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Special Technology Supplement

Deploying renewables across all sectors through 'Power-to-X' is crucial to achieving carbon neutrality.



Wind farm decommissioning: planning ahead

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UN climate conference calls for action

French President Emmanuel Macron urged world leaders to respond more urgently to climate change

With carbon emissions at their highest and sea levels rising, world leaders committed to more urgent action on climate change at this year's UN Climate Change Summit in New York. **Junior Isles**

World leaders and businesses gathered at last month's UN Climate Change Summit to call for urgent action to avoid catastrophic climate change.

At the end of September at the New York summit, more than 60 heads of state, spurred by António Guterres, UN secretary-general, announced a series of new climate targets, with about 66 countries pledging to reach "net zero" carbon emissions by the middle of the century.

Guterres set the tone for the gathering, saying: "If we don't urgently change our way of life, we jeopardise life itself. My generation has failed in its responsibility to protect our planet.

That must change."

In the run up to the meeting Guterres lobbied world leaders to come to the summit with concrete commitments to stop subsidising fossil fuels, stop building new coal power stations and move toward net zero emissions.

He also barred leaders from the US, Brazil and Saudi Arabia from taking the stage because of their failure to support the Paris climate agreement, as well as from other leading economies such as Japan and Australia because of their continued support for coal.

In one of a number of three-minute speeches from heads of state, French

President Emmanuel Macron urged world leaders to respond more urgently to climate change and said France would not pursue new trade negotiations with countries that were not following the Paris climate change agreement.

Signatories of the agreement pledged to limit global warming to well below 2°C and ideally to 1.5°C, but their current climate commitments do not add up to the emissions cuts required.

Carbon dioxide emissions have hit record highs and a report just published by the International Panel on Climate Change (IPCC) claims that

by 2100 a sea level rise of as much as 1.1 m was likely under a business-as-usual scenario, where global carbon dioxide emissions keep increasing.

With coal widely acknowledged as a major driver of rising emissions, the IPCC said in a report last year that limiting warming to 1.5°C would require cutting coal use to virtually zero and cutting emissions to net zero by the middle of the century. Another report issued by Climate Analytics during the summit said global carbon emissions from coal fired power stations need to peak next year, and coal

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Corporations embrace sustainability as climate change battle heats up

A large group of multinational companies signed up to the UN Global Compact (UNGC) at last month's UN Climate Action Summit in New York.

With the announcement of 59 new participants, the group, with its campaign to keep global warming below 1.5°C, now has 87 companies with a combined market capitalisation of \$2.3 trillion. The initiative was launched earlier this year with 28 companies signing up in July.

Although over 600 companies have already committed to limiting global warming to 2°C in line with the Paris Agreement, their progress on actually hitting their goals has been mixed.

Companies signing the UNGC pledge have agreed to set independently verified "science-based" targets and create decarbonisation plans within 24 months to start bringing

their emissions down to keep warming below 1.5°C. They also have the option to publicly commit to reaching net-zero emissions by no later than 2050.

Andrew Steer, a board member at the Science Based Targets Initiative – a coalition between the UNGC and various environmental research and activist groups in charge of vetting the companies signing the pledge – said companies now realise that smart policies on climate change encourage more resource efficiency and the development of new technology, which can improve, rather than reduce, competitiveness.

"Just five or 10 years ago, the vast majority of CEOs, boards and governments believed it would be nice to do something about climate change but it would require a trade off," he said.

Engie Impact was created this year by French multinational electric utility company to offer consulting and services for sustainability strategy development, execution and tracking to accelerate sustainability transformation for corporations, cities and governments.

Speaking on the sidelines of New York Climate Week, the company's CEO, Mathias Lelievre, said: "Sustainability is really a business compatible approach. We are hearing good stories everywhere of people reducing energy consumption, water consumption, putting some circular thinking into how they design their products. This is happening locally because they can reconcile the business with the carbon dollars.

"What we are uncovering is that when you reduce your energy consumption, for example, and change

how you consume key resources, it gives a direct bottom line opportunity to plug all of that into renewable schemes, etc."

He said, however, the question is how to scale this at speed. "It's all about how to accelerate this energy transformation. It's difficult and very complex."

One of the key challenges for companies is formulating a good roadmap based on reliable data to take action.

"Today, only a few [organisations] are really equipped to measure in real-time what's going on when considering the impact on the environment, and really getting what they need to make sure they are addressing the right priorities, investing in the right projects and tracking those projects. This is a key element that is not there today," said Lelievre.

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must be eliminated from electricity generation by 2040.

The International Renewable Energy Agency (Irena) said that more than \$18.6 trillion of planned fossil fuel investments by 2050 should be redirected to low carbon technologies including renewables. In its climate investment report published just ahead of the New York summit, the agency said with just 11 years left for action to limit the effects of climate change, annual investments of \$4.3 trillion in the energy sector until 2030 is the world's most practical and readily available climate solution.

In response to country needs to mobilise low-carbon, climate-resilient investments, at the start of the summit Irena, together with Sustainable Energy for All (SE4ALL) and the UN Development Programme (UNDP), announced a partnership in coordination with Green Climate Fund. The new global initiative known as the Climate Investment Platform (CIP) aims to increase the flow of capital in developing countries to meet climate ambitions.



World Energy Congress: per capita energy demand was predicted to peak in 2030

The CIP is an inclusive partnership welcoming all stakeholders from governments and international organisations to the private sector to scale-up climate action and translate ambitious national climate targets into concrete investments on the ground. With energy accounting for two thirds of total greenhouse gas emissions, the platform's first service line is dedicated to the global transition to clean energy.

Although there are have been constant calls for a shift to clean energy and renewables in particular, DNV GL says there is no single pathway to a decarbonised energy mix. In its recent 2019 Energy Transition (ETO) published in mid-September it said gas, renewables and carbon capture and storage (CCS) must work together to secure a rapid energy transition.

The outlook forecasts gas and variable renewables will be the only energy sources for which demand is higher in 2050 than today, but noted that they must work together alongside greater uptake of CCS. It says, however, that CCS – the only currently available technology to deeply decarbonise hydrocarbon use – will not be employed at-scale until the 2040s unless governments enact more definitive policies on its use.

The 2019 ETO provides an independent forecast of developments in the world energy mix to 2050. It predicts that by this time, gas will account for nearly 30 per cent of the global energy supply.

The ETO came as the World Energy Council in collaboration with Accenture Strategy and the Paul Scherrer Institute launched an updated World Energy Scenarios report. Among the key findings of the update, launched at the World Energy Congress in Abu Dhabi, UAE, were that per capita energy demand is projected to peak before 2030 and innovative net zero carbon pathways include hydrogen.

Electricity leads decarbonisation but other sectors need to act

- Nearly 60 per cent of electricity carbon neutral
- Electricity share in energy consumption must triple

Junior Isles

Decarbonisation of the power sector is gaining pace in the EU but further political action is needed to ensure timely decarbonisation of other end-use sectors such as transport, heating and energy-intensive industries, according to the Power Barometer published by Eurelectric.

In 2018, 58 per cent of all electricity produced in the EU was carbon-neutral, said the report – a trend that is continuing and deepening in 2019. By 2030, 75 per cent of all power generation is expected to be carbon-neutral. In the same timeframe, the balance of the remaining fossil capacity will tip towards gas as a consequence of an accelerated coal phase-out, further reducing CO₂-intensity.

“Power sector decarbonisation is on fast-forward. But we need to see

additional investments in both generation and grids in order to stay on track”, said Kristian Ruby, Secretary General of Eurelectric.

Eurelectric said additional investments will also be needed to decarbonise other energy-using sectors such as heating, industry and transport. To fully decarbonise the European energy system, the share of electricity in total energy consumption must almost triple – from 22 per cent today to at least 60 per cent by 2050.

In particular the transport sector needs to see change. Today, only 1 per cent of energy used in transport is electric. That needs to increase to 63 per cent to achieve full decarbonisation.

Last month WindEurope listed several priorities for the incoming head of the European Commission. It said Ursula von der Leyen's, who is due to assume office on November 1st,

should first focus on both ambition and delivery on decarbonisation, noting that zero-net carbon by 2050 is technically and economically feasible. “The 2030 National Energy & Climate Plans should make clear progress towards this goal – not least to meet the growing demand for renewable energy from consumers and industry,” it stated.

It said the Commission should take a smart approach to electricity and gas. The share of electricity in the energy mix has to rise from 24 per cent today to at least 60 per cent by 2050. “It's the most cost-effective and energy-efficient way to decarbonise heating, transport and much of industry. Hydrogen from renewable electricity will also have a role to play,” said WindEurope.

It also advises the Commission to adopt a low-carbon industrial policy

with renewable energy as the backbone. The wind industry employs more than 300 000 people in Europe today and exports €8 billion worth of high-tech equipment outside the EU each year.

The importance of the wind sector in providing ongoing business for European companies was highlighted in research from Wood Mackenzie.

According to the company, a total of 65 GW of European onshore wind turbines will need upgrading or replacing by 2028.

The ‘European Onshore Wind Lifetime Extension Outlook’ report finds that from 2019 to 2028, an average of 4 GW of turbines a year that are reaching end-of-design-life will be what it calls lifetime extension (LTE) suitable. LTE is an alternative to decommissioning or complete repowering, said Wood Mackenzie.

Mixed reception to German climate plan

Germany's new package of measures aimed at getting its climate change ambitions back on track has received a mixed reception.

The range of measures notably include the introduction of a carbon price for key sectors such as transport and a €54 billion spending package to encourage companies and households to reduce carbon emissions.

The deal was largely welcomed by fellow politicians but has come in for heavy criticism from environmental groups and industry experts, who have criticised the low carbon price in particular.

Martin Kaiser, Director of Greenpeace Germany, described the price as “ridiculously low”, adding: “If you rely on such measures you might as well jump from an aeroplane with a plastic bag as a parachute.”

Under the new proposal, companies that produce and sell petrol, coal, heating oil and similar fuels will have to buy certificates to offset their CO₂

emissions. Such a system already exists at the European level, though only for heavy industry, aviation and the energy sector. The German carbon price, however, will be significantly lower than the current EU price – starting at €10 per tonne in 2021 and rising to €35 by 2025.

German Environment Minister Svenja Schulze said Germany's climate targets are now going to be legally defined for the first time. She added: “It will be clearly regulated what happens if an area deviates from the agreed climate course and if so, who has to make improvements and how.”

Friedrich Merz, a member of the conservative centre-right Christian Democratic Union (CDU) called it a “decent package”. He said, however that “it remains to be seen whether the sum of the many individual decisions will be sufficient to move closer to the climate targets”.

Germany has set a target to cut greenhouse gas emissions by 55 per cent

from 1990 levels by 2030. The country is phasing out both nuclear and coal fired generation, and is investing in renewable energy. Yet carbon emissions have hardly reduced over the past decade, forcing the Merkel government to scrap its climate targets for 2020.

As part of the new agreement, Germany has also committed to being carbon-neutral by 2050.

Patrick Graichen, Director of German energy policy think-tank Agora Energiewende, however, described the package as “shockingly feeble and fainthearted”. He said: “In particular the proposed CO₂ pricing is a bad joke: €10 per tonne won't do anything, the annual increases... are barely more than inflation. There is no progress for the expansion of renewables either – to the contrary the conditions for wind power are worse. That way the 2030 climate targets will definitely not be achieved.”

Germany has been under pressure to

phase out coal but at the same time has struggled with its renewables ambitions, particularly wind.

Last month, the government announced it was joining the Powering Past Coal Alliance, a group of 30 governments whose aim is to stop the construction of new coal plants, end international funding for coal and adhere to the Paris Climate Agreement goals. In January, Germany said it will exit coal by 2038 but has not yet passed a law.

At the same time, the dramatic decline in new wind farms this year has been of particular concern. Only 290 MW of new capacity were installed in the first half of 2019, a decline of more than 80 per cent compared with the same period last year.

Achim Dercks, Deputy Director of the German Chambers of Commerce and Industry, said last month: “If this continues the government will fail to meet its self-proclaimed goals for climate protection and renewable energy.”

Focus increases on EVs and grid integration

Nissan and EDF Group have signed a cooperation agreement to accelerate the delivery of electric mobility, highlighting the importance of electric vehicles (EVs) to the power sector and the growing number of collaborations between the energy companies and car manufacturers.

The agreement, which applies to the United Kingdom, France, Belgium and Italy, focuses mainly on developing smart charging solutions (vehicle to grid, or V2G). Smart charging solutions include technologies to control when vehicles charge and how quickly they power-up, as well as allow the two-way flow of electricity between vehicle and charger. Thanks to V2G technologies, the energy accumulated in the batteries of electric vehicles can also be used for businesses own energy needs or the grid when required.

As part of the cooperation agreement, Nissan is responsible for the sale of V2G compatible electric vehicles, and EDF Group is in charge of V2G charging solutions and related services.

The agreement follows a previous partnership in the UK between EDF Energy and Nissan. Signed last year, the two organisations agreed to collaborate around the development of shared offerings in the areas of electric mobility, smart charging, second-life battery use, energy storage and renewable energy sources.

It was EDF's second significant move last month in the EV business. At the start of September, EDF Renewables North America acquired electric vehicle EV charging technology startup PowerFlex Systems in a move to further expand in the distributed energy market.

PowerFlex Systems has patented a technology called Adaptive Charging Network (ACN) that is used in EV charging systems powered by renewable energy. Its software solution simultaneously balances electricity demand and supply and also prevents building owners from incurring peak demand charges.

“By incorporating the PowerFlex technology alongside our existing solar, storage, and energy management offering, we are now able to provide building owners and facility managers with a single energy ecosystem where all assets work to deliver clean, reliable, and affordable carbon-free power,” explained Raphael Declercq, Executive Vice President of distributed solutions and strategy at EDF Renewables.

Czech utility CEZ Group also made

a significant announcement in September. The company said it has chosen Driivz to help expand its CEZ Electromobility EV charging network, which is the largest in the Czech Republic.

Driivz, a global EV charging software, will support the CEZ Group's existing network and its expansion plans with its platform, at a time when the integrated electricity conglomerate is investing in its EV charge point portfolio.

Currently, there are approximately 3000 EVs registered in the Czech Republic and around 400 charging stations. With the number of EVs expected to rise to 500 000 by 2030, the Ministry of Transport is aiming to cater for the increased demand by constructing an additional 500 charging stations by 2023.



