, for operation in 2024. Valborg noted that Aker has been approached for CCS projects worldwide but is currently focused on Northern Europe. Four segments have been prioritised, including cement, where emissions are hard to abate; gas-to-power; bioenergy and blue hydrogen. Aker is using the Haldor Topsoe process in partnership with a research institute to make mega-scale hydrogen plants more efficient and has tested carbon capture at a hydrogen plant run by Preem in Sweden.

People, power and platforms

The final word goes to Kristian Ruby, Secretary General, Eurelectric, the Federation of the European Electricity Industry. 'We are living in the Age of Zero,' he said. 'It is an era of exponential development, disruption and new interconnections, where we need to think differently about people, power and platforms.'

'We call 18- to 20-year-olds Generation Z, which stands for Zero. They've grown up in an era since 2000 where nearly every year was a heat record and an emission record. No wonder they care about their carbon footprint. All they have seen is political failure and failure to align with the science... We will see Boomers go out and Generation Z gradually take over with different expectations for utilities,' he said.

The numbers speak for themselves. 'The Age of Zero is an era of exponential development, with need for 500,000 MW of renewables, 30mn heat pumps and 40mn EVs... We face an unprecedented scaling of our sector, with €400bn to be invested in grids in Europe over the next 10 years.'

He continued: '40,000 MW of self-consumption means that PV panels will be as common as a fridge was in the 1960s. We need to think how to integrate all that new electricity and new consumers in the system. And 40mn EVs means a complete revamp of the transport segment. Maritime is the new kid on the block and will be included in the ETS [European Emissions Trading System] by 2023. By 2030, all major ships docking in Europe will be required to source their energy from clean shore power, and radically reduce GHG intensities by 2050.'

'In the Age of Zero, electricity is the lifeblood not only of households but also the broad economy. We need to go from silo thinking to sector integration, and think differently about platforms. The platform economy is social, economic activity, facilitated by online services, apps and a technological framework, allowing for a more participatory, integrated grid of value creation. We need to think differently because the hardware is getting stronger, the software smarter, and the networks better.'

Indeed, by the end of the E.ON Innovation conference my little robot avatar's eyes were truly spinning!

More information at www.energy-inst.org/middle-east-forum

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LEGAL

Climate litigation and energy

John McElroy, Committee Member of the London Solicitors Litigation Association (LSLA) and a Partner at Hausfeld, highlights some of the key cases and future trends in climate litigation.

In July 2021, the London School of Economics (LSE) published the third report in its *Global Trends in Climate Litigation* series, presenting the trends originating from climate cases filed or concluded between May 2020 and May 2021. The report identified the most common types of climate litigation, which included compliance with climate commitments; constitutional and human rights cases; corporate and financial markets cases; and climate adaptation-focused cases.

As well as exploring the growth of strategic climate litigation brought by activists to increase ambition on climate issues, the report also highlights cases that result in challenges to climate change policies, either intentional or otherwise.

Key cases

A recent, high-profile victory for climate activists came courtesy of the *Milieudefensie vs Shell* case, where the District Court of the Hague held that Shell owed a 'duty of care' to the claimants to reduce emissions resulting from its operations by 45% by 2030, relative to 2019 emission levels. This marked the first time that a company had been held legally responsible for its individual contribution to global emissions.

This is one of the forward-looking cases emphasised by the report that centres on the current and future activities of major emitters. Such cases aim to obtain a court declaration that the climate targets of major emitters comply with the Paris Agreement.

Another of the cases touched on in the report is the Australian case of *McVeigh vs Rest*. This claim was brought by a 23-year-old member of an Australian pension fund, who claimed that the fund's trustees were not doing enough to disclose and manage climate change risks. In November 2020, the fund settled the claim, acknowledging that 'climate change is a material, direct and current financial risk to the superannuation fund across many risk categories, including investment, market, reputational, strategic, governance and third-party risks'.

The broader impacts of the settlement (which are expected to be felt beyond the Australian jurisdiction) are likely to include increased pressure on funds globally to manage climate change risks actively and set out initiatives to that effect; with increased pressure on businesses to manage and report to their investors on any financial risk posed by climate change; and members demanding more from their funds and carefully scrutinising the management of climate-related financial risk.

Future trends

The report identified supply chains as a possible target of future climate litigation. In such cases, claimants could hold companies liable for climate-related acts or omissions of their supply chains.

In *Milieudefensie*, the court differentiated emissions from the Shell group and those resulting from wider entities within Shell's business network. The court held that Shell had an obligation to reduce emissions (including from its value/supply chain) but acknowledged that Shell had a higher level of responsibility for its own operations and emissions. The court afforded Shell a lower standard of obligation, ie 'significant best efforts' for supply chain emissions. But the report concluded that emphasis on such emissions could be taken as a 'growing consensus' around the need to limit cumulative emissions, with a focus on upstream as well as supply-side emissions.

However, whilst the *Milieudefensie* judgment is an example of courts stepping in to develop the law in concert with the climate crisis, the case is being appealed and may ultimately be overturned. Observers from outside the Netherlands might well question whether such a judgment could be given in less climate-progressive jurisdictions.

Analysis in the report also noted that lack of attention to supply chain resilience (in relation to extreme weather events caused by climate change) may lead to shareholder and other stakeholder claims against directors. In the UK, with rapidly evolving regulatory and common law obligations concerned with reporting climate risk, it is also possible that there will be an increase in scrutiny around reporting by security issuers on the effect of climate change on their business and related risk mitigation.

Future claims may also relate to government subsidies and tax breaks for sectors with high emissions, of which there have been relatively few to date. The report draws attention to a UK case filed against the state-owned Oil and Gas Authority's (OGA) strategy to support new exploration and production initiatives in the North Sea, which could signal an expansion in focus for strategic climate litigation.

More to come

The cumulative number of climate change-related cases has more than doubled globally since 2015. Indeed, the overall impression of the report is that climate change litigation is expected to continue to grow.

Furthermore, the increasing impact of climate change on commercial issues indicates that the range of claims and defendants is expected to broaden. We at the LSLA and Hausfeld agree with the conclusions in the report relating to increased litigation in the financial markets and in connection with listed security issuers. The courts are expected to play an important role in developing the law to ensure that all stakeholders, across society, are incentivised to put the risks (financial or otherwise) posed by the climate crisis at the heart of their decision-making processes.

An increasing number of strategic climate litigation cases have been brought by activists to increase global ambition on climate issues

Photo: Shutterstock

FINANCE

SSLs – greenwash or not?

Is there a role for sustainability-linked loans in the upstream sector? ask *Jason Fox*, Managing Partner, London, and *Eimear Murphy*, Partner, Bracewell (UK) LLP.

The issue of climate change and sustainability has become an existential question for hydrocarbon companies with climate change and environmental, social and governance (ESG) pressures severely impacting access to capital for independent exploration and production (E&P) companies. The global pandemic has unquestionably accelerated the energy transition and the oil and gas sector is facing intense scrutiny from shareholders and other stakeholders, increasingly lenders, to demonstrate that action is being taken to implement ESG improvements.