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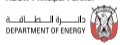







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Virginia boosts US offshore dreams

■ Dominion outlines 2.6 GW plans ■ Ørsted roots for GE 12 MW platform

Siân Crampsie

Dominion Energy has recently put forward plans to develop a huge 2.6 GW offshore wind farm in US waters in order to boost its renewable energy credentials.

The energy company has filed an application with PJM, the regional transmission organisation (RTO), to connect the proposed project to the grid. The project would be the largest of its kind in the USA, with over 220 wind turbines.

Dominion announced its plans as the state government in Virginia confirmed plans to target installation of 2.5 GW of offshore wind capacity by 2026.

Dominion's proposed wind farm would occupy the company's 112 800 ha lease area located 45 km off the coast of Virginia Beach. The filing is "a vital first step" in developing Virginia's full offshore wind potential, the company said.

"Offshore wind is an excellent renewable energy source and this filing with PJM shows how serious we are about bringing commercial-scale offshore wind to Virginia, giving our customers what they have asked for – more renewable energy," explained Mark D. Mitchell, Vice President of generation construction at Dominion. "Governor Ralph Northam has made it clear Virginia is committed

to leading the way in offshore wind. We are rising to this challenge with this 2600 MW commercial offshore wind development."

Dominion added that ocean survey work for the project is expected to begin in 2020 and a construction and operations plan will be submitted in 2022. It will build the project in 880 MW phases, the first of which is targeted for commercial operation in 2024.

Plans for offshore wind in Virginia are a key part of the USA's developing offshore wind sector. According to the US Department of Energy, the country's offshore wind energy project development and operational pipe-

line grew in 2018 to an estimated 25 824 MW.

The DOE said in a new report that falling technology prices, accelerated federal offshore wind lease auctions, and state procurement mechanisms, have helped drive the offshore sector. "US offshore wind is poised to be a significant part of our comprehensive energy portfolio in the coming years," said US Under Secretary of Energy Mark W. Menezes.

State offshore wind procurement policies now total almost 20 GW by 2035, with commitments from seven states across the north east of the country. On the west coast, 100 per cent renewables portfolio standards and

carbon reduction policies are driving offshore wind development in states such as California and Hawaii, the DOE said.

Last month, Ørsted said it would deploy GE's Haliade-X 12 MW offshore wind turbine at two of its offshore wind projects in US waters.

Subject to final agreed and signed approvals, Ørsted will deploy Haliade-X 12 MW wind turbines on the 1100 MW Ocean Wind off the coast of New Jersey, and the 120 MW Skipjack off the coast of Maryland.

The wind farms are expected to be commissioned in 2024 and 2022, respectively.

Greengate gets green light for 400 MW Travers solar project

Greengate Power Corporation is to build Canada's largest solar energy project after sealing consent from the authorities in Alberta province.

The Calgary-based renewable energy developer will invest C\$500 million (\$377.5 million) in the Travers solar project, which will have a capacity of 400 MWac.

Dan Balaban, President and CEO of Greengate, said that the Travers solar farm "will bring significant investment, employment and clean renewable energy to Alberta while strengthening the province's position as a global energy and environmental

leader". It will equip the facility with around 1.5 million PV panels.

Alberta is seen as the renewable energy heartland of Canada due to wind- and solar-friendly policies, but its new pro-oil United Conservative Party (UCP) threatens to derail clean energy growth.

After coming into office, the UCP government swiftly cancelled the fourth round of the province's renewables auction, which had been set for mid-2019.

Greengate expects construction of the Travers project to start in 2020, with full commercial operation in 2021.

Duke sets clean energy standard

Duke Energy has become the latest US utility to increase its low carbon ambitions.

The company – one of the largest energy firms in the USA – has revealed plans to achieve net-zero carbon emissions by 2050, with an interim target of 50 per cent carbon emission reductions by 2030.

It had previously set a goal to reduce carbon emissions by 40 per cent by 2030. It says that sustained, low natural gas prices and declining costs for renewables and storage have allowed it to accelerate that goal.

"We are making a cleaner energy future a reality for our customers and communities," said Lynn Good, Chairman, President and CEO. "A diverse mix of renewables, nuclear, natural gas, hydro and energy efficiency are all part of this vision, and we'll take advantage of economical solutions to continue that progress. In the longer-term, innovation and new technologies will be critical to a net-zero carbon future."

Duke says it has already reduced carbon emissions by 31 per cent since 2005. This reduction meets or exceeds the standards of the former Clean

Power Plan and the 2025 US commitment to the Paris Agreement, the company said.

To achieve the new goal, it will collaborate with regulators, customers and other stakeholders in each state that it serves, and at least double its portfolio of solar, wind and other renewables by 2025. It will also expand energy storage capacity and energy efficiency investments, but says that new natural gas investments will also be required to meet its goals.

Other investments will include grid modernisation and electric vehicle infrastructure.

Other US utilities to have established ambitious, long term clean energy goals include Xcel Energy and Southern Company.

"With Duke's announcement, electricity providers representing more than 30 per cent of US electric sales are now committed by pledge or law to fully phasing out climate warming emissions," said Armond Cohen, Executive Director of Clean Air Task Force. "We look forward to working with Duke to advance the technology and policies needed to make this transition swift and affordable."

Davis-Besse tests hydrogen technology



The USA is investigating ways of improving the commercial outlook for its nuclear energy sector through the development of nuclear-to-hydrogen technology.

The Department of Energy (DOE) has awarded funding to a project led by FirstEnergy Solutions and the Idaho National Laboratory aimed at finding an economical way to use nuclear energy to produce hydrogen that can be stored and used in other parts of the energy value chain.

The project partners, which also include Akron, Xcel Energy, and Arizona Public Service (APS), will initially demonstrate and deploy a 1-3 MWe low-temperature electrolysis unit to produce commercial quantities of hydrogen. The first site, planned for 2020, is FirstEnergy Solution's Davis-Besse Nuclear Power Station near Toledo, Ohio.

Hydrogen from Davis-Besse may initially be used to supply public transportation fleets in Ohio or in industrial projects. The project will demonstrate how hydrogen from commercial

nuclear operations can be used to produce "green" products and commodities in significant quantities for domestic use and for export to international markets where green and low-carbon attributes are incentivised.

"This first-of-a-kind project represents significant advances for improving the long-term economic competitiveness of the light water reactor industry," said Bruce Hallbert, Director of DOE's Light Water Reactor Sustainability Program, based at INL. "They will enable the production of commodities such as hydrogen in addition to electricity from commercial nuclear power plants."

"This project also accelerates the transition to a national hydrogen economy by contributing to the use of hydrogen as a storage medium for production of electricity, as a zero-emitting transportation fuel, or as a replacement for industrial processes that currently use carbon-emitting sources in hydrogen production."

According to the US Energy Information Administration in a June tally,

there were 97 nuclear reactors at 59 commercial power plants in 29 states producing about 20 per cent of the nation's energy. Most of the reactors are decades old, and many are having a tough time competing economically with other forms of energy production.

APS' Palo Verde nuclear generating station near Phoenix, Arizona, will also participate in the demonstration. Hydrogen from Palo Verde may be used as energy storage for use in reverse-operable electrolysis or peaking gas turbines during times of the day when photovoltaic solar energy sources are unavailable and energy reserves in the US Southwest are low, and could also be used to support a burgeoning hydrogen transportation fuel market.

Experience from this pilot project will offer valuable insights into methods for flexible transitions between electricity and hydrogen generation missions in solar-dominated electricity markets – and demonstrate how hydrogen may be used as energy storage to provide electricity during operating periods when solar is not available.



Australia's energy landscape is more productive and profitable than ever before, according to a recent report into domestic supply and usage. **Syed Ali**

Key findings from the Australian Energy Update 2019, covering all types of energy used across the Australian economy, show that energy productivity has improved by 20 per cent over the past decade as the emissions intensity of the economy continues to fall, while electricity prices fell in the June Quarter 2019 to their lowest level since September 2017.

While noting that fossil fuels remain an important part of meeting the country's energy needs, the report by the Australian Department of the Environment and Energy's Minister for Energy, highlighted that renewable energy use continues to grow strongly, driven largely by technology improvements, falling costs and consumer choice.

Electricity generation from renewables increased 10 per cent in 2017-18, contributing 17 per cent of all generation. This upward trend continued in calendar year 2018, with renewable generation increasing to 19 per cent of total generation. The share of renewables is expected to continue to grow strongly over the next few years thanks to record levels of investment in 2018.

At the end of August, with the approval of a 148.5 MW wind farm in Tasmania, Australia reached the 6400 MW of capacity needed to meet its Renewable Energy Target (RET) for 2020. The Clean Energy Regulator (CER) said it has authorised enough capacity to guarantee that the large-scale RET of 33 000 GWh will be fulfilled in 2020.

The Energy Update, said, however, that the challenge in the energy sector is integrating the renewables boom to deliver affordable and reliable power. A press release from the Department of Environment and Energy said: "That means keeping our existing generation in, and running at full tilt, and supporting complimentary investment in dispatchable generation and storage."

"While renewable energy grew, fossil fuels remain an important part of meeting our energy needs." Coal, oil and natural gas provided 94 per cent of Australia's primary energy in 2017-18 and 81 per cent of electricity generation in calendar 2018. Coal fired electricity generation still accounted for 60 per cent of total generation in 2018.

Although excluded from speaking at the recent UN Climate Change Summit in New York due to its continued support for coal, parts of the country have made notable progress in transitioning to a clean energy economy.

South Australia state is now held up as a global example of how traditional base load generation can be eliminated from the electricity supply system.

In its latest National Energy Emissions Audit, public policy think-tank, The Australia Institute, says total renewable generation in South Australia has equated to more than half of total consumption in nine of the past 12 months.

The South Australian Government has also assessed applications for almost 2 GW of renewable energy

generation across six projects in the past six months.

Last month renewable energy giant Neoen announced plans for a major hybrid power plant featuring 1200 MW of wind, 600 MW of solar and 900 MW of battery storage. The proposed Goyder South project is to be built near Burra in the Mid North region of South Australia, which has become a major hub for renewable energy generation.

Elsewhere, the Australia Capital Territory (ACT) government last month announced it will contract for the construction of up to 250 MW of new renewable energy generation. This will ensure the ACT maintains at least 100 per cent renewable electricity into the mid-2020s.

New minister calls for end to nuclear in Japan

Japan's new Environment Minister has called for the country's nuclear reactors to be scrapped to prevent a repeat of the Fukushima nuclear disaster.

Just hours after becoming the new minister, Shinjirō Koizumi said: "I would like to study how we will scrap them, not how to retain them. We will be doomed if we allow another nuclear accident to occur."

The comments could put him on a collision course with Japan's pro-nuclear Prime Minister, Shinzo Abe.

Tepeco's Fukushima Daiichi plant suffered meltdowns in three of its six reactors after it was struck by a tsunami on 11 March 2011. Waves reaching up to 14 m in height knocked out the plant's backup power supply, causing fuel inside the reactors to melt.

Nuclear power accounted for about 30 per cent of Japan's energy production before the disaster. The government wants nuclear power to make up 20-22 per cent of the overall generation mix by 2030 but only nine reactors are back in operation, having passed stringent safety checks introduced after the meltdown.

The decision to continue the pursuit of nuclear has drawn criticism from campaigners who say nuclear plants will always pose a danger given the country's vulnerability to large earthquakes and tsunamis.

In September three former executives at Tepeco were acquitted of failing to prevent the Fukushima meltdown,

in the only criminal action resulting from the disaster.

Last month Japan's nuclear watchdog decided to resume a probe into the cause of the meltdowns after determining that radiation levels have fallen enough to allow investigators into the site.

All of the country's 54 reactors were shut down after the disaster but Abe has since called for them to be restarted, arguing that nuclear energy will help Japan achieve its carbon dioxide emissions targets and reduce its dependence on imported gas and oil.

As Japan looks to replace lost nuclear generation, wind power has become a focal point. In September Tepeco revealed plans to build a 370 MW wind farm offshore Choshi City in the Chiba prefecture. If approved, the wind farm would be operational after 2024. Earlier this year, Tepeco and Ørsted signed a memorandum of understanding to jointly develop offshore wind farms, including the Choshi project.

Also in September Cosmo Eco Power, a unit of Japanese oil company Cosmo Oil Co Ltd, announced plans to build an up to 1 GW offshore wind farm near the cities of Ishikari and Otaru in Hokkaido.

Earlier this year, market research company Wood Mackenzie said Japan would top 4 GW of offshore wind capacity in 2028, which would be a 62-fold increase from 2018.

Pakistan to treble generating capacity

Pakistan has announced plans to increase its power generation capacity by almost 300 per cent in the next 20 years under the Indicative Generation Capacity Expansion Plan (IGCEP) 2018-40.

The plan, finalised by the National Transmission and Dispatch Company in consultation with all the federal and provincial agencies and private sector consultants, aims to ensure low-cost development of future projects and to comply with the regulator's Grid Code obligations.

The IGCEP 2018-40 represents the first complete iteration of an integrated planning exercise for the power sector of the country and will be revised every year on the basis of changing realities.

It would see generating capacity increase to 111 GW and the phasing out of almost all of the existing thermal power plants to meet rising energy demand at affordable costs. The plan puts current total capacity at about 29 GW even though total installed capacity stands at about 33.5 GW, of which 23 GW is thermal is capacity.

The Asian Development Bank moved last month to support the transformation of Pakistan's energy sector with the approval of a \$350 million loan. The loan will specifically support reforms and financial sustainability programmes in the energy sector.

In late August, the Ministry of Privatisation invited expressions of interest from financial advisers to kick-start the process of selling two state-owned combined cycle power plants with a combined generation capacity of more than 1270 MW.

Solar programme surpasses expectations

Vietnam's renewables policymakers have been rewarded for their steady management of the solar feed-in-tariff (FiT) programme, delivering impressive renewable capacity gains, says a new report by the Institute for Energy Economics and Financial Analysis (IEEFA).

Vietnam's solar FiT programme awarded \$0.09/kWh to solar developers delivering new capacity by the end of June 2019. Regional experts were cautious about whether the programme offered enough upside to funders focused on market risk. In the end, the programme delivered an estimated 4.46 GW of new clean solar capacity to the benefit of Vietnamese consumers.

Report author Melissa Brown, energy finance consultant with IEEFA, said: "Delivering 4.46 GW of new

capacity over two years is a tremendous achievement. It validates the renewable energy ambitions of the Vietnamese government."

The government aims to have renewable sources account for 21 per cent of installed capacity by 2030, with solar and wind comprising some 11 per cent.

Vietnam had 89 wind power and solar power plants with a combined capacity of 5038 MW by June 2019, accounting for 9.5 per cent of the nation's total power capacity. It is expected that about 1000 MW of renewable energy will be connected to the national grid by the end of 2019, helping to ease power shortages.

The next phase of Vietnam's renewables programme focuses on wind, to take advantage of the excellent offshore wind potential.

The report suggests near-shore and offshore sites have the greatest potential for the wind sector and can be built near areas where power is needed most, like Ho Chi Minh City.

Brown said, however, that new partnerships between foreign and local developers would be crucial for technically demanding offshore wind projects.

The report also says that one of the main stumbling blocks in taking advantage of Vietnam's considerable current and future renewable energy capacity additions is the state of the grid.

Vietnam needs to finance a grid build-out that can support more diverse generation. New sources of capital, including green bonds, could be an important part of the funding equation, according to the IEEFA report.

Offshore wind reaps rewards in UK auction

UK developers say that the record low strike prices achieved in the latest CFD auction represent a landmark moment for the offshore wind sector.

Siân Crampsie

The UK's latest renewable energy auction has generated record low strike prices thanks to plummeting costs in the offshore wind energy sector.

The competitive auction awarded contracts for difference (CFD) contracts for 6 GW of renewable energy capacity, with offshore wind projects winning 5.5 GW. Strike prices of £39.65–£41.611/MWh (in 2012 prices) were achieved—a 30 per cent reduction on those generated in the last comparable auction in 2017.

As the strike prices are below forecast electricity prices, the winning projects will operate largely subsidy-free, according to analysts. “The UK government expects a negative notional budget impact of deploying offshore wind based on their reference price,” said Shimeng Yang, Wood Mackenzie Senior Research Analyst. “The actual CFD top-up payment will

be determined by the wholesale power price over the next 15 years. However, we expect this would lead to a positive gain for the UK government.”

Winning bidders in the auction include 3.6 GW of offshore wind farms at Dogger Bank by Equinor and SSE, and Innogy's 1.4 GW Sofia wind farm. Several onshore wind farms planned on remote Scottish islands such as Orkney were also awarded 15-year CFD contracts, as well as energy-from-waste projects.

CFD contracts guarantee projects a strike price for their electricity for 15 years. If the wholesale power price is below the strike price the state pays the wind farm the difference. When it's above, then the wind farm pays the difference to the state.

“Achieved at record low prices with no additional cost to the consumer above forecast wholesale prices, these contract awards demonstrate the value for money that new renewable

generation, and these projects in particular, represent to UK energy customers,” said Jim Smith, Managing Director of SSE Renewables.

WindEurope's CEO Giles Dickson said: “This UK auction at 6 GW is the world's largest ever wind energy auction. This auction also confirms the UK's position as the leader in offshore wind in Europe. They have the largest auction plans: 2 GW a year to 2030. They've the best auction model, and they've the best model for government-industry collaboration... Other European countries should take careful note as they finalise their offshore wind plans as part of their 2030 National Energy & Climate Plans.”

According to Yang, discussions with winning bidders would now focus on other issues, including capacity caps to ensure competitiveness, and volumes needed to reach the 30 GW offshore wind target set by the UK. However, the declining prices for offshore wind

would force developers to examine future plans, including the possibilities for a merchant route-to-market for their projects Yang added.

Analysis from Cornwall Insight indicates that offshore wind projects will still require price support from CFD contracts because of the so-called cannibalisation effect, where large amounts of low-cost wind generation on the system effectively force down wholesale prices.

“The captured wholesale price of wind technologies will fall as more projects come online,” said James Brabben, Wholesale Manager at Cornwall Insight. “This will lead to very low wholesale prices at times of modest system demand in future. By 2023-24, this cannibalisation effect will have grown and our analysis shows that regular levy payments may be still be needed for these wind projects during the life of their CFD contracts.

“So, while it is right to say these con-

tracts represent an outstanding deal for consumers, they are not necessarily guaranteed to be cost-free just yet.”

Cornwall Insight also said that up to 2 GW of offshore capacity took part in the auction but was unsuccessful. “The question will be whether this rolls forward to provide immediate competitive tension in the next CFD round anticipated in 2021,” said Brabben.

The UK's Crown Estate has also set out plans for its Round 4 tender process, inviting developers to identify and propose offshore wind projects in waters off the coasts of England and Wales.

The Crown Estate will offer 60-year leases for projects located across four broad areas of seabed with water depths of up to 60 m.

The prequalification process is expected to start in October 2019, with development rights awarded as early as 2021. Round 4 projects would then start operating towards the end of the 2020s.

TSOs strain under weight of climate goals



Europe's TSOs are ramping up capital expenditure in order to cope with increasing amounts of intermittent renewable energy generation on their grids, according to new analysis.

Scope Ratings says that several recent announcements of increased capital spending points to rapidly mounting costs as major grid firms around the region update their networks to enable more new connections as well as boost their ability to cope with the intermittency of technologies such as wind and solar.

France's grid operator RTE has increased planned investment to €33 billion (\$36 billion) for the next 15 years, equivalent to roughly €2 billion a year against recent annual capex of €1.3 billion, while German grid operators, including TenneT-TSO Germany, 50Hertz, Amprion and TransnetBW, have raised expected expansion capex to €52 billion by

2030, up from €33 billion.

Meanwhile the Dutch government is considering a full or partial sale of state-owned grid operator TenneT to help finance its €35 billion investment programme through 2028, and Italy's Terna recently increased its five-year investment plan by 20 per cent to €6.2 billion to help it integrate renewable energy supplies.

“The side-effects of Europe's energy transition are becoming more and more obvious, begging the question: who is paying the bill?” said Sebastian Zank, analyst at Scope, which says that variable renewable energy generation are straining Europe's networks, requiring additional spending.

“In the end it will be the end customer who has to pay the bill as investments will be converted into increased grid tariffs,” added Zank.

The capex surge has profound consequences for TSOs owners and

creditors. Most TSOs in Europe, apart from Germany and the UK, are still in the hands of sovereign and sub-sovereign shareholders which have benefited from their reliable dividends. TSOs now face a more delicate arbitrage between returning cash and investing more in their networks.

“Privatisation, such as the Dutch government might consider for TenneT, can also have rating implications as most regulated grid operators benefit from rating-supportive state shareholders which helps lower their cost of capital,” said Zank.

■ A new 700 MW interconnection cable between the Netherlands and Denmark started operating in September. TSOs TenneT and Energinet said that the 325 km-long Cobra Cable was made available to the market in early September and would help the two countries exchange excess renewable energy generation.

Germany pledges plan for onshore wind woes

Germany's government has pledged to create an action plan to stimulate growth in the country's ailing onshore wind energy sector.

German Federal Minister for Economic Affairs & Energy, Peter Altmaier, held a crisis meeting with wind industry representatives, state governments and citizen's groups in early September to discuss issues affecting the onshore wind industry, which has seen a 66 per cent slump in installations this year.

Altmaier agreed to create an action plan within weeks of the meeting that would, in particular, address the rising tide of wind farm opposition in Germany. The plan will also address the slow and overly complex permitting procedures that are holding up a large

number of projects.

According to Germany wind industry association BWE, it now takes developers over two years to obtain permits for their projects, compared with just 10 months just a few years ago. Permitting procedures are increasingly complex, and projects can be subject to legal challenges even after permits are issued.

WindEurope says that 11 GW of onshore wind capacity is stuck in various stages of the permitting process in Germany.

The delays mean that fewer wind farms are being submitted in Germany's renewable energy auctions, and the country's ability to meet its climate and renewable energy targets is under threat.

EDF unveils Heysham hydrogen plan

EDF Energy says it is leading an “innovative and exciting” project to generate hydrogen from the Heysham nuclear power station in the UK.

The company's R&D branch is leading a consortium of academic and industrial partners to design a system for generating hydrogen gas in bulk from Heysham. The gas would then be used in transport or heating, EDF said.

The consortium will start with a feasibility study, followed by a pilot demonstration project, starting in 2020 and

running for two years.

The project will be funded as part of the UK government's £20 million (\$24.6 million) Hydrogen Supply programme. Heysham was selected for the H2H demonstration as the site has strong links with the community and businesses. There are also significant opportunities to use the hydrogen locally, replacing fossil fuel, helping the region deliver on its local climate change strategy, encouraging new industry and improved air quality.

International News

Deadlines drive wind turbine orders

■ China, USA lead turbine orders ■ Demand sees prices rise

Siân Crampsie

Subsidy deadlines in both China and the USA have driven record order intakes for wind turbines in the second quarter of 2019.

New analysis from Wood Mackenzie shows that globally, wind turbine orders increased by 111 per cent year-on-year in 2Q 2019, overtaking the previous record of 13.2 GW set in Q4 2018.

Wind turbine orders in Q2 2019 topped 31 GW, according to the Wood

Mackenzie report, 'Global Wind Turbine Order Analysis'. China and the US enjoyed top quarters for new wind turbine capacity ordered, as developers rushed to procure turbines with sufficient time to commission projects ahead of 2020 subsidy deadlines in both countries.

"Developers in China ordered more than 17 GW in Q2 2019, a 267 per cent uptick year-on-year compared to Q2 2018," said Luke Lewandowski, Wood Mackenzie Director of Americas Power & Renewables Research.

"Seventy one per cent of firm order capacity was secured in the Northern region's onshore wind market in Q2 2019. The order volume for five major developers in China exceeded 1 GW last quarter.

"The record quarter in China included more than 3 GW of offshore capacity, nearly 2 GW more than in Q2 2018, and a 800 MW increase on the previous quarterly record in the country (Q1 2019). This added to a backlog of nearly 12.5 GW."

According to the report, Vestas won

the largest share of order capacity for the fifth straight quarter, enjoying the best quarter for an OEM in any year.

"Despite a massive quarter for orders in China, diversity in the market – illustrated by seven OEMs with more than 1 GW of order capacity – prevented a dominant leader, which allowed Vestas to retain the top spot.

"Eight of the top ten onshore models in Q2 are manufactured by Chinese OEMs, six of which made the top 10 for the first time ever. All six were new models that had never been ordered

publicly prior to Q2. Vestas was the only non-Chinese OEM with any models in the top 10," Lewandowski added.

Other trends noted in the report include increased turbine prices in a number of markets due to strong demand and larger, newer, more expensive models hitting the market.

"Pricing in the US and China increased due to strong demand, as order books continue to fill up in preparation for 2020 installations," Lewandowski noted.

Mitsubishi backs solar start-up



Japan's Mitsubishi Corporation has invested in a UK-based solar start-up firm providing off-grid energy to homes in Africa.

London-based BBOXX installs pay-as-you-go solar energy systems in areas lacking energy infrastructure and was spun out of Imperial College London. The \$50 million series D funding includes "a substantial investment" from Mitsubishi and will help drive the firm's growth in Africa and Asia, it said.

BBOXX has so far installed 200 000 solar home systems in 12 African countries. The solar systems are remotely modelled. The company has replicated this model to provide clean cooking solutions using LPG, and has ambitions to deliver other utilities and products in new markets.

"The funding is further evidence of

Japanese interest in Africa and in PAYG solar energy globally," said Mansoor Hamayun, CEO and Co-founder, BBOXX. "Mitsubishi Corporation's extensive reach, sector specific and technological expertise will help us to reach more people without reliable access to modern utilities and services at even greater scale.

"We look forward to this next phase of growth that will help us to transform more lives, unlock potential and grow our already global footprint by opening up new markets and develop further our product range."

The deal provides Mitsubishi with a foothold in the African energy market, where half the population – around 493 million people – do not have access to grid power.

Other participants in the Series D

round are Engie Rassembleurs d'Energies, which promotes access to sustainable energy for all and is affiliated to Engie Group; Luxembourg-based pioneering impact investor, Bamboo Capital Partners; DOEN Participaties, a Dutch impact investment fund supporting sustainable and social startups; and MacKinnon, Bennett & Company (MKB), a Montreal-based growth equity firm focused on the clean energy, transportation, and smart city sectors.

The investment follows a string of deals and strategic partnerships including the \$31 million investment from Africa Infrastructure Investment Managers in January. Last year EDF, the world's leading electricity company, became a joint shareholder in BBOXX Togo with a 50 per cent stake.

Kenya aims to double capacity

Strong economic growth in Kenya is driving plans in the country to double its electricity generating capacity by 2022.

The government says that rising energy demand means that generation capacity will probably reach 5221 MW within three years, up from 2700 MW currently. The additional capacity will come mainly from renewable energy sources, it added.

In June, Kenya Electricity Generation Co. said it plans to more than double its geothermal-generating capacity, partly to support the development of industrial parks at four sites.

Investments in key economic areas, including manufacturing, housing, farming and healthcare, are driving annual economic growth levels to reach 7 per cent.

Last month Japanese developer Eurus Energy and Australian wind developer Windlab signed a provisional deal with Kenyan authorities to develop a solar-plus-wind-plus-storage facility with a combined capacity of up to 80 MW.

The Meru County Energy Park will comprise 20 wind turbines and 40 000 solar panels, with construction due to start in 2021.

Kepeco, Barakah One look to expand

South Korea's Kepeco and Barakah One Company (BOC), a subsidiary of the Emirates Nuclear Energy Corporation (ENEC), are to explore opportunities for collaboration in overseas markets.

The two companies have signed a memorandum to jointly explore opportunities in new nuclear energy markets using their combined expertise and experience in large-scale energy projects and building on their existing venture at Barakah One, the first nuclear power plant in the United Arab Emirates (UAE).

The collaboration includes a range of areas including investment and financing, licensing and safeguards, operations and maintenance as well as training and exchange of scientific and technical expertise in the field of nuclear energy. It could also include nuclear fuel cycle management, localisation and development of nuclear energy infrastructure.

"Going forward, by sharing expertise and experience, leading to combining respective strength, we will now explore opportunities to successfully collaborate to support global nuclear energy projects," said Jong Kap Kim, CEO and President of Kepeco.

"We will collaborate to identify potential prospects to support the establishment of nuclear energy projects in

other countries that will benefit from the unique knowledge and skills developed at Barakah through the development of the UAE Peaceful Nuclear Energy Program," said Nasser Al Nasser, Chief Executive Officer (CEO) of Barakah One Company. "The MoU reinforces the continued collaboration between the UAE and South Korea within this critical sector."