With certain of the oil and gas majors* in the US and Europe suffering shareholder rebellions, we are witnessing a clear shift in how companies are being held to account for their activities and associated environmental impacts. This places ESG considerations resolutely at the top of every E&P company's agenda. Against that backdrop, we wish to analyse here whether there is a role for sustainability-linked loans (SLLs) in the upstream sector.

What is an SLL?

An SLL is a loan that aims to support environmentally and socially sustainable economic activity and incentivises the borrower to achieve ambitious sustainability objectives pre-agreed in loan documentation. In contrast to 'green loans', which provide funding to borrowers for green projects, SLLs carry no restrictions on how the loan proceeds can be used, making them a viable option for E&P borrowers.

SLLs link the interest payable to the company's progress against pre-determined sustainability objectives, employing a 'carrot and stick' approach to motivate borrowers with a reduction in the margin for meeting ESG targets and an increase in pricing for failure to do so. There has been exponential growth in the use of SLLs in the last few years with an increasing number in the upstream financing space. Standard & Poor reported that issuances of SLLs reached $350bn in the first half of 2021 alone (almost twice the figure for all of 2020).

With some banks retreating from providing finance to fossil fuel companies and, in some cases, reduced capital allocations for upstream financings, there is a paucity of liquidity in the market. Reduced access to capital means that lenders who remain in the sector are playing a significant role in shaping borrower behaviour by requiring borrowers to adopt an ESG strategy with ambitious sustainability performance targets and monitoring compliance against those targets. Financial institutions can demonstrate to their own stakeholders that there is engagement to implement ESG improvements in this sector.

Several E&P companies have now agreed sustainability-linked targets in their corporate and reserve-based lending facilities. New financings for E&P companies and amendments to existing facilities are likely to incorporate these features going forward, as it is a means to unlock greater access to capital and maintain relationships with lenders who require sustainability-linked features to maintain their exposure to companies in the upstream sector.

It is of paramount importance that financial institutions ensure that sustainability performance targets in SLLs are robust and meaningful, in order to avoid allegations of 'green sheen' and the reputational risk associated with 'greenwashing'.

Following a framework

Earlier this year, the Loan Market Association released a framework setting out what borrowers, lenders and their advisers should consider when seeking to integrate sustainability factors into loan documentation. The framework focuses on identifying key performance indicators (or KPIs), setting sustainability performance targets (typically the setting of such targets is an iterative process between the borrower, a lender appointed as the sustainability coordinator and ESG advisors), agreeing the terms applying to the margin ratchet, nominating an independent adviser to verify performance against sustainability performance targets and including a reporting regime. This construct seeks to circumvent allegations of 'sustainability washing' by ensuring that sustainability performance targets are suitably ambitious, with accurate measurement and disclosure of borrower performance against such targets.

The KPIs that we see in E&P companies' facilities generally concentrate on the 'E' (or environmental) element by achieving reductions in carbon intensity and flaring, as well as boosting renewable electricity generation. Amid escalating stakeholder pressure for oil and gas companies to report their ESG efforts, the incorporation of KPIs and targets in these facilities and, more importantly, meeting those targets demonstrates a borrower's commitment to improving its ESG performance. Getting the ESG narrative right may result in stronger stakeholder engagement, better access to capital and improved corporate reputation for E&P companies.

As the acceleration of the energy transition continues apace, we expect there to be a significant increase in the number of SLLs being provided to E&P companies. To the extent there is a scarcity of upstream lending from commercial banks, the liquidity shortfall could be filled by funders who face less scrutiny from stakeholders and apply less stringent ESG targets (or none whatsoever). While some may consider the use of SLLs in the upstream sector with some cynicism, SLLs motivate borrowers to implement ESG improvements in a more timely fashion than may otherwise have been the case. Loans which support environmentally sustainable activity and incentivise the borrower to achieve ambitious sustainability targets during the energy transition is arguably a good outcome for all parties. ●

**Editor's note:* ExxonMobil, Chevron and Royal Dutch Shell have all faced highly-publicised shareholder revolts on ESG issues.

Sustainability-linked loans motivate borrowers to implement ESG improvements in a more timely fashion

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Q&A

Driving the energy transition

A bright energy future lies ahead as the world transitions to a low-carbon future, says *John MacArthur*, Chair, International Energy Week 2022*, and Group Climate Change Officer, ADNOC.

International Energy Week 2022 will take over from the Energy Institute's (EI) longstanding International Petroleum Week event – what does this mean for the global energy industry?

This new name signals our confidence in a bright energy future for everyone involved in the EI and our global energy industry. As an inclusive organisation, it makes sense that our major annual event is called International Energy Week.

The energy skills of the EI's individual members are valuable to building a sustainable energy future. Many of the EI's company members are involved in new energies or are transforming to become international energy companies. The EI is the natural home for energy professionals working in diverse roles. Energy today ranges from geothermal to carbon capture and storage (CCS), green and blue hydrogen, bioenergy, renewable electricity, oil and gas – which remains vital to our modern way of life. I am confident these vibrant energy opportunities will attract the next generation of talent to our industry.

Focusing on ADNOC, what is the company doing in terms of tackling climate change, reducing carbon emissions and developing renewables?

In the early 1970s, ADNOC was one of the first in the world to decide not to flare associated gas and instead export LNG. Our methane emissions intensity remains low today. To tackle climate change, the world must use the lowest-possible emissions petroleum products as a priority.

That leadership foresight continues in ADNOC today. We have pledged to further reduce our greenhouse gas (GHG) intensity by 25% by 2030. ADNOC also operates Al Reyadah, the world's first carbon capture, utilisation and storage (CCUS) facility for the iron and steel industry, capturing up to 800,000 t/y of CO_2 before being injected into the Rumaitha and Bab oil fields. Building on its success, we are expanding our CCUS ability to 5mn t/y by 2030. This underscores our commitment to being an industry leader in environmental sustainability.

John MacArthur, Chair, International Energy Week 2022 and Group Climate Change Officer, ADNOC

What can be done to accelerate the pace of change in Middle East energy operations, given the significant dependence on oil and gas-related revenue?

Petroleum is an incredibly useful natural resource that transforms lives, and is also made into numerous useful products, from the face masks worn by medical workers to mobile phones.

Lower carbon intensity petroleum products are also essential to drive the energy transition, to mine minerals, manufacture wind turbines and solar panels. The Middle East will also see greater integration of intermittent renewables with flexible natural gas, CCUS and baseload nuclear in the energy system. The Middle East will increasingly provide low carbon energy products to customers and industry partners. ADNOC is also an early pioneer in the emerging hydrogen market and is embarking on a world-scale 'blue' ammonia production facility.

What do you see as the major areas of innovation in Middle East operations technologically, socially in terms of workforce diversity and global political alliances?

I enjoy working in an industry with so many nationalities involved and diversity in all its individual forms. Our next generation of young professionals will have a strong presence at International Energy Week. We also have outstanding female leadership role models in ADNOC, with Fatima Al Nuaimi, CEO of ADNOC LNG, recently named CEO of the Year at the Gastech Awards.

Digitalisation is advancing rapidly, from digital measurement of GHG emissions using lasers at ground level or by satellites in space, to automated integration with existing production and financial systems to enhance real-time monitoring and operational excellence. I am also excited by innovation and new business models for low carbon fuels like hydrogen.

As we explore those new low carbon growth opportunities, a strength of ADNOC is its history of collaborating with global partners. That core strength is important as we work with industry partners to help them to thrive in the energy transition.

What are you expecting from COP26 for the energy industry?

Fundamentally, this is the first test of raising our collective global ambition to limit warming to 1.5°C. Another priority is to mobilise climate finance from developed countries to support climate action in developing countries.

I would like to see an agreement on international carbon trading (Article 6 of the Paris Agreement). This mechanism would assist governments to implement their Nationally Determined Contributions (NDCs) more easily by allowing countries with low emissions to sell their excess allowances to larger emitters, within an overall reducing cap of GHG emissions. In other words, states exceeding their NDCs would be able to reduce emissions at the lowest cost carbon price.

A well-designed Article 6 mechanism would establish an international policy foundation for emissions trading systems, which may lead to global or regional carbon prices. Through this flexible, lowest cost approach, GHG emissions would fall faster, with carbon prices stimulating innovation and growing markets for lower carbon fuels and technologies, accelerating the energy transition. ●

*International Energy Week will take place in London as a hybrid (online and face-to-face) conference on 22–24 February 2022. See p19 for details.

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AVIATION

Sustainable fuel taking off

The civil aviation sector is pushing ahead with deploying sustainable aviation fuels (SAF) across the industry, writes *Keith Nuthall*.

Aviation has always been regarded as a tougher sector to convert to low carbon fuels than road transport, because of the high intensity burn required to power aeroplanes, which traditionally has been supplied by fossil-based kerosene. In 2019, before COVID-19 knocked the industry off a seemingly unstoppable growth trajectory, 95bn gallons of fuel was burned by commercial airlines worldwide, according to statistical service Statista.

However, sustainable aviation fuel (SAF) is set to play an increasingly important role on the road to net zero, reportedly capable of reducing carbon emissions over its lifecycle by up to 80% versus conventional jet fuel. SAF is an aviation fuel produced with an alternative feedstock to crude oil recognised by ASTM D7566. It has the same qualities and characteristics as conventional jet fuel – meaning it can be used as a drop-in replacement, blended with conventional jet fuel, without the need for new engines.

Jane Hupe, Deputy Director for Environmental Protection at the International Civil Aviation Organisation (ICAO) says analysis undertaken by the UN agency found 'that, by 2050, it would be physically possible to meet 100% of international aviation jet fuel demand with SAF, corresponding to a 63% reduction in emissions'. However, according to Hupe, 'this level of fuel production could only be achieved with extremely large capital investments in SAF production infrastructure and substantial policy support. She notes that the effort required to reach these production volumes 'would have to significantly exceed historical precedent for other fuels, such as ethanol and biodiesel for road transportation'.

Test flight of Gripen fighter plane fuelled by 100% biofuel, at manufacturer Saab's facilities in Linköping, Sweden

Photo: Saab AB/Linus Svensson

Working together

Fortunately, efforts are being made, with civil aviation a prime target of global initiatives to reduce carbon emissions. One major player in SAF manufacturing is Finnish biofuel major Neste, which currently produces 100,000 t/y of SAF. Production is set to rise, with plans to expand the company's Singapore refinery and invest in its Rotterdam, the Netherlands, refinery, with the aim of producing 1.5mn t/y of SAF by January 2024.

Meanwhile, in October 2021, a coalition of global air transport players – covering airlines, airports, air traffic control (ATC) and aviation manufacturers – adopted a long-term climate goal of net zero carbon emissions by 2050. Signatories included the International Air Transport Association (IATA), Airports Council International (ACI), ATC organisation CANSO and major manufacturers Airbus and Boeing.

Another example is the World Economic Forum's Clean Skies for Tomorrow Coalition initiative, which includes major airlines, airports, fuel suppliers and other aviation innovators from around the world. In September 2021, 60 of these companies signed a pledge to cooperate to ensure global aviation drew at least 10% of its power from SAF by 2030.

Much of this ambition includes the development of bio-based feedstocks to make aviation fuel or blends with kerosene. Companies involved include BP, Shell, Suncor and Norsk e-Fuel; British Airways and Delta; Heathrow and Schiphol airports; and aviation manufacturers such as Airbus and Rolls Royce.

While SAF has already fuelled more than 250,000 commercial flights, there are difficulties in scaling up production and use, because manufacturing aviation fuels from bio-based feedstocks instead of using kerosene is much more expensive, notes the World Economic Forum. 'Costs will fall if production scales up, but fuel providers are facing headwinds due to high price pressure on low SAF demand, and high risks associated with policy and investment uncertainty,' it says.

One way in which coalition members are trying to bridge that gap is through the development of SAF certificates (SAFc), where aviation consumers (especially corporate customers) can pay more for flights, knowing that this has funded the use of SAF. These certificates can count towards their own greenhouse gas reduction commitments in regulatory and trading schemes.

Carbon offsetting

Such market-based systems are at the core of encouraging the world's civil aviation companies to use SAF, notably the CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation) system that has been in place for the industry since January 2019. Established by the ICAO, it involves airlines buying emission permits from trading systems or funding carbon offset projects that reduce CO_2 emissions elsewhere. In this way, there is a financial incentive for the industry to reduce its carbon footprint.

Using SAF is one way this can happen, as long as its production and use complies with ICAO standards that insist the carbon emissions must be at least 10% lower over the fuel's lifecycle than standard fossil-based aviation fuel. ICAO has added some additional criteria, such as feedstocks should not replace food production; or be grown on areas that were previously old-growth forest, wetlands and peatbogs; and that any increase in carbon emissions caused by a change in land-use when switching to biofuel production is taken into account in greenhouse gas calculations. SAF must also be as safe to use as existing fossil-based fuels. Under CORSIA, third-party certification organisations are approved to assess and approve aviation biofuel consignments' compliance with ICAO lifecycle sustainability criteria.

Five fuel conversion processes are recognised by ICAO as being acceptable within CORSIA. These are the Fischer-Tropsch (FT) process; hydro-processed esters and fatty acids (HEFA); alcohol (isobutanol) to jet (ATJ); alcohol (ethanol) to jet; and synthesised iso-paraffins (SIP) systems. As for potential feedstocks, the UN agency recognises the use of agricultural and forestry residues, municipal solid waste, used cooking oil, tallow, corn oil, soybean oil, rapeseed oil, palm oil, sugar cane, sugar beet, corn grain, poplar, miscanthus, switchgrass and palm fatty acid distillate. ICAO is particularly keen on the use of miscanthus and switchgrass, given that they absorb carbon when grown, and so could deliver a negative carbon balance over their lifecycle.