The construction of the Barakah nuclear plant is progressing steadily, with Unit 1 currently undergoing commissioning and testing, prior to regulatory review and receipt of the Operating License, Barakah One Company said. After receipt of the operating license, loading of the first nuclear fuel assemblies can take place.

Overall, construction of the four units at Barakah is 93 per cent complete, Barakah added.

■ Abu Dhabi Department of Energy (DOE) signed a memorandum of understanding with State Grid Corporation of China (SGCC) to support the energy sector in Abu Dhabi as it transitions towards more efficient consumption behaviours and expands its clean and renewable energy networks. Under the deal, the DOE will work with companies owned by SGCC, to promote knowledge transfer, energy efficiency, and the shift towards clean energy.

Iraq plugs into Gulf grid

Authorities in Iraq have announced plans for a 300 km-long electricity transmission line that will connect the country to the Gulf power grid for the first time.

Iraq has signed a landmark deal with the Gulf Cooperation Council (GCC) for the 500 MW transmission line, which will run from Kuwait to Iraq's

southern port of Faw.

Finance for the project will be provided by the GCC, and the project could be operating by as early as 2020, Iraq said.

The project will form a major part of the country's plans to boost electricity supplies and could be one of several new interconnection projects

planned by Iraq and its neighbours. It will cost up to \$220 million, GCC said.

The deal came just a day after Iraq signed a \$1.3 billion agreement with German industrial conglomerate Siemens to add 1.7 GW to the grid by repairing war-damaged power plants in the northern city of Baiji.

E.On ready for “swift” RWE integration

■ E.On moves on Innogy takeover ■ Energy giants ready for new focus

Siân Crampsie

E.On says it is looking to take the next “decisive step” in its realignment after winning approval from the European Commission for its merger deal with RWE.

The German energy giant said last month that the 76.8 per cent stake in

Innogy previously held by RWE has already been transferred to E.On, and that it also planned to also close the voluntary public takeover offer to Innogy’s minority shareholders.

The transaction is part of a wider, complex merger deal between E.On and RWE that will see E.On focus on energy networks and services to retail

customers, and RWE become largely a renewable energy firm.

In February the Commission approved the acquisition by RWE of certain generation assets owned by E.On, but wanted to take a closer look at the retail side of the proposals over concerns about the impact on competition. Following its investigation, the

Commission concluded the deal would not result in significant loss of competition in Germany or other European markets.

In exchange for E.On’s takeover of Innogy, RWE will receive an equity interest of 16.7 per cent in E.On and a seat on its supervisory board. E.On will also transfer its renewables activities

and minority interests in two nuclear power plants to RWE. Innogy’s entire renewable energy business, gas storage business and stake in Austrian utility Kelag will come to RWE as “quickly as possible next year”, RWE said.

E.On will also receive financial compensation worth €1.5 billion from RWE.

Masdar and EDF in Esco venture

Masdar and EDF are targeting the energy services sector in the United Arab Emirates (UAE) through a new joint venture.

The two firms have announced that the joint venture will explore and collaborate on opportunities in non-utility scale renewable energy and energy efficiency investments.

The agreement will reinforce EDF’s and Masdar’s “already strong” ties in the region, where they are currently collaborating on large-scale renewable energy projects, Masdar said in a statement.

The agreement is “a reflection of Masdar’s global clean energy ambitions and further supports the UAE’s Energy Strategy 2050 objectives to increase renewable energy usage and energy efficiency across the UAE, the

region and internationally,” said Mohamed Jameel Al Ramahi, Chief Executive Officer of UAE-based Masdar.

Both firms will leverage their international experience and expertise to expand in small-scale solar and energy efficiency.

“Having accomplished several common successes in renewables, EDF and Masdar are now extending their cooperation to energy-efficiency services,” said Marianne Laigneau, Group Senior Executive Vice President of EDF in charge of the International Division. “Along with Masdar, our ambition is to develop innovative solutions to optimise energy consumption and reduce the carbon footprint of our customers in the Middle East and in other countries where both companies already cooperate.”

In August, the consortium of EDF Renewables and Masdar announced that they had reached financial close on the 400 MW Dumat Al Jandal wind project in Saudi Arabia, the country’s first utility-scale wind farm.

In May, the Moroccan Agency for Solar Energy (MASEN) announced that the consortium of EDF Renewables, Masdar, and Green of Africa, was the successful bidder for the design, construction, operation and maintenance of the 800 MW Noor Midelt I multi-technologies solar power plant.

Both companies are also partners in developing the third phase of the 800 MW Mohammed bin Rashid Al Maktoum (MBR) solar park in Dubai, 200 MW of which was commissioned in 2018 and 300 MW is expected to enter into service in 2019.

Ovo sets out Plan Zero strategy



Kvaerner looks to new growth

Norway’s Kvaerner is looking to new growth areas in its renewables and oil and gas divisions to boost its business.

The company has announced plans to expand operations in the offshore wind energy sector and floating production units, targeting 40 per cent growth “within a few years”.

In the offshore wind sector, Kvaerner sees increasing opportunities in Europe and North America. It has already delivered 50 units for offshore wind projects and is currently involved in early phase work for

several customers.

Earlier this year, the company signed a contract with Equinor to study how floating concrete substructures for offshore wind turbines for the planned Hywind Tampen project in the North Sea can be designed and constructed.

“The market for the development of offshore wind power is growing exponentially. If such developments are to be profitable for both energy companies and society, it is important that suppliers can contribute with safe and

efficient execution. We bring valuable knowledge from the oil industry where the cost over time has been significantly reduced,” said Karl-Petter Løken, Kvaerner ASA CEO.

“From now on, Kvaerner will, together with customers, subcontractors, and public knowledge institutions etc. aim to build a whole new industry with jobs, expertise and value creation.”

Overall Kvaerner is aiming to increase its annual revenues from around NOK 7.3 billion (\$803.9 million) in 2018 to NOK 10 billion by 2023.

Senvion in talks with SGRE

Senvion has said that it was aiming to close a deal for the sale of parts of its business to Siemens Gamesa Renewable Energy (SGRE) by the end of September.

The troubled German turbine manufacturer announced last month that it had entered exclusive, non-binding talks with SGRE for the sale of “selected services and onshore assets in Europe”.

“The parties are now entering final negotiations and, if final agreements are reached, expect that the necessary decisions will be taken by the end of September,” Senvion outlined in a

statement. It added that it is continuing to explore options and negotiations with investors for the remaining parts of its business.

Senvion also said that the financial arrangements to secure ongoing business activities continue to be in place. “Wind turbine continuation projects are underway and will secure a majority of production jobs for the next months, with some going into 2020,” it added.

Yves Rannou, CEO of Senvion, said: “Today’s announcement means that we are close to finding a safe harbour for a significant part of the business

and substantial parts of its employee base. In these difficult circumstances, these are positive news.

“Looking ahead to the weeks to come, the management team will continue to put all efforts behind finding the best solutions possible for the rest of the business.”

In early 2019 Senvion announced that it had filed an application in Germany for self-administration proceedings, a pre-emptive insolvency process.

The company secured €100 million of funding to help shore up its finances in May.

UK energy utility Ovo has launched a zero-carbon business strategy ahead of its planned takeover of SSE’s energy retail unit.

Ovo and SSE last month confirmed a takeover deal in which Ovo will pay £500 million to acquire SSE’s GB household energy and services business. The deal will make Ovo the second-largest energy supplier in the UK and enable SSE to focus on its renewable energy and regulated network assets units.

Ovo’s ‘Plan Zero’ strategy aims to drive progress towards zero carbon living and is a direct response to the climate crisis. “Plan Zero demonstrates the clear role that businesses and individuals have to play in reducing carbon emissions and acting together to fight the climate crisis,” Ovo said in a statement.

Under the plan, Ovo hopes to mobilise its customers to create a zero carbon community, helping them halve their total lifestyle carbon emissions, and eliminate their household emissions by 2030. Ovo will also commit to optimise 5 million homes with flexible, low carbon technologies such as smart EV chargers and smart heaters, it added.

The company also plans to reach net zero emissions across its operations and supply chain by 2030.

Ovo currently serves around 1.5 million customers in the GB market. It

will pay £400 million in cash plus £100 million in loan notes for SSE’s retail unit, which provides energy, telecoms and home services.

The deal for SSE’s retail unit will accelerate its ambitions, the company said. This transaction marks a significant moment for the energy industry,” said Stephen Fitzpatrick, CEO and founder of Ovo. “Advances in technology, the falling cost of renewable energy and battery storage, the explosion of data and the urgent need to decarbonise are completely transforming the global energy system.

For the past three years Ovo has been investing heavily in scalable operating platforms, smart data capabilities and connected home services, ensuring we’re well positioned to grow and take advantage of new opportunities in a changing market,” he added.

Ovo was launched in 2009 and has a market share of five per cent. The purchase of the SSE retail unit will increase its market share to 18 per cent, just behind Centrica-owned British Gas, with 19 per cent.

Last year Ovo announced an investment in German start-up energy supplier, 4hundred, marking a move into Europe’s energy markets.

Earlier this year Ovo secured investment from Japan’s Mitsubishi Corporation in exchange for a 20 per cent stake to help it fund future growth.

Special Technology Supplement

Power-to-X: the pathway to a carbon-free world

Deploying renewables across all sectors of the global energy economy is seen as crucial in meeting zero carbon emissions targets. Power-to-X is the key to unlocking the potential of this so-called sector coupling.

Junior Isles

There is a general consensus that far more has to be done, and far more quickly, if the world is to avoid irreversible climate change. In an effort to limit global warming to well below 2°C above pre-industrial levels, the Paris Agreement, negotiated at the 2015 United Nations Climate Change Conference, requires effectively zero emissions by 2050.

The global climate effort has resulted in huge investment in renewables in the electricity sector, increasing the share of renewables to up to 22 per cent globally. But it has had little impact on global carbon emissions. Some 60 per cent of global carbon emissions come from outside power generation, i.e. in transportation, buildings, industry and heating, and there has been very little progress in decarbonising these sectors.

To reach the target of zero CO₂ emissions by mid-century, there has to be an integrated approach to decarbonising all sectors of the economy.

Using renewable electrical energy from the power sector – especially energy from wind and solar that cannot be immediately consumed – to decarbonise energy across all sectors unlocks enormous environmental and business benefits. This so-called

‘sector coupling’ is one fundamental element of the energy transition and involves increased direct electrification of other sectors as well as provision of renewable energy to other sectors in a suitable (e.g. chemical) form.

It is a growth area that Siemens believes has tremendous potential and is therefore investing in technologies known as Power-to-X (P2X) that enable sector coupling.

Commenting on the idea, Dr. Volkmar Pflug, Vice President Energy Consulting, Siemens AG, said: “Of all the buzzwords over the last 10 years, sector coupling is a very big one because it really can change the world.

“The idea of sector coupling is nothing more than bringing renewable energy from the power sector into the other sectors to thereby decarbonise the entire energy system, making electricity the backbone of energy supply in the future. As an example, an increase of power generation by 25 per cent would reduce primary fossil energy consumption by a half, due to the increased efficiency associated with electrification of other sectors.”

Although there has been growing

interest around this line of thinking for the past two or three years, it has really come to the fore in recent months. “This,” says Dr Pflug, “is because there are now, practically, not just theoretically, enough technologies available at reasonable cost that can help decarbonise the world.”

As one of many activities to decarbonise global energy production and use, Siemens is active in the “Power-to-X for Applications” Working Group at the Mechanical Engineering Industry Association (VDMA), which has 3200 member companies and is Europe’s largest mechanical engineering organisation. Siemens says its involvement with VDMA is part of its commitment to social and environmental responsibility.

Siemens is driving three pathways for P2X. The first is what it calls e-hydrogen – using renewables to generate electricity, which is then fed to an electrolyser to produce hydrogen. Hydrogen is a versatile energy carrier, which can be stored and used in the transport, industrial or chemical sectors or as a fuel in gas turbines.

Currently, over 50 Mt of hydrogen is produced worldwide every year from fossil sources via the steam methane reforming (SMR) process.

About half of it is used for the synthesis of ammonia, which is the basis for ammonia phosphate or urea and other chemicals, mainly methanol. Hydrogen is also used in refineries for hydrocarbon cracking and other processes.

Unlike the SMR method, the generation of e-hydrogen via electrolysis of water with electrical energy from renewable sources is completely free of CO₂ emissions. “This pathway is pretty straightforward,” said Dr Pflug. “We are already seeing the first projects because it can be done on a small scale, e.g. for private passenger cars or hydrogen buses and trucks.”

He added: “Right now we are developing a project in Chile. This is the world’s best renewables location and we can produce green hydrogen from electrolysis at the same cost as from steam reforming of natural gas.”