Bruno Silva, ICAO Environment Officer says: 'We expect that this will help facilitate the future deployment of SAF.' ICAO currently projects that sustainable fuels will deliver half of the industry's carbon reductions towards meeting its goal of ensuring there will be carbon-neutral growth.

Aeroplane refuelling at Athens International Airport
Photo: Jebulon

'There is much focus within the aviation industry on expediting the widescale deployment of sustainable aviation fuels and the EI is also reviewing options to minimise greenhouse gas (GHG) emissions associated with ground handling activities. The deployment of low carbon aviation fuel provides another important route to reducing the carbon intensity of aviation. All opportunities to reduce GHG emissions need to be taken to help the industry achieve its ambition of being net zero by 2050.'

Martin Hunnybun, Head of Good Practice, Fuels and Fuel Handling, Energy Institute (EI)

Growing market

ICAO says commercial production of SAF increased from an average of 0.29mn litres/y in 2013–2015 to 6.45mn l/y over 2016–2018. The UN agency projects that potential global SAF production will reach 8bn litres by 2032.

Finnish paper, pulp and energy conglomerate SCA and Finnish energy group St1 have created a joint venture to produce and sell advanced biofuels, which will include aviation lines. The companies are building a new biorefinery at St1's current refining complex in Gothenburg (Göteborg), Sweden, able to produce 200,000 t/y of liquid biofuels. While the facility will be able to use a range of feedstocks, it will have access to SCA's tall oil, a by-product from pulp production at the company's mills based in Östrand, Obbola and Munksund, also in Sweden, and will operate from 2023. Meanwhile, in the US, DG Fuels has developed plans to create a manufacturing plant in Louisiana supplying 151mn gallons/y (571mn l/y) of Fischer-Tropsch process-made SAF.

In September 2021, Russia's gas major Gazprom struck a deal with Russian flag carrier Aeroflot on producing the country's first SAF from plant-based feedstock. Meanwhile, Italian energy major Eni has announced plans to supply hydrotreated vegetable oil (HVO) biofuel to airport operator Aeroporti di Roma (ADR).

Adam Zampini, spokesperson for Airports Council International (ACI), stresses that airports can play an important role in extending the use of SAF. 'They all have to work in a coordinated way to make this possible,' he says. 'Preparations for SAF implementation can take many months or even years. It is likely that current airports wanting to facilitate SAF will need to bring it from across borders.' According to Zampini, at present SAF 'should be preferably procured already blended with conventional aviation fuel to minimise customs or transportation barriers'.

Other developments

Another sustainable, but non-bio based, fuel is being made by Silicon Valley, US, electrofuels start-up Prometheus Fuels, which recently announced it was selling 10mn gallons of zero net carbon Promethean Forged jet fuel to American Airlines. Prometheus uses a novel process claimed to capture CO_2 and water molecules exhaust pollution from the air, recharging and recombining these molecules into hydrocarbons and then converting them into gasoline, diesel, or – in this case – jet fuel. According to founder and CEO Rob McGinnis, it is 'the world's first electro-SAF and the first SAF that can beat fossil fuels on price – our jet fuel costs one cent less per gallon than fossil fuel'.

Meanwhile, ICAO is also looking at recognising lowering carbon content through the reduction of flaring, the use of renewable energy in refineries and carbon capture storage and usage (CCUS) technology.

Another focus for the UN agency is the potential contribution to carbon reduction offered by small hybrid and electrical aircraft. One major issue here is the weight of the batteries.

Meanwhile, the development of hydrogen-based aircraft is also being considered by ICAO as an emissions reducer, with researchers assessing design issues associated with the volume of fuel tanks required. European air traffic control organisation Eurocontrol is among the industry bodies taking this concept seriously. It staged a seminar on hydrogen propulsion powered aircraft in May 2021 that highlighted a Clean Sky 2 and Fuel Cells & Hydrogen 2 Joint Undertakings study that confirmed such planes emit zero CO_2 and reduce climate impact by 50–75%, and, if using fuel-cell technology, by 75–90%.

Aircraft manufacturer Airbus in 2020 revealed three concepts for zero-emission commercial aircraft powered by hydrogen, which could enter service by 2035 (see *Petroleum Review*, December 2020/January 2021 for details).

Zampini agrees that all these advances will be needed. 'Net zero will require several solutions – new technologies, which will allow for aircraft to fly 100% on SAF, and the development of new electric and hydrogen-powered aircraft, efficiency improvements, additional operational opportunities to reduce emissions, sustainable infrastructure and negative emissions technologies (NETs) [that remove and sequester carbon from the air].' ●

HYDROGEN

Realising the potential for a hydrogen revolution

How big a role will hydrogen play in the future energy mix and what needs to be in place to ensure it reaches its full potential? asks *Adrian Del Maestro*, PwC Strategy&.*

PwC Strategy& recently spoke to a number of UK fleet managers about how they would decarbonise their heavier vehicles. While electrification was a possibility, many believed hydrogen would likely be the technology of choice. But when probed about the rationale for this fuel, all they said was that hydrogen would come to the rescue 'sometime in the near future'.

In many ways this illustrates the promise of hydrogen and the hype associated with this emerging energy source. Viewed by some as the panacea to decarbonise hard-to-abate sectors, just how big a role will this fuel play in the future energy mix? Which sectors will be the early adopters? And, perhaps most importantly, what needs to be in place to ensure hydrogen really takes off?

Gaining momentum

It certainly feels as though we are at a tipping point, with a number of factors converging to propel hydrogen into the limelight, including:

- The wave of net zero announcements from cities, countries and corporates.
- The growing momentum for a greener economic recovery led by multiple governments.
- The scaling up of renewables (wind and solar) and the associated declining costs to produce electricity.
- The potential for hydrogen to provide seasonal storage optionality to counter the intermittency of renewable power.

Hydrogen has a critical role, complementing other low carbon technologies, in helping decarbonise society, especially hard-to-abate sectors

Photo: Shutterstock

There is also a growing consensus that hydrogen has an important role to play in the future energy mix. What is less clear is how much. The Climate Change Committee has suggested a share of some 10% in UK energy demand, while Snam CEO Marco Alverà is more bullish, asserting a global share of as much as 25%. Current global demand for hydrogen is about 70mn t/y. There are a wide range of scenarios out to 2050 suggesting demand will grow, ranging from the International Energy Agency's (IEA) 287mn t/y (under its Sustainable Development Scenario) to Barclay's Base Case of 575mn t/y. These scenarios indicate demand rising by a factor of four and eight respectively. So clearly a robust increase in demand is expected, but with a broad range of expectations.

On the supply side, Europe is helping to lead the charge on hydrogen. The recent 'Fit for 55' announcement sees a target of 40 GW of electrolyser capacity by 2030 and with a sole focus on green hydrogen (produced through electrolysis from renewable sources). Moreover, the plan is for hydrogen refuelling stations to be available every 150 km on major transport routes for both light-duty and heavy-duty vehicles. These ambitions are significant, dwarfing the 2030 hydrogen targets of other countries such as Chile (25 GW), South Korea (15 GW) and the UK (5 GW).

Market still in its infancy

While hydrogen is expected to grow significantly in the medium term, the market is currently very much in its infancy. And it is also a market shaped by the 'chicken and egg' syndrome. Some companies are reluctant to invest in hydrogen production without the sufficient demand pull. And on the demand side, other companies are wary of investing in heavy transportation fuelled by hydrogen without the infrastructure and supply in place.

As for the production economics of hydrogen, this further complicates the situation. Grey hydrogen (made from natural gas and emitting CO_2) is the most cost competitive at about $1–1.5/kg. Blue hydrogen (natural gas with carbon capture) ranges from $2–3/kg and green hydrogen is north of $5/kg. There is an expectation by analysts that the scaling up of electrolyser technology combined with the falling cost of renewables power will make green hydrogen competitive with blue by 2030.

Given the infancy of the hydrogen market coupled with the need to scale-up investments, regulatory intervention will

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be an important enabler. This is why we are witnessing numerous national governments announcing hydrogen strategies and incentivising the private sector to accelerate the growth of the hydrogen economy.

Early adopters

So, in light of these dynamics which end-demand sectors are likely to take off? In the UK for example, industrial clusters such as Zero Carbon Humber (ZCH) and Net Zero Teesside (NZT) are likely to be pioneers. The intent in Humber is to produce blue hydrogen and use that to provide fuel for heavy transport in the region, generating feedstock for the world's first 100% hydrogen-fuelled power generation plant (part of the SSE and Equinor joint venture for Keadby Hydrogen), and for hydrogen to be blended into local heating networks.

There are already other pilot projects which are focused on heat, such as HyDeploy, exploring blending up to 20% hydrogen in gas networks. In the UK decarbonisation of heating will be a significant challenge. More than 85% of households use natural gas for heating. Hydrogen offers the prospect of using existing gas infrastructure to transport the fuel as a blended source of energy with methane over the short to medium term.

Elsewhere, heavy transportation, such as buses, trains and trucks, are likely early adopters. The UK government is keen to promote zero emission buses, with hydrogen buses already a common sight in London.

Accelerating growth

However, if hydrogen is really going to take off in the UK and in other countries, what needs to happen to accelerate growth?

Firstly, governments have a hugely important role to play in unlocking the hydrogen economy. They need to set the national ambition by establishing a vision, articulating a strategy with targets and implementing a detailed road map. They also need to establish a regulatory regime that enables private sector investment to flow in. Interestingly, it is not just about governments injecting money. Clearly government investment in pilot projects will help provide incentives for the private sector.

The enabling regulatory regime will be critical for the development of the hydrogen industry. Think of the UK experience in offshore wind. The UK government set a clear ambition to become a world leader, defining targets and enabling investment through Contracts for Difference (CfD). Having started this journey in the early 2000s, the UK attracted a wave of private sector investment which saw offshore wind capacity reach some 10 GW in 2020. Now the UK government is seeking to build on this success to reach 40 GW by 2030. The UK government will need to replicate this success in hydrogen and is in consultation with industry to explore a similar CfD regime.

As for investors and the private sector, there is appetite to invest in low carbon projects. Overall investment in the global energy sector is large and growing. According to the IEA, global investment in energy infrastructure is forecast to rise by 10% in 2021 to reach $1.9tn. While investment in fossil fuels has declined in recent years across upstream, midstream and downstream, the trend for power is different. In contrast, between 2019 to 2021, the IEA expects investment in renewables to grow some 5% year-on-year, to reach $370bn in 2021. Electricity networks and battery storage are set to grow 4% year-on-year in the same period, to total about $300bn.

As a nascent industry, investment in hydrogen is on a much smaller scale. The Hydrogen Council suggests over $300bn will flow into this energy source between now and 2030. And more capital will be essential to help scale up the hydrogen industry. This will only be forthcoming if there are viable business models and a clear line of sight to revenue and profitability for investors. Hence the importance of government support.

Finally, partnerships will be critical. Not only the partnership between government and the private sector as previously alluded to, but also partnerships between corporates. One of the interesting themes emerging from the energy transition is the plethora of partnerships we are witnessing – Ørsted, the Danish wind developer, partnering with BP to advance green hydrogen production; Shell and Daimler joining to build a hydrogen refuelling network and to manufacture hydrogen trucks respectively; and SSE partnering with Equinor, as already referenced, to build a 100% hydrogen-fuelled power station. These partnerships are necessary to mitigate technical and financial risk. But they are also important because they help build capabilities where individual companies may struggle.

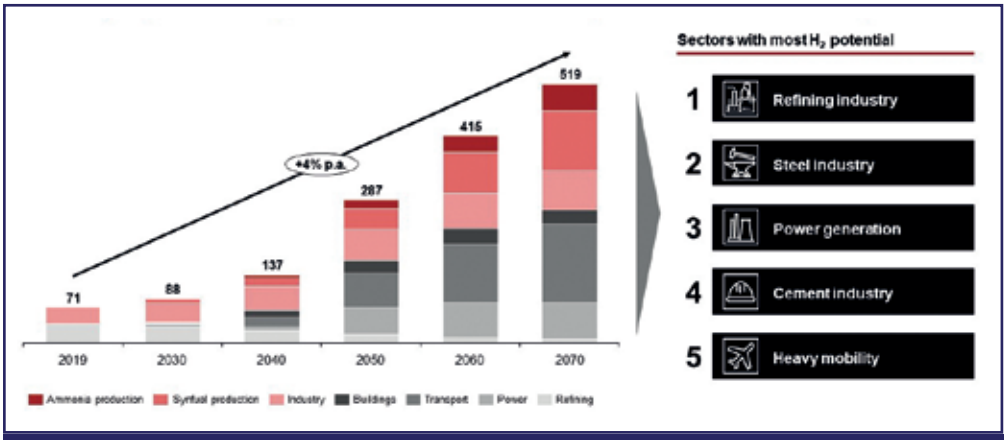

Figure 1: Global hydrogen demand by sector in IEA Sustainable Development Scenario, 2019–2070, in mn tonnes
Source: IEA/PwC Strategy&

Looking ahead

Looking ahead, hydrogen has a critical role, complementing other low carbon technologies, in helping decarbonise society, especially those hard-to-abate sectors like steel, fertilisers and cement manufacture. There are also some end user applications that are likely to take off sooner, such as in industrial clusters or heavy-duty vehicle transportation. But if hydrogen is to fulfil its potential it will require significant government intervention and private sector capital to scale up the industry and bring costs down. By laying these foundations in place a future hydrogen market is more likely to be reality than wishful thinking. ●

*This article is based on a PwC Strategy& report, *Laying the foundations of a low carbon hydrogen market in Europe*, and the PwC/World Energy Council paper *Hydrogen on the horizon*.

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ENERGY TRANSITION

A challenging net zero roadmap

Serious power shortage problems affected various parts of China in the run-up to the COP26 United Nations Climate Change Conference in Glasgow, Scotland, highlighting the challenges facing the world's largest carbon emitting nation as it works on developing a carbon zero strategy, writes *David Hayes*.