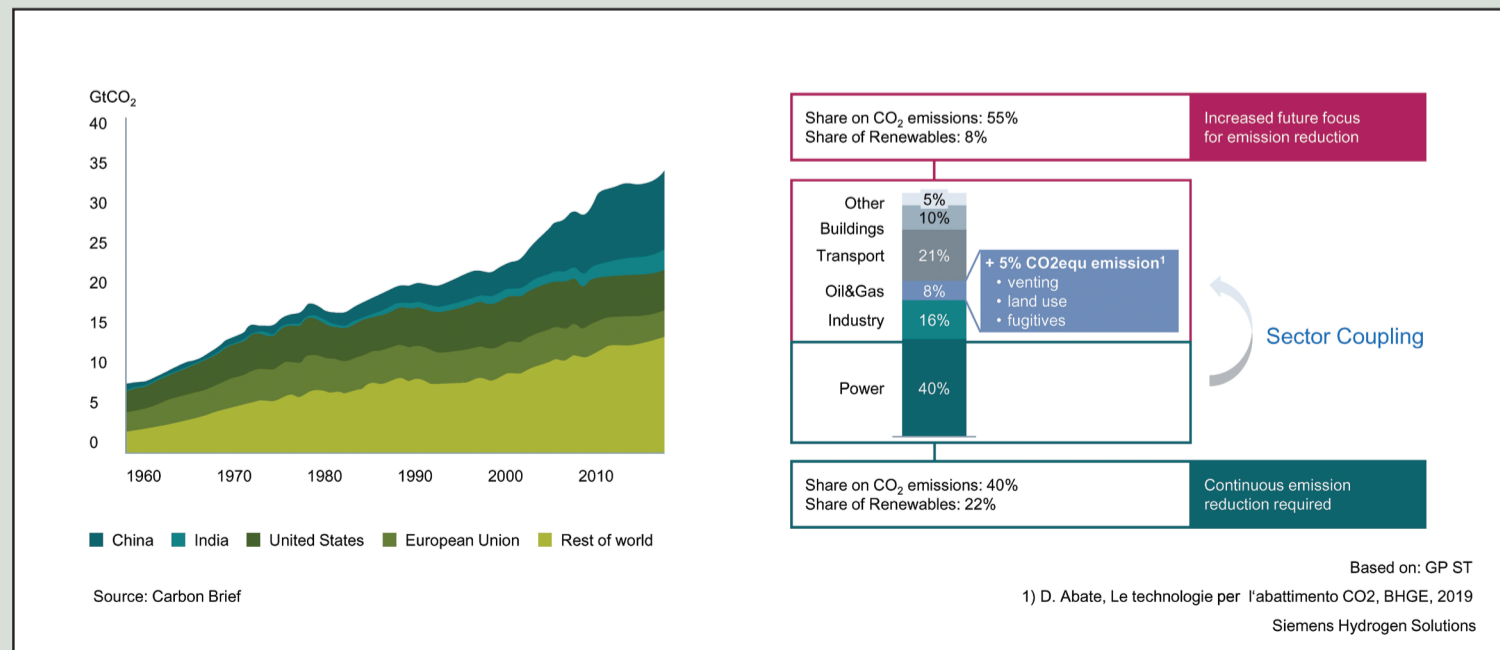
The second pathway, which Dr Pflug believes will be “a significant part of the future”, is using hydrogen to produce synthetic fuels. Although the direct electrification of cars through batteries is an important lever in the utilisation of green electricity, he says it cannot be applied to all types of transport.

“If you look at the energy consumed in mobility, 50 per cent goes to heavy trucks and long haul marine and aviation. These three areas cannot use battery-based energy storage. This is where hydrogen and synthetic hydrocarbon fuels kick-in.”

Using synthesis with carbon dioxide (from biogenic sources, unavoidable industrial emissions or from the air), hydrogen can be converted into synthetic, sustainable ‘e-fuels’ such as e-methanol or e-jet fuel or other carbon-based chemicals.

These “green fuels” can replace fossil fuels, lowering the carbon emissions from their expended energy by as much as 90 per cent. They can also replace biofuels, such as ethanol, which now consumes considerable farmland to grow its main feedstock, corn. This can resolve the food-versus-fuel debates on the use of increasingly valuable farmland and return acreage to food production or non-crop uses, such as nature reserves, recreation areas, residential developments and reforestation.

E-fuels can immediately be mixed with fossil fuels to reduce the overall carbon footprint. P2X thus allows a



CO₂ emissions reduction has so far focused on power, but all sectors in the economy must contribute

Special Technology Supplement

smooth transition from the fossil world to one that is largely carbon-neutral.

Dr Pflug noted that synthesising to methanol is hugely important. “We strongly believe that methanol is the substance of choice; it could be a substitute in the replacement of bio-ethanol, for example. The big advantage is that, basically, you can create any kind of hydrocarbon fuel using methanol as the basic substance.”

“You could also use existing infrastructure [for methanol], e.g. transport logistics and refuelling stations, which you could not do if you go the (molecular) hydrogen pathway. And you avoid step increases in technology that are initial cost and performance hurdles to their widespread implementation in established markets”

Notably, Dr Pflug says that the need for CO₂ in producing e-fuels could trigger a renaissance of carbon capture, i.e. carbon capture and utilisation. CO₂ could be captured from existing, unavoidable point sources, e.g. from cement production, biomass power plants or fossil fuelled power plants. In future, recovering CO₂ from the atmosphere (direct air capture, DAC) could also become an option, especially for regions that are rich in renewable energy but far away from industrial sites.

The third pathway that Siemens is pursuing, is power-to-ammonia. Here, e-ammonia (NH₃) is synthesized from e-hydrogen and nitrogen derived from an air separation using the Haber-Bosch process. E-ammonia can be used as feedstock for fertilizers (urea, ammonia phosphates) and other chemicals. With about 175 kg hydrogen per tonne of ammonia, it is an excellent carrier of hydrogen to transport it over long distances. Ammonia cracking processes are under development for recovering the hydrogen.

“The problem here,” says Dr Pflug, however, “is that there are no green drivers for ammonia, and no one wants to make food more expensive. So, reducing the cost of green ammonia production is an imperative.”

Siemens is currently developing technology solutions in line with the three pathways that it foresees for hydrogen.

One clear component is the electrolyser. There are three types of electrolysis: alkaline, which has the longest experience; solid oxide (SO), which is currently used at smaller-scale; and proton-exchange membrane (PEM) electrolysis. With PEM technology the electrolyser can be switched on and off without preheating, leading to high flexibility, ramp rates and overall system efficiencies even with partial loads.

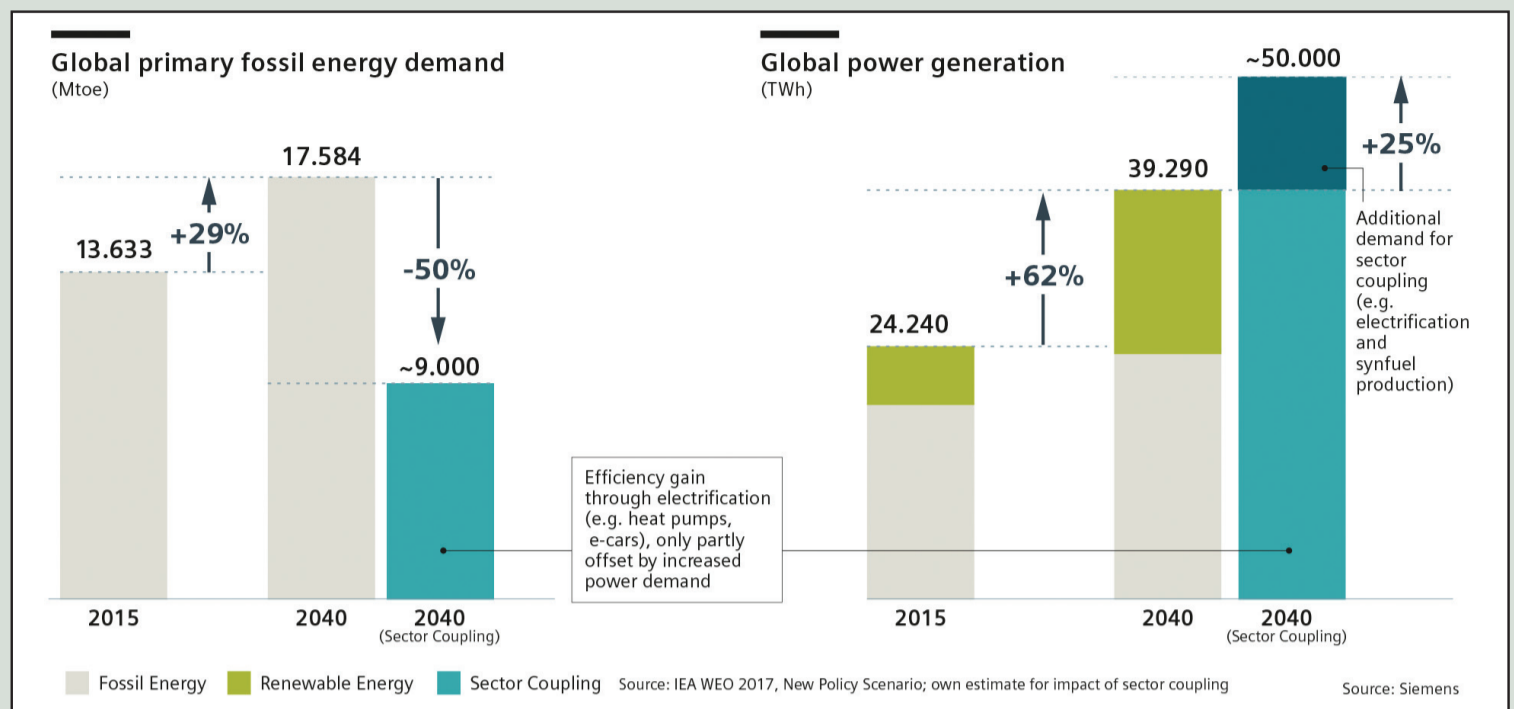
With an extended operating range, PEM technology can ramp up instantly in its operating capacity. It can then operate at from 5-100 per cent of capacity at very high ramp rates.

This, says, Siemens makes it perfectly suited for the load profiles of renewable power sources like wind and solar which are volatile by nature.

Siemens has what it calls its H₂ package, which comprises all units to produce e-hydrogen. “We have one of the most advanced PEM electrolyser portfolios,” noted Dr Pflug.

In 2015, Siemens deployed the Silyzer 200, a large-scale, commercial version of PEM electrolysis at one of the world’s largest power-to-gas plants in Germany. Today, the company has taken that technology into its third generation, with the deployment of the Silyzer 300 at the H2FUTURE project, in partnership with Verbund Solutions GmbH, voestalpine Stahl GmbH, K1 MET GmbH, and the Austrian Power Grid AG.

The Silyzer 300 consists of up to 24 PEM electrolytic modules per array that together draw 17.5 MW of power



to produce up to 340 kg/h of virtually pure hydrogen with no CO₂ emissions. The system operates at over 75 per cent efficiency,

The Siemens Silyzer development roadmap targets fourth-generation hydrogen plants that, by 2023, can draw more than 100 MW of power for hydrogen production at ever greater efficiencies. By 2030 and beyond, Siemens envisions building 1000 MW, fifth-generation plants.

The second area of technology development for Siemens is what Dr Pflug calls “Power-to-X solutions”, where the current focus is power-to-methanol and power-to-ammonia. Here Siemens can provide all equipment related to these applications, including the electrolyser, compression and storage equipment, instrumentation and controls, electrical equipment (transformer, switchgear, rectifier etc.); water treatment and de-ionisation equipment, hydrogen cleaning systems, etc.

The third big area is in developments that allow hydrogen to be fired

in gas turbines. Green hydrogen produced by electrolysis can be converted into electricity again (re-electrification) and used as an admixture with natural gas or in pure form to fuel gas turbines.

“Over time, oil and gas will be displaced by green fuels or green gases. Hydrogen would be a very good option here,” said Dr Pflug.

Several gas turbine manufacturers are already making progress in this area.

In 2019, as part of its commitment toward environmental sustainability, Siemens signed a European industry agreement that promises that its new gas turbines will be capable of operating on 20 per cent hydrogen (mixed with natural gas) by 2020 and 100 per cent hydrogen from 2030 onwards.

Parts of these commitments have already been fulfilled, as much of the Siemens gas turbine portfolio can use fuel mixtures with hydrogen levels of up to 30 per in large gas turbines, 60 per cent in medium sized machines and even up to 100 per cent in

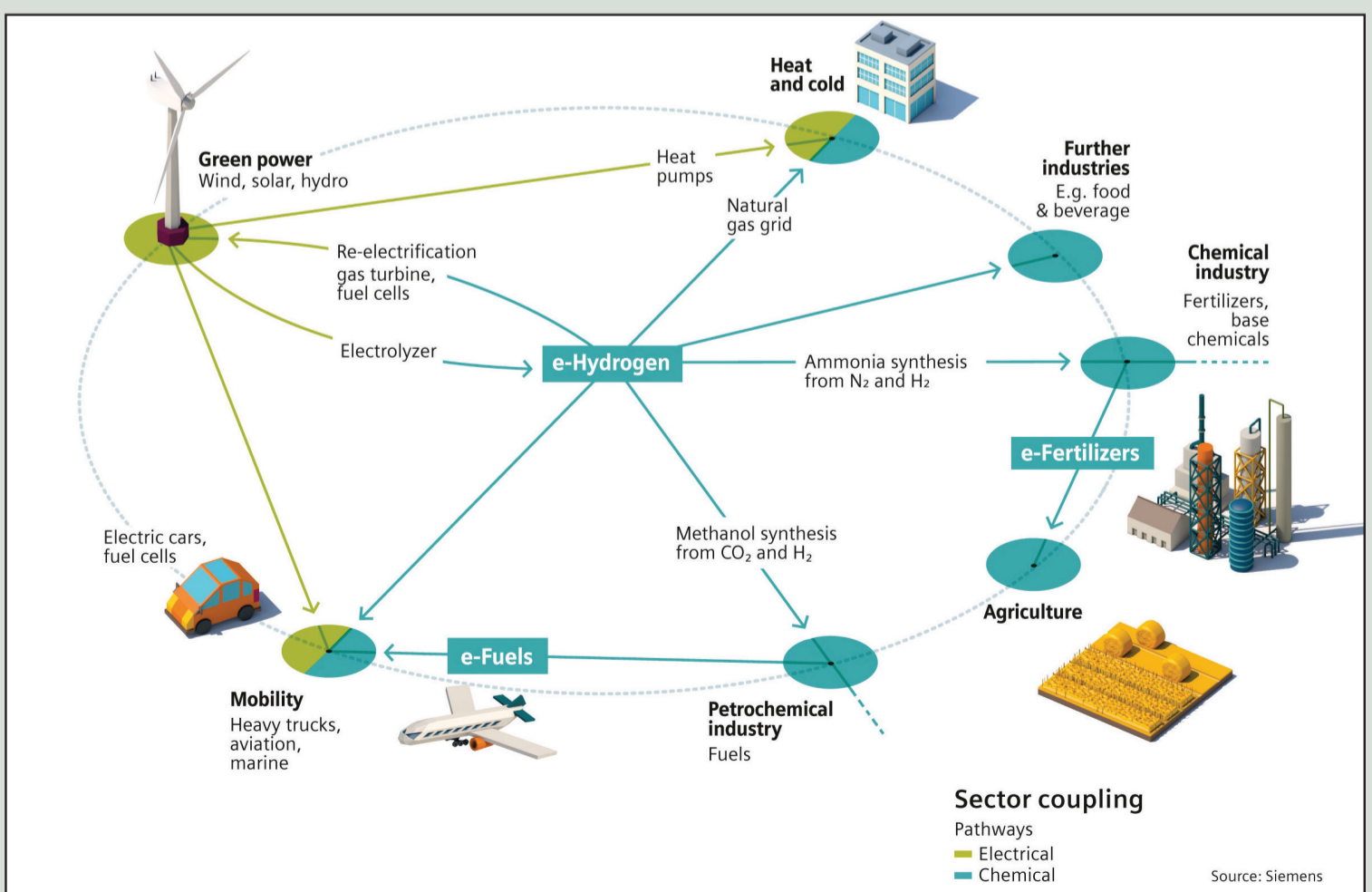
aeroderivative models with a wet low emissions system.