Chinese government efforts to reduce rising power consumption and the share of coal-fired generation this year have led to coal supply shortages and high prices. Coupled with a reduction in Indonesian coal imports due to heavy continuous rain and lower Russian imports, the resulting power cuts began affecting household consumers in north-east China's Liaoning, Jilin and Heilongjiang provinces, home to almost 100mn people, by late September. This was despite power restrictions having been put in place for factories in more than 10 provinces, including the large manufacturing centres of Guangdong, Shandong and Jiangsu.

In addition to residential apartment lifts not working and cuts in home heating, traffic lights and street lighting also were off due to power outages.

The disruption to electricity supplies quickly prompted major investment banks, including Morgan Stanley, Goldman Sachs and China International Capital Corporation, to downgrade their economic growth forecasts for China. Meanwhile, Chinese property developer Evergrande's debt crisis also threatens the economy, with some fearing it could turn into China's equivalent of the US Lehman Brothers bankruptcy.

The power shortages follow a series of power outages in several coastal and central provinces in late 2020 as electricity consumption rose in response to China's economic recovery, led by energy intensive industries including steel, cement, fertiliser and aluminium production, and rising post-COVID-19 pandemic international demand for Chinese manufactured goods.

China's renewable energy, energy storage and power transmission are not yet large enough to meet large demand spikes. As a result, some observers believe the power shortages could be used to justify the construction of additional coal-fired plants in China, with China Electricity Council and China State Grid currently expected to add hundreds of GW of new coal-fired facilities over the next few years while at the same time average utilisation hours for thermal power plants have declined to 4,216 hours, well below 50%.

As China's energy needs are too large to give up coal, carbon capture is expected to play an important role in achieving greenhouse gas (GHG) reduction targets in the future.

Key point in time

Although the power shortages emphasise China's continuing reliance on coal-fired generation and could require increased coal supplies as a short-term solution, China is at an important stage in its energy transition. President Xi Jinping has already pledged for China's carbon output to peak in 2030 and for the country to reach carbon neutrality by 2060, in his announcement to the UN General Assembly in September 2020. At this year's meeting, he announced that China will stop financing new coal power stations overseas.

Although remaining reliant on fossil fuels, in particular coal and imported oil, China has been establishing a foundation to transform its energy sector over the past decade, with renewable energy at its centre and building the world's largest hydroelectricity, solar voltaic and wind energy capacities.

According to the China Electricity Council, which represents China's electricity generating companies, the nation's total installed generating capacity at the end of 2020 was 2,200 GW, 10% more than the government's targeted 2,000 GW at the end of the 13th Five Year Plan (2016–2020). China's total installed wind power capacity stood at 281.5 GW, one third more than the 210 GW target, while solar installations totalled 253.4 GW, more than double the 110 GW target.

Speaking at the UN's 76th General Assembly in September, China's President Xi Jinping announced that China will stop financing new coal power stations overseas – his announcement followed last year's pledge for China to achieve carbon neutrality by 2060 and for carbon output to peak in 2030

Photo: United Nations

Both nuclear and hydropower capacity were below target, however, with nuclear capacity totalling 49.9 GW compared with a goal of 58 GW, while China's combined hydropower and pumped storage capacity was 370 GW, just below the goal of 380 GW.

China's 1,080 GW coal-fired power station generating capacity at the end of 2020 accounted for 49% of total capacity, 6% lower than the 13th Plan target due to both wind power and solar power installation being ahead of target during the plan period.

China is expected to announce more details of its 2030 peak emission and 2060 carbon neutrality pathway at COP26 after the nation's leaders approved China's 14th Five Year Plan (2021–2025) earlier this year. Among targets announced for a low carbon future in this latest plan, the share of non-fossil fuels will increase to 20%, up from 15%. The plan also includes a nuclear power capacity target of 70 GW for 2025. More details are due to follow when China's new electricity sectoral plan is published.

Energy intensity per unit of GDP is targeted to reduce by 13.5% from 2020 levels under the 14th Plan, slightly lower than the 15% reduction target set under the previous period. The new five-year plan does not include a cap on total energy consumption, but does call for minimum energy production

South-east Asian energy transition

South-east Asian countries continue to work on plans to reduce GHG emissions, which are expected to be announced at COP26.

The energy transition creates a major challenge for many countries in the region, as most are trying to relaunch their economies after suffering in the pandemic, while relying heavily on fossil fuels, especially coal, natural gas and oil.

Most Association of South-east Asian Nation (Asean) countries. which number 11 in total, already plan to use renewable energy to reduce carbon emissions. However, the degree of planning and preparation varies widely among the different countries.

'Despite the view in the West that South-east Asia is lagging behind in implementing carbon zero, the Asean region has made progress in some areas but has been limited by the scale and regulations to drive the energy transition,' comments Peter Godfrey, Regional Managing Director for Asia at the Energy Institute. 'Thailand, Vietnam, Malaysia and Indonesia are doing different things but all are planning how to move from hydrocarbons and developing their net zero strategy; however, there still is a long way to go.'

South-east Asia's emerging economies face different issues to Japan, South Korea and more developed western countries in preparing their individual energy transition roadmaps. Although the energy transition offers opportunities to use domestic energy resources and reduce fuel imports, Asean governments are keen to ensure the availability of sufficient energy supplies during the transition period, mindful of the well-publicised coal shortage problems that currently affect China.

'The policy and political issues driving South-east Asia's transition are different to those affecting the West; energy demand growth still exists in South-east Asia but not in the West,' says Godfrey. 'South-east Asian countries are still growing and they need to drive more energy into their economies. In the West, there is less connection between energy and GDP growth, so Europe and the US see the carbon zero transition more as an opportunity. Energy needs in the West are constant and demand growth is not great, if at all, but in South-east Asia energy has seen rocketing demand with economic growth.'

Multilateral financial support is expected to play an important role in assisting South-east Asian countries navigate the energy transition by reducing investment risk for banks and private investors helping set up renewable power projects and other clean energy schemes.

'The net zero expectation of Asean is that multilateral funding will be an important element of a de-risking leg-up. We also can expect more European, US and Japanese financial support to South-east Asian countries,' Godfrey notes.

Carbon pricing

Asia's energy transition will not get fully underway until Asean members and other Asian countries achieve carbon price discovery.

'The only way to value environmental issues is a carbon price, there needs to be more veracity to get a carbon price to drive change,' Godfrey explains. 'All countries need a zero carbon plan; without that plan they do not have a carbon price and they need that to drive change. China and Asean do not have a zero carbon plan yet, but people do not understand the situation fully. No country has firm net zero targets yet in Asia or developed plans, but many have renewable energy targets. Advanced economies are putting a carbon price in place and it's likely they will put a tax on non-resource efficient imports; so carbon price pressure will affect exporters and others in Asean and other countries to offset the difference.'

Energy switch

Among the Asean countries, Indonesia's state-run electricity company, Perusahaan Listrik Negara (PLN), has pledged to stop building new coal-fired power plants and plans to switch its existing coal-fired stations to renewables between 2025 and 2060. The transition is unlikely to be easy as Indonesia currently generates 48% of its electricity from coal-fired stations, according to the Ministry of Energy and Mining Resources.

PLN Deputy CEO Darmawan Prasojo told a parliamentary hearing in May that the state utility will look to replace coal and coal-gas-fired power plants totalling 11,000 MW with renewable energy by 2025. In addition, PLN will retire coal-fired stations totalling 49,000 MW in stages by 2056 as the nation moves to carbon neutrality.

Indonesia's electricity demand is forecast to reach 1,800 TWh in 2060. PLN expects 53% to come from solar and wind power sources by then. Less than 1% come from solar and wind energy today, according to the International Energy Agency (IEA).

Indonesia is planning to develop its own EV industry in a bid to lower overall domestic oil consumption. Rising ownership of gasoline-fuelled vehicles in recent years has caused oil imports to rise, resulting in the country becoming a net oil importer. The government aims to boost EV production to 30% of total automobile output by 2030.

Thailand, meanwhile, expects its energy transition to take longer than other Asean member countries and is targeting achievement of carbon neutrality somewhere from 2065 to 2070.

At present just over 40% of Thailand's primary energy demand is met by oil. Under its recently approved National Energy Plan 2022, Thailand plans for renewable energy to account for at least 50% of total power generation, depending on the cost of long-term battery storage facilities, Ministry of Energy Permanent Secretary Kulit Sombatsiri said in August.

Currently, natural gas accounts for 57.5% of Thailand's power generation mix, while coal's share is 17%, mostly locally-mined lignite.

Elsewhere, the Philippines raised its carbon emission reduction target to 75% by 2030 earlier this year, a 5% increase from its 70% pledge made four years ago.

Highlighting the importance of multilateral finance in assisting developing countries achieve their GHG emission reduction targets, the Philippines Department of Finance has stated that most of the targeted reduction is dependent on support of climate finance, technologies and capacity development provided by developed countries under the Paris Agreement. The remaining small share of the reduction target will be implemented mainly through domestic resources.

from various sources equal to 4.6bn toe.

Among other developments, China introduced carbon emissions trading in July this year. Trading started with the power sector, which is controlled by large state and provincial government utilities. China's five largest electricity generating companies currently account for 44% of the nation's installed 2.2 TW generating capacity. More industrial sectors are expected to begin carbon trading in due course, with aluminium and ferrous metals among the likely sectors to be targeted.

China accounted for 28.4% of the world's carbon emissions in 2018. Last year, in the middle of the COVID-19 pandemic, it was the only major economy to record growth in CO_2 emissions, which the US Energy Information Administration (EIA) reported as an 0.8% increase over 2019.

Commentators say the Chinese government will need to support carbon price discovery (the process of determining the price in the marketplace through the interactions of buyers and sellers) to encourage greater CO_2 emissions cuts, after initial carbon prices following the start of carbon trading were considered too low at $7.88–8.76/t to drive large-scale decarbonisation of the power sector.

A different story

While China's energy transition is focused on managing future energy demand growth and supply as economic development spreads to less developed provinces and rural areas around the country, the situation facing Japan and South Korea is quite different.

As industrialised countries with falling birth rates, neither Japan nor South Korea expect energy demand to grow in the future. As a result, their energy transition will focus on converting existing energy use to carbon neutral sources – a journey that poses major challenges for both countries.

The Japanese government has ambitions for nuclear to hold a 20–22% share of the country's energy mix, with industry leaders and power utilities still keen to see nuclear power regain its status as a major base load power supply source

Photo: Shutterstock

Japan's strategic energy plan

Japan is finalising its Sixth Strategic Energy Plan (SEP), detailing measures to reduce GHG emissions by 2030. Scheduled to be presented at COP26, the latest SEP is based on carbon emission reduction targets announced by former Prime Minister Yoshihide Suga, who in October 2020 declared that the country would become carbon neutral by 2050.

Six months later, under pressure from western countries to increase medium-term carbon emission reduction efforts, Suga announced in April 2021 at the Leader's Summit on Climate hosted by US President Joe Biden that Japan would almost double its 2030 carbon emission reduction target to reduce GHG emissions by 46% from actual 2013 emission levels compared with the 26% reduction level targeted previously.

The power generation fuel mix has been revised in order to meet this GHG emissions target, increasing Japan's self-sufficiency in energy to 30%. The first draft of the latest energy policy includes a higher target for renewable energy in the nation's power generation fuel mix for 2030 but leaves unchanged the previous target for nuclear power despite the continuing struggle to reactivate mothballed nuclear stations since the Fukushima Dai-Ichi plant meltdown disaster in 2011.

Among the main points detailed in the draft SEP, Japan's total energy consumption will reduce from about 312mn toe in 2013 to around 241mn toe in 2030, including targeted energy savings of 53mn toe. The reduction will be achieved through reduced demand following improved energy efficiency and energy conservation.

Total power generation in 2030 is forecast to be 930–940 TWh under the new SEP, of which renewables will account for 36–38% of total power supplies.

The share of renewables, which will be mainly solar energy and wind power, is double the 18% recorded in Japan's financial year ending 31 March 2020 and 50% more than the Ministry of Economy, Trade and Industry's (METI) previous target of a 22–24% renewables share in 2030, detailed in the 2018 SEP.

Under the draft proposal the share of fossil fuels in Japan's power generation fuel mix will decrease, from 56% in 2019 to 41% in 2030, which will have a significant impact on future international coal, LNG and oil demand, being equivalent to about 10mn t/y of LNG demand.

Coal's share of the electricity fuel mix will decrease to 19% by 2030 under the draft plan, down from the previous target of 26%.

The natural gas share, which is imported as LNG and accounts for most of Japan's remaining fossil fuel generation mix, is targeted to account for 20% in the draft plan, while oil has a 2% share.

Hydrogen/ammonia will also enter the mix as a new fuel, accounting for 1% of the 2030 generation fuel mix.

Meanwhile, Japan's targeted nuclear share of generation remains unchanged at 20–22% in the draft plan, with industry leaders and power utilities still keen to see nuclear power regain its status as a major base load power supply source.

Bold plans are all well and good, notes Ken Koyama, Chief Economist at Japan's Institute of Energy Economics, in a recent paper published by The Oxford Institute for Energy Studies, but it will be difficult to achieve the ambitious targets outlined in the draft SEP with only nine years to implement the new policy.

To achieve the 20–22% nuclear target, for example, will require 27 nuclear plants to be in normal operation – to date, only 10 nuclear reactors have been brought back into service, compared with the 54 reactors that were in service before the Fukushima disaster, some of which now are permanently shut down. There is also the public's anti-nuclear sentiment which developed after the Fukushima accident to take into consideration, while the process of restarting 27 nuclear units will require approval for a life-time extension to 60 years from Japan's Nuclear Regulatory Agency, Koyama explains, making the nuclear restart programme complicated and uncertain.