“It’s an area where we are continually working,” said Dr Pflug. He stressed: “Gas turbines can operate on natural gas from fossil sources or green gas such as hydrogen. This makes gas turbine plants a sustainable investment and avoids the risk of ending up as stranded investments when decarbonisation is enforced by regulators. All scenarios for a deeply decarbonised world in the year 2050, consider gas turbines as the most economic option to provide security of supply.”

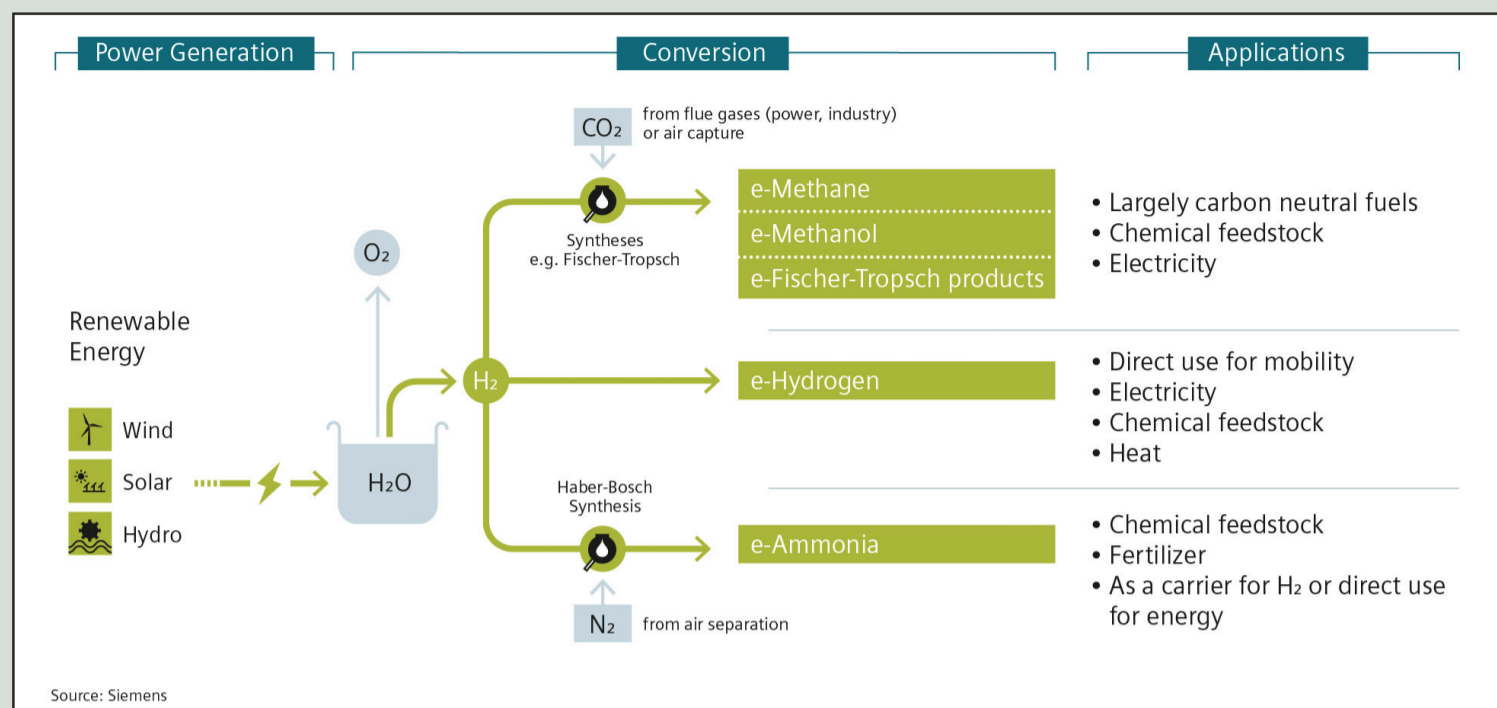
Erik Zindel, Director Energy Consulting at Siemens added: “Fifty or 60 per cent of the time, there is sufficient sun, wind or hydro available. The rest of the time, you can use the stored hydrogen by combusting it in conventional combined cycle plants. Gas turbines are the technology of choice for providing dispatchable power when there is not enough solar or wind power in the grid. It is an area of great interest to plant owners, many

With sector coupling, the increased electrification reduces primary energy consumption significantly

Sector coupling is nothing more than bringing renewable energy from the power sector into other sectors to thereby decarbonise the entire energy system



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Three pathways of power-to-x: electricity-based molecular hydrogen, ethanol and hydrocarbons, as well as ammonia

of which are already investigating whether their machines can be upgraded in the future to burn hydrogen.”

“This would enable the transition to 100 per cent renewables. But we expect this to happen at a later stage, as we believe that at the moment the value of green hydrogen is higher in other sectors than in the pure power generation industry.”

Hydrogen is expected to first penetrate the areas, outside of the power sector that are proving difficult to decarbonise such as parts of the chemical sector, the steel and cement industries and mobility.

For P2X to really materialise, however, both technology, which will enable cost reductions, and policy will have to develop simultaneously.

While Siemens says that e-hydrogen can already present a positive business case in some instances, costs will need to be driven down by lowering capex and the levelised cost of electricity of the renewable energy that is used to feed the electrolyser. It also said much depends on the amount of hours that the electricity produced is available. The capacity factor is as important as the LCOE because it defines the capital efficiency of the electrolysis plant.

“These are the main three parameters that define the cost of the hydrogen

produced,” said Dr. Pflug. “In terms of technology, we are at the beginning of driving down costs by automating the manufacturing side of electrolysers for example. And if you look at carbon capture, you could say we are still at the beginning there too, considering that CO₂ capture never really took off. If you can make this very cheap, it will eventually be a disruptive technology.

“This is another area where we are doing some technology development,” he added.

Siemens has developed a process for the post-combustion removal of CO₂ from power plant flue gases. Employing an environmentally friendly aqueous solution of an amino acid salt (PostCap™), approximately 90 per cent of the CO₂ from flue gases are captured. Siemens is looking for an opportunity to re-demonstrate its PostCap technology together with customers/partners in the context of P2X.

With regards to policy, Siemens believes a few things have to happen. First and foremost there has to be legislation in support of carbon reduction. “As these technologies are still more expensive than the conventional black fuels, all of this won’t happen if there is not a clear regulatory push for decarbonisation,” said Zindel. “It’s a

bit like solar and wind power; 20 years ago they were completely out of the market in terms of cost... now their LCOEs are a third of most modern gas fired stations. You need incipient markets to warrant R&D investment and economies of scale to bring the costs down.”

Secondly, the value of e-fuels produced from green hydrogen has to be recognised by governments. “The use of synthetic fuels from green sources has to be accepted,” said Dr Pflug. And to some extent, this is already happening. Under the new Renewable Energy Directive (RED II) the EU stipulates that green fuels should represent 14 per cent of the market share of transport fuels by 2030.

Despite the target, Dr Pflug believes, however, that the emphasis that governments have put on EVs has created an uneven playing field for technologies. “There has to be a level playing field between e-cars and [cars running on] synthetic fuels,” he stressed.

“The emissions they associate with e-cars are measured from the battery to the wheel, so there are no emissions. But if you look at the lifecycle – taking into consideration battery production and the energy mix used to provide electricity to charge the battery – for the first one or two years,

e-cars emit a similar amount of CO₂ as a regular car,” Dr Pflug explained. “And if the lifetime of a battery is only around four years before it has to be disposed of, you have a significant carbon footprint for a battery-powered car.”

He argues that if carbon emissions are assessed over the entire lifecycle, there would be much greater focus on e-fuels or hydrogen fuelled cars.

Thirdly, Dr Pflug says there needs to be government support for the installation of large scale demonstration projects, as we have seen in Germany. Germany is investigating how hydrogen can be used on a large scale as an energy carrier in the heat market, the transport sector and industry. The project will cost the ministry more than €100 million per year, and results should be seen by 2020.

In July this year, Federal Economics Minister Peter Altmaier said Germany wants to be a global leader in the development of hydrogen technologies. The government also said it will develop a hydrogen strategy by the end of the year.

In terms of frontrunners, geographically, Siemens says much depends on production and consumption.

Zindel said: “If we are talking about methanol, we don’t have to produce the methanol in the same country that it will be consumed. We can produce it in areas where there is good wind or solar and export it those where there is a good price premium for it, such as Europe, California or Japan.”

Dr Pflug added: “Much depends on the regulatory regime and energy policies. If the green fuel is attractive and fetches a premium, then it makes a business case feasible. Projects are developing in Austria, Denmark, Germany, Switzerland and the UK, and we see a number of things coming up in Latin America, Central America, Canada, China and parts of the US.”

Essentially, developed countries with a goal to decarbonise are the main areas for consumption, while production will be in places where conditions are good for renewable energy, such as the Middle East, which is increasingly looking to take advantage of its favourable solar conditions.

According to Siemens, it is seeing varying degrees of interest from potential customers.

Zindel said: “They are not so aware of it in places like Africa and Latin America but in Central Europe and Japan, it’s already a topic. Some industries like oil and gas know they are in a business that is not sustainable, politically and in terms of regulation, over the long term. Oil majors like Shell and Total are already thinking about these technologies. Utilities looking to reduce their CO₂ emissions are also asking us about our hydrogen capabilities on gas turbines. We have also had a lot of meetings with utilities in the US about hydrogen in recent months.”

This interest, adds Zindel, extends across various sectors, noting that car manufacturers and airlines are also enquiring about Siemens’ capability in the field of synthetic fuels.

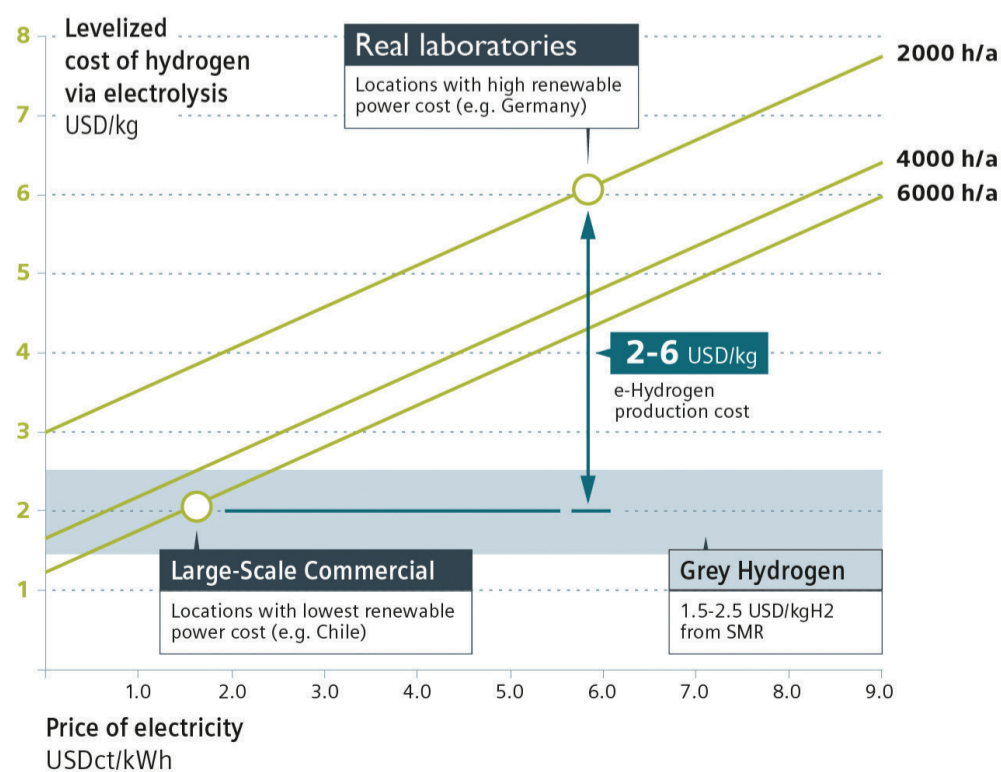
Siemens believes the world is only at the beginning of the switch to a sustainable future. In the power sector there has already been a shift from fossil fuels to renewables but Siemens says it is about more than just the power sector.

Zindel concluded: “It’s about energy consumption in all the sectors in the economy worldwide. There has been a huge movement from conventional energy to renewables in the last 10-20 years but looking worldwide at all the sectors, we are just at the beginning of the transition. It’s probably one of the largest transformations in energy technology that the world will have seen in the last 100-200 years.”

E-hydrogen can already present a positive business case in some instances

Hydrogen from electrolysis becomes competitive

Highly available, low-cost renewable power already generates green e-hydrogen at costs of conventional hydrogen from steam methane reforming (SMR)



Source: Siemens

Main impact by WACC; electrolyzer_ CAPEX, OPEX, electrolyzer efficiency, lifetime

SIEMENS
Ingenuity for life

Solar (PV)

Green power

Re-electrification

e-H₂

e-H₂

e-H₂

H₂ compression,
storage, gas grid

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A smoother transition to a fully sustainable world starts today. Siemens Power-to-X technologies can produce fuels that have an immediate decreasing effect on greenhouse gas emissions, bringing reduced carbon emissions to multiple industries and paving the way for decarbonization in any future energy landscape. Worldwide decarbonization of the overall energy systems is urgently needed to mitigate global warming. Power-to-Hydrogen. Power-to-Fuels. Power-to-Ammonia. With Siemens as your partner you can start your journey today. Visit our website to learn more.

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Tenders, Bids & Contracts

Americas

SGRE reinforces Mid-American partnership

Siemens Gamesa Renewable Energy (SGRE) has been selected by MidAmerican Energy Company for the Southern Hills Expansion wind power project in Iowa, USA.

The project will use 21 SG 4.5-145 wind turbines operating at 4.8 MW. SGRE's contract also includes a 3.5-year service and maintenance agreement.

"We are once again proud to have been awarded a project by MidAmerican Energy Company, strengthening our long-standing relationship with them," stated José Antonio Miranda, CEO of Onshore Americas at SGRE.

Ørsted selects GE Haliade-X for US projects

Ørsted has selected GE Renewable Energy as the preferred turbine supplier for two of its US offshore wind farms.

Subject to final agreed and signed contract and all required project approvals, Ørsted will deploy Haliade-X 12 MW wind turbines on the 1100 MW Ocean Wind project off the coast of New Jersey, and the 120 MW Skipjack project off the coast of Maryland. The wind farms are expected to be commissioned in 2024 and 2022, respectively.

Siemens barges support New York

Astoria Generating Company and Siemens have signed a contract for the turnkey construction of two SeaFloat power barges to support New York's power system.

The barges will be equipped with eight Siemens SGT-A65 gas turbines and will replace four existing power barges located at Gowanus generating station in the Upper Bay of Brooklyn, New York City. Siemens will pre-install the high-efficiency power generating facilities on two newly constructed floating barges with a generation capacity of about 300 MW each.

Retrofitting the station with SGT-A65 gas turbines and generators will improve the plant's power generating efficiency by nearly 50 per cent while significantly reducing potential emissions of pollutants like carbon dioxide and monoxide, Siemens said.

Goldwind secures Canadian order

Potentia Renewables has awarded China's Goldwind a contract to supply the wind turbines for the 200 MW Golden South wind project located in Assiniboia, SK, Canada.

The Golden Wind project will use 50 permanent magnet direct drive wind turbines. It was a successful proponent of the recent SaskPower request for proposals and has executed a 200 MW, 25-year power purchase agreement with SaskPower to supply both energy and environmental credits.

Construction of the wind farm started in August 2019.

Asia-Pacific

Van Oord wins Taiwan cable order

Dutch contractor Van Oord has won an order from wind farm developer Ørsted for the cable installation works at the 900 MW Greater Changhua 1 & 2A offshore wind projects in Taiwan.

Van Oord will be responsible for the transportation, installation and burial of the 111 inter array cables, with a total length of approximately

135 km, and the three export cables, with a total length of approximately 145 km.

Greater Changhua 1 & 2a offshore wind farms will be the first cable project in Taiwan for Van Oord. Once operational in 2022, the wind-farms will contribute significantly to the Taiwanese governments target of 5.7 GW offshore wind by 2025.

The wind projects are located between 35 and 60 km off the west coast of Changhua County, Taiwan.

MHPS wins Lamma contract

Mitsubishi Hitachi Power Systems, Ltd. (MHPS) has received an order for natural gas fired gas turbine combined cycle (GTCC) power generation equipment for Lamma power station's Unit 12 to be built in Hong Kong by HK Electric.

MHPS will supply the main components through Mitsubishi Corporation (MC), the prime contractor on the project, with operation of the new 380 MW unit scheduled to begin in early 2023.

The unit will be constructed on Lamma Island, adjacent to the existing Unit 9 and Units 10 and 11, which are currently under construction. MHPS will manufacture and supply its M701F gas turbine, a steam turbine, a heat recovery steam generator, and a Selective Catalytic Reduction System (SCR). Mitsubishi Electric Corporation will supply the generator.

The project is part of a push by the Hong Kong government to expand gas fired power generation.

Pondera picked at Jeju Hanlim

Dutch wind engineering consultancy Pondera and Korean company Hanmi Global have been appointed to act jointly as owners engineer on the 100 MW Jeju Hanlim offshore wind farm off the coast of South Korea.

The Jeju Hanlim Offshore Wind consortium awarded the contract for its commercial-scale project, which will be the third offshore wind project in South Korean waters.

Jeju Hanlim is located near the Tamra offshore project just off the coast of Jeju Island, southwest of the mainland.

A developer consortium is led by Korea Electric Power Corporation Engineering and Construction (E&C).

WestWind selects GE turbines

GE Renewable Energy has been picked as co-developer and preferred turbine supplier for the over 1 GW Golden Plains wind park in Victoria, Australia.

The capacity will be installed in stages, with construction slated to begin in 2021, developer WestWind Energy said. The whole complex is planned to become fully operational in 2025, becoming the largest wind farm in the southern hemisphere.

GE will supply over 200 units of its blade Cypress platform wind turbines.

Europe

APG signs up ABB

ABB has signed a five-year framework contract with Austrian Power Grid (APG), Austria's transmission system operator, to supply gas-insulated switchgear (GIS) for the largest electricity grid expansion to date in Austria.

Under a contract worth potentially more than \$100 million, ABB will supply the GIS equipment to help

APG to reinforce its grid and improve renewable energy integration. The programme will support Austria's so-called #mission2030 plan, under which it plans to be a fully carbon-free society by 2030.

Landis+Gyr land LKW contract

Landis+Gyr has been awarded a new Software as a Service (SaaS) contract for the smart metering system of Liechtensteinische Kraftwerke (LKW), the public body that provides electric power to the principality of Liechtenstein.

The contract expands an existing partnership between Landis+Gyr and LKW, which has been using Landis+Gyr's advanced metering infrastructure (AMI) solution since 2011. It will see Landis+Gyr provide LKW with AMI software and IT system hosting and maintenance for 45 000 electricity, gas and water metering points on a contracted subscription basis, utilising cloud-based software to support metering updates and audits, order and billing data collection and management, and implementation of necessary security and data-protection measures.

The contract will enable LKW to reduce risk by outsourcing all services associated with AMI data hosting and maintenance, Landis+Gyr said.

Vestas boosts Norwegian wind

Vestas has received an order for the Haramsfjellet wind project on the island of Haramsoya in western Norway.

The company has developed a solution for the 34 MW wind farm that includes eight V136-4.2 MW turbines and a long-term service contract to optimise energy production for the lifetime of the project in a high wind location.

The order was placed by Finnish-based Taaleri Energia, investing via its SolarWind II fund. The contract includes the supply, installation and commissioning of the wind turbines, as well as a 27-year Active Output Management 5000 (AOM 5000) service agreement.

Iberwind extends Nordex contracts

Iberwind, one of the leading wind turbine operators in Portugal, is extending its service contracts with the Nordex Group for 132 of its turbines.

As part of a Premium Service contract the Nordex Group will be handling the service and maintenance of 110 N90/2500 and N90/2300 turbines and 22 N60/1300 machines until 2025. The extended service contract for 290 MW covers 70 per cent of the wind capacity installed in Portugal by the Nordex Group.

GE equips 374 MW Spanish portfolio

GE Renewable Energy is to equip Copenhagen Infrastructure Partners' recently acquired 374 MW Monegros portfolio of onshore wind projects in Spain.

The portfolio consists of nine separate projects, distributed within two clusters in Spain's Aragon region.

In addition to providing the wind turbines for the projects, GE will service the equipment under a 20-year contract.

The Monegros projects were awarded in Spain's renewable energy auction in May 2017. CIP purchased the portfolio through its Copenhagen Infrastructure III K/S (CI-III) fund.

Vestas bags BayWa order

Vestas has secured an order from BayWa r.e. for a 95 MW wind project in Kronoberg County, Sweden.

The Lyngssa wind farm will feature 22 V150-4.2MW turbines delivered in 4.3 MW power optimised mode. Vestas intends to deliver the wind turbines in the first quarter of 2021, while the commissioning is planned in the second quarter of 2021.

The order includes supply, installation, commissioning of the wind turbines, in addition to a 25-year Active Output Management (AOM 5000) service agreement and a VestasOnline Business SCADA solution.

Dudgeon opts for Green Marine

Orkney-based Green Marine has won a three-year contract to deliver operations and maintenance work for Equinor's Dudgeon offshore windfarm in the UK after a competitive tendering process.

Green Marine will supply its Damen-built 2610 Twin Axe vessel, Green Storm, to assist in the operations and maintenance of the 402 MW windfarm alongside support from the company's experienced onshore team.

Green Storm is a dedicated vessel for the offshore wind industry, providing safe transportation of personnel and cargo to offshore installations.

Dudgeon started operating in 2017 off the coast of Norfolk, eastern England.

International

TAPCO picks out Ansaldo

Independent Water and Power Producer (IWPP) Taweelah Asia Power Company (TAPCO), one of the largest IWPPs in the Middle East, has awarded Ansaldo Energia a 10-year structured service agreement for their Taweelah New B Extension (TNBE) combined cycle power plant in Abu Dhabi, United Arab Emirates.

TNBE produces a net 947 MW of power and 68.4 million imperial gallons per day (MIGD) of water using multi-stage flash desalination units and is located 80 km from Abu Dhabi in Al Rahba City.

The full-scope, turnkey service agreement covers three dual fuel Siemens SGT5-4000F gas turbines and SGEN5-1000A air-cooled generators, coupled with a Siemens SST5-6000 Steam Turbine and SGEN5-2000H hydrogen-cooled generator, including all related auxiliaries.

Coverage consists of all scheduled and unscheduled power generation and related auxiliary equipment maintenance, a parts supply programme including upgrades, repair and refurbishment of parts, and remote monitoring and diagnostics including Ansaldo's APEX digital predictive maintenance tools.

Siemens rebuilds in Iraq

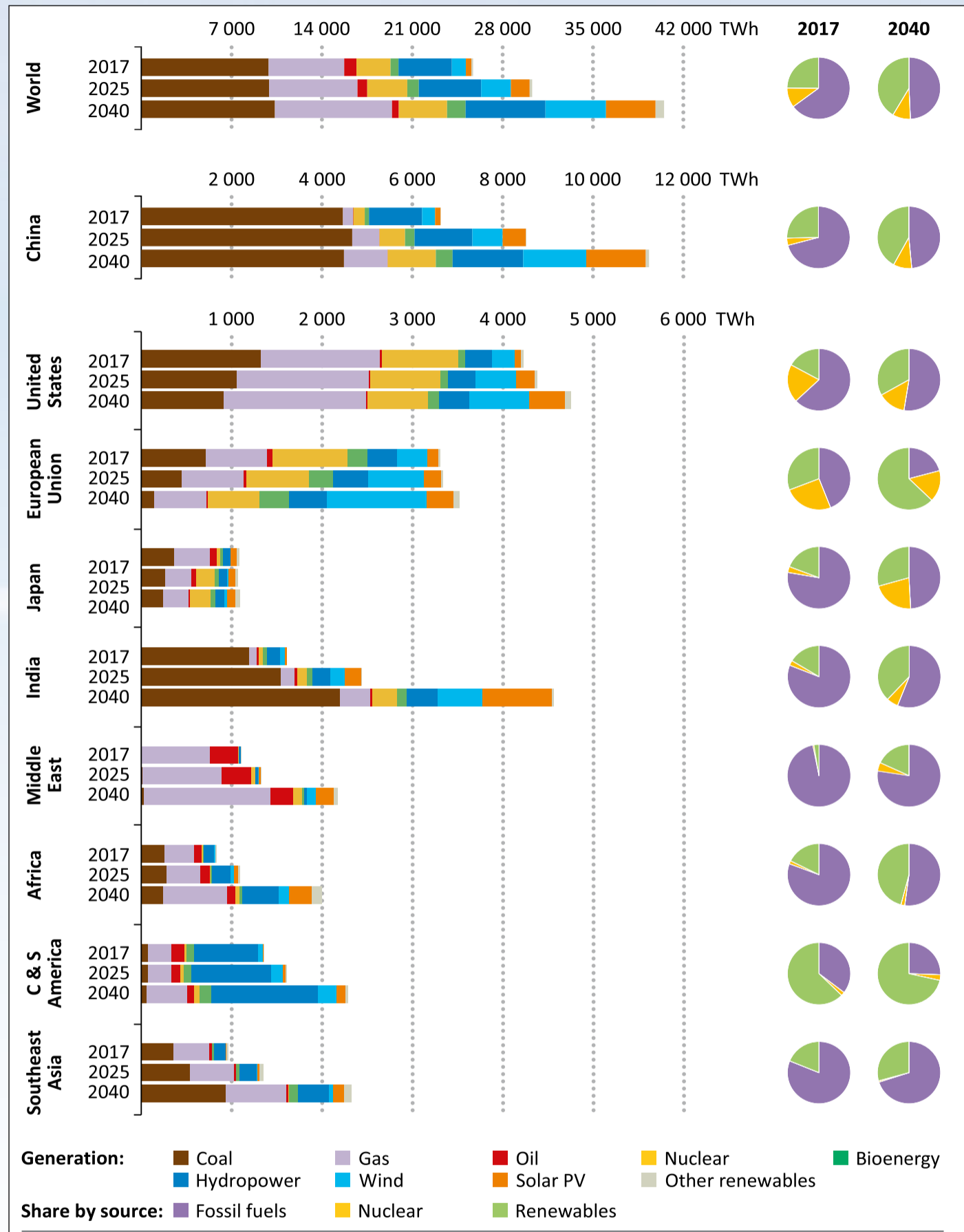
Siemens and Orascom Construction have signed an agreement with Iraq's Ministry of Electricity to rebuild the Baiji 1 and Baiji 2 power plants in northern Iraq.

The plants will have a combined generation capacity of 1.6 GW when completed and are a major step in Siemens' roadmap for rebuilding Iraq's power sector.

Work at Baiji, which is about 250 km north of Baghdad, will begin once the contracts are approved by Iraq's Council of Ministers and a financial agreement is reached with the Ministry of Finance. The projects are expected to be completed within 28 months after the financial closing.



Electricity generation mix and share by source in the New Policies Scenario



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Note: C & S America = Central and South America.
 World Energy Investment 2018, © IEA/OECD, Figure 8.12, page 343

Oil

Attack on Saudi oil infrastructure plays to global oversupply

- Global growth demand forecast revised downward
- Opec+ commits to “oil market stability”

Mark Goetz

The energy ministers who attended the Opec and non-Opec (Opec+) joint meeting in Vienna in July concluded their meeting by agreeing to extend their countries’ “voluntary production adjustments” until 31 March 2020 because of “the underlying large uncertainties and its potential implications on the global oil market.”

Despite continuing efforts by Opec+, which includes cutting output by 1.2 million b/d, the oil market has remained saturated. Stocks remain sufficient to meet demand in the midst of a global economy that is showing signs of strain in the continuing trade war between China and the US, the UK’s Brexit conundrum, plus other factors that indicate the economy might be headed for recession.

The latest Opec oil market report released in early September revised downward the forecast for global growth in demand by 60 000 b/d to 1.08 million b/d in 2020, acknowledging that the market would continue to have too

much oil available to return to balance next year. Opec said that growth in oil demand during 2020 would be outpaced by strong production growth coming from non-Opec producers like the US, which is now the world’s largest producer of oil due to the boom in shale oil and gas production.