Expanding renewable energy also poses challenges. Solar power accounts for around 65% of renewables growth in the draft SEP as the lead time for wind power is longer due to various issues including ownership of offshore sites. However, finding sites for large-scale solar power installations is also problematic due to limited suitable sites being available as Japan is 70% covered by mountains.

Koyama points out that the sixth SEP does not include any clear proposal for Japan's targeted 2050 energy mix. However, METI's advisory council has discussed a

reference concept for the energy mix to achieve 2050 carbon neutrality. The proposed reference concept forecasts electricity demand rising from 20% of total energy consumption at present to about 45% in 2050, largely driven by growth in the electric vehicles (EV) market. Total power generation is expected to reach 1,350 TWh in 2050, up one third from today's level. Meanwhile, renewable energy is targeted to reach 50–60% of electricity generation in 2050, while nuclear plus fossil fuel power generation with carbon capture, utilisation and storage (CCUS) is expected to be 30–40%, and CO_2-free hydrogen/ammonia 10%.

Energy costs also will influence Japan's energy transition pathway. Assuming a 10% nuclear share and fossil fuel generation with CCUS at 23%, Koyama notes the Research Institute of Technology Innovation for the Earth forecasts that electricity costs in Japan will double by 2050 from today.

Other energy transition scenarios all forecast increased electricity costs, the highest involving a 100% renewable energy share of generation, while the lowest forecast electricity cost involves a 20% nuclear power share scenario.

South Korea looks to hydrogen

South Korea's National Assembly, meanwhile, recently passed new legislation to reduce GHG emissions following President Moon's announcement last October that South Korea will achieve carbon neutrality by 2050 while pushing to become a 'hydrogen society' that uses hydrogen as a major energy source for electricity generation and transportation.

Passed in August 2021, South Korea's Climate Crisis Act targets a 35% reduction in GHG emissions by 2030 compared with 2018 levels. The target is 9% greater than the country's previous GHG emission reduction commitment but is non-binding. Critics also note the new legislation does not include information on South Korea's intention to include international aviation or shipping in its carbon neutral programme, nor does it explicitly rule out the use of international credits to achieve its target. Another cited shortcoming is the lack of detail on the government's review process and its plan to reach net zero CO_2 emissions.

However, the government did announce three proposals to reduce carbon emissions by restricting consumption of coal and LNG for power generation. Feedback received from industry and the public on the proposals have been used to finalise South Korea's carbon zero transition roadmap, which is to be unveiled at COP26.

Although South Korea's current ruling party committed to stop financing coal-fired stations, to introduce a carbon tax and to boost renewable energy in its 'Green New Deal', only support for renewables was included in the final new deal package.

South Korea has yet to adopt a strong carbon zero policy. Currently, the government still supports the construction of new coal-fired power plants domestically and overseas, recently bailing out Doosan Heavy Industries, a major coal-fired plant manufacturer.

Separately, however, increased government budgeting is being lined up for carbon reduction schemes. The Moon administration is proposing to allocate KRW12tn ($10.3bn) to reduce carbon emissions in its 2022 state budget, which first will require National Assembly approval.

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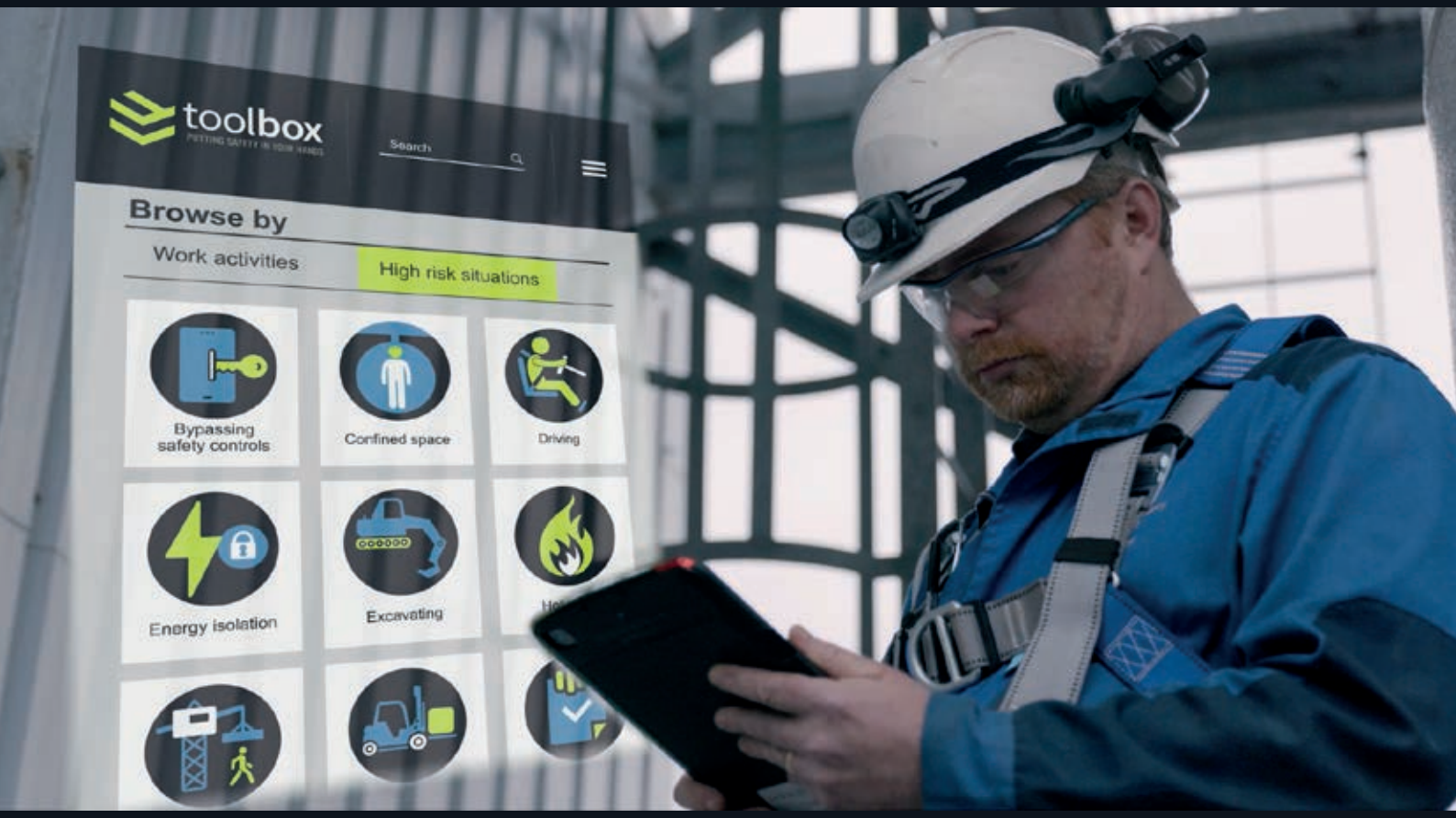

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