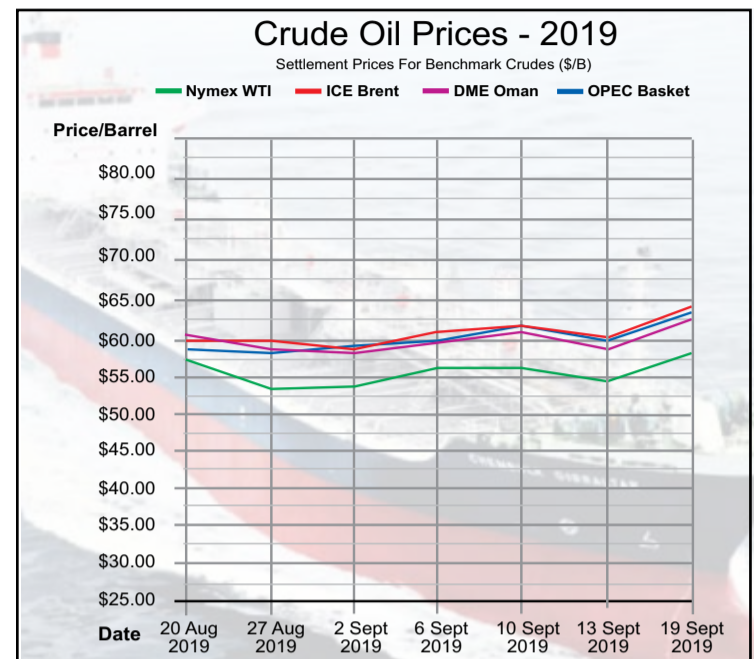
The Opec report said crude stocks in July were still over the five-year average – the scale that Opec uses to determine market balance – by 36 million barrels. It estimated that if Opec production continues at its current rate, there will be a surplus of 340 000 b/d on the market in 2020.

The release of the report was followed by a meeting of Opec+ Joint Ministerial Monitoring Committee (JMMC) in Abu Dhabi during the course of the World Energy Congress, where delegates were also informed by UAE Minister of State and Adnoc CEO, Dr. Sultan Ahmad Al Jaber, that the oil and gas industry would require investments totaling \$11 trillion over the next two decades to keep pace with growing energy demand.

“We know that the world will still rely on oil and gas as the majority source of energy for many decades to come – in fact about \$11 trillion of investment in oil and gas is needed just to keep up with the current projected demand,” Al Jaber said. “At Adnoc, we are on track to achieving our production capacity goals of 4 million [b/d] by 2020 and 5 million [b/d] by 2030,” he added.

The JMMC meeting concluded on September 12 with agreement that Opec+ would continue with its commitment to “oil market stability on a sustainable basis.” Conformity to the voluntary production adjustments were at 136 per cent in August, the group reported. This was due primarily to Saudi Arabia cutting back output from its allotted quota of 10.311 million b/d to 9.789 million b/d in August. The group urged all those involved with production adjustments to stay on course and for those that have yet to meet their target quota to make every effort to do so.

The gathering also marked the first



appearance of the new Saudi Energy Minister Prince Abdulaziz bin Salman, who replaced Khalid al-Falih in early September in a restructuring of the Saudi energy sector in anticipation of an IPO for Aramco in the coming months. Falih was also replaced as CEO of Aramco by Yasir al-Rumayyan, who is head of Saudi Arabia’s sovereign wealth fund.

The oil market appeared to be content with itself despite oil prices in the lower \$60/b range, over supply, a burgeoning US oil sector, and a slipping global economy, and then came the attack on some of Saudi Aramco’s major oil facilities in Abqaiq and Khurais in the eastern oil province on September 14.

Some 17 targets were hit in what was the largest single supply disruption of oil production in a day. Saudi Aramco acknowledged that 5.7 million b/d had been taken offline by an attack using numerous drones. Yemen’s Houthi

rebels claimed responsibility but US Secretary of State Mike Pompeo claimed to have evidence that Iran, which supports the Shia Muslim Houthis, was behind the attack.

As could only be expected, oil prices spiked when markets opened the following Monday morning. Opec responded by assuring the markets that sufficient supplies and stocks existed to cover any shortfall and that there was no reason for the organisation to hold an emergency meeting.

The attack has revived political risk as a factor in the oil market. Prices remain above the recent norm, and their future level now depends on how quickly the Saudi’s can restore production. A prolonged outage will likely eat into the over supply and will push prices higher. Much depends too on what follows politically. If it is shown that Iran was indeed involved, retaliation could ratchet the region into a new crisis.

Gas

Natural gas begins to lose its lustre as a bridge to renewables

For decades, natural gas has been promoted as a cleaner, safer, cheaper bridge fuel that would take us to a world in which renewable energy rules. But increasingly, the argument is appearing that natural gas is every bit as problematic to global warming as coal and crude.

David Gregory

For anyone who watches the news regularly, it has become obvious that climate change – which is now increasingly called the climate crisis – is an issue that is finally gaining worldwide attention, as those who have denied this phenomenon for so long are pushed aside.

Throughout the month of the September young people organised a number of demonstrations across the globe to demand that politicians and business leaders take concrete measures to address the climate crisis.

Despite the science around global warming and the facts about the impact that burning fossil fuels has on the planet, those governments and industries that depend on fossil fuels to run their economies and earn billions of

dollars from their use, continue to insist that hydrocarbons will be a major source of energy for decades to come.

At the World Energy Congress in Abu Dhabi last month, the UAE Minister of State and CEO of Abu Dhabi National Oil Company (Adnoc) said the world would need to invest \$11 trillion in oil and gas exploration and development in order to keep pace with forecast global energy demand in the years ahead.

Based on the world’s current mode of operation, he is probably correct. Adnoc would boost crude production from 4 million b/d in 2020 to 5 million b/d by 2030, he stated.

“The world [will] still rely on oil and gas for many decades to come,” he said, adding that Adnoc would be unlocking vast reserves of natural gas by developing gas caps, undeveloped

reservoirs and unconventional [shale/tight] resources.

For decades, natural gas has been promoted as a cleaner, safer, cheaper bridge fuel that would take us to a world in which renewable energy rules. There has been a rush towards natural gas – its exploration and development, developing markets and its use as an alternative – one that would provide the world with some lead-time in the move to renewables.

But as more attention is focused on the burgeoning gas industry, researchers are discovering that it will not provide the world with any respite. Increasingly, the argument is appearing that natural gas is every bit as problematic to global warming as coal and crude and that it really won’t save consumers any money in the long run.

While natural gas is seen by those in

the hydrocarbon market as the fuel of the future, many have concluded that solar and wind are already capable of producing energy at a cheaper rate than hydrocarbons and that emphasis should be shifted away from gas and directed towards renewables.

A recent study carried out by the Colorado-based Rocky Mountain Institute (RMI) found that there are 177 new natural gas plants under construction, planned or announced in the US that are due to come into operation by 2025 at a cost of \$70 billion.

The RMI study found that a combination of energy efficiency, wind and solar, and storage batteries could replace 90 per cent of those plants more cheaply while providing the same level of reliable electric service.

That would save customers \$30 billion and avoid millions of tons of

carbon dioxide emissions, the report said.

A report issued last month by the Berlin Think-and-Do-Tank found that production of “highly climate-damaging natural gas will further exacerbate climate change.” In a statement concerning the study, former German MP and President of the Energy Watch Group, Hans-Josef Fell, called for a rethink in the political debate about the future of the energy sector.

“Existing and new subsidies for natural gas are incompatible with the Paris climate protection targets,” Fell said. “Instead, we urgently need more investments in renewable energies, because only these have an immediate and lasting positive effect on the climate.” As might the current and future actions of a young population determined to secure its future.

Adding value through digitalisation

Omnetric believes the ability to add value through digitalisation and IoT are key to the success of utilities – and to achieving its own near-term growth targets. **Junior Isles caught up with Daniel Felicio, the company's new CEO.**

There is a broad consensus that the electricity and energy sector is just at the start of an enormous scaling of the digitisation of businesses, where the Internet of things (IoT) and related services will play an increasingly important role. The accelerating shift means that players need to better understand how to move away from a pure proof-of-concept approach to a situation where they understand the value of digitalisation and implementing IoT at scale, and how it can generate real value.

It is an issue that Daniel Felicio sees as one of the most immediate challenges facing the industry, and one of the first tasks he will address as the new CEO of Omnetric.

Initially formed in 2014 as a joint venture company owned by Siemens (51 per cent) and Accenture (49 per cent), Omnetric brought together Siemens' range of products and solutions with Accenture's management and technology consulting, systems integration and managed-services capabilities.

Felicio joined Omnetric in September 2018, shortly after Siemens acquired Accenture's share in the company to become sole owner. Since the start of this year he has been CEO of Omnetric as well as CEO of Siemens' IoT solutions and implementation unit.

He commented: "My biggest challenge is how we convey the right messages and produce the right lighthouse projects that show the industry we can generate value for our customers through IoT and digitalisation and create a new economy, not only in energy but also in other industries."

When it was first formed five years

ago, Omnetric was heavily involved in the smart meter rollout that is still ongoing across Europe. It has also been participating in projects aimed at integrating distributed generation sources into the IT space. Now things are changing. Today it is much more about creating systems that allow sharing of utility data, even with potential competitors, to allow new business models to be created.

Felicio explained: "[In the past] projects were not so much driven by a vision to generate a partner eco-system to create a digital system. But today, in one project that we are doing with a large central European utility, we are connecting the leader data management platform to the billing, to the SAP and to the portal. The utility said either they play a role in creating an eco-system of partners where

which presents differing levels of opportunity. The US is seen as being in the "second generation after smart meter production", where projects are "very much driven" by IT. "We see there is a good follow up and expansion of the IT platforms to allow the companies to transform," he said.

Like the US, Europe has been stimulated by the expansion of renewables but, says Felicio, digitalisation has been slowed by data protection and regulatory issues. "Sometimes, I would like to see more boldness in the transformation of utilities. There are very good examples like Enel, who very early on recognised the need to transform themselves, but a lot more needs to happen."

In the Middle East, where the energy sector is largely still state-owned,

so they will be using IoT to create a digital twin of the substations to understand, exactly, things like whether there is a danger or if the substation needs maintenance. This is very clear but it's not so obvious for other organisations and utilities."

He says that, generally, US utilities are aware that they need to collect and make better use of their data and that IoT and digitalisation are important. And while maybe 20 or 30 per cent are talking about bold digitalisation strategies, the operation at scale is "really not there yet".

Felicio noted: "They need to understand how to go forward and start piloting with clear criteria; implement at scale and if it doesn't work, move to the next pilot."

Looking to Omnetric's future in addressing the industry's near to mid-term challenges, Felicio re-iterated the company's mission: to capitalise on the industry change in order to generate value for its customers. "All of our growth and profitability will only come from creating value for our customers," he said.

With utilities looking to become smarter, greener and more diverse, Omnetric notes that it has a lot of competence in the areas that utilities are looking to expand in the short to mid-term. "We will be going from the meter rollout that we had in the past to all these areas around the rollout. Utilities will be concentrating more and more on business optimisation, which I believe will run at a larger scale.

"With our IoT and IT integration capabilities, we are in a good position. And together with our buildings technologies unit of Siemens, we have a very good offering.

"The expansion of renewables and EVs will also be playing a role, and here we can count on the support of our colleagues in 'future-grid' in our smart industries operating unit. These areas will bring us the growth required in the next one to three years."

Going forward, Omnetric says it is building on the expansion of IoT in other industries, with the goal of building a €3 billion business by 2023. This will come from expansion into other verticals in the Siemens domain. Felicio cited smart infrastructure and logistics mobility as examples, where it can build on its competencies in the pure energy/utility arena.

"Building a €3 billion by 2023 is an awesome challenge and part of what attracted me to Siemens. But we've had lots of growth and I'm very confident. If you think of why Siemens acquired the share from Accenture, our strength is that we have the IT capabilities. We have the IT DNA but we can also use the operational technology (OT) competencies of Siemens and very quickly define the relevant use cases and assess the impact on our customers' businesses, based on the assets they already have. With the deep knowledge of IT and OT assets, we really understand where we can deliver value."

"... we can generate value through IoT and digitalisation and create a new economy, not only in energy but also in other industries"

the partners can connect to the platform and use customer data... to create new business models, or risk competitors passing them by and becoming irrelevant.

"This is a good example of a project where we have delivered a platform with interfaces to the billing, to the SAP, and to the portal, etc., and are now creating the use cases. For example, a developer might have solar panels or EV charging and want to connect to a billing platform and customer access platform. They could now simply connect to this [leader data management] platform via the portal as a business-to-business [user] and draw from all the consumer and billing data that the customer already has, and provide an added value service to their consumers and share the revenue with the utility.

"This is a very concrete example of how utilities are not only thinking about IT driven by regulatory issues or smart metering, but are really thinking about creating new business models and building an eco-system of partners."

Although utilities are now actively building new business models, experts often question whether they are moving at a fast enough pace in the rapidly changing energy landscape.

"What I'm very worried about – and I also see it as our role and task to help drive this process with [our] customers – is the HR transformation that is also required. This is often neglected in projects; utility organisations still too often act in silos. But I am hopeful," he said. "More and more, I see the CIO, or chief digitalisation officer, and the COO at the same table. So although I am very worried at the speed at which the industry is transforming itself, there are some positive signs."

Felicio notes, however that the speed of transformation and challenges vary from market to market,

progress is much slower. "Although the smart cities initiative is driven by a lot of money, energy utilities are typically very conservative," noted Felicio.

In Asia, the biggest transformation is ongoing in China, where the government says it will fully digitalise its energy network by 2022. "We are tracking it very closely and feel there is definitely an opportunity there. But we don't yet have a clear view of how they can achieve such a timeline," he said.

Digitalisation and IoT bring many benefits but there are also dangers. The technologies allow adopters to deliver myriad outputs without having a large amount of resources and the associated fixed costs. "It allows a company to be much lighter, more dynamic and able to give much more added value to the customer, and have more direct contact to the customer, etc.," said Felicio.

Yet, introducing IoT into a company is not straightforward. "It's not a case of creating all of your stats and outcomes at the beginning and implementing steps one, two and three to get there," Felicio noted. "The world is now much more dynamic and volatile. You need to start with specific assumptions, start implementing pilots and quickly go to scale. But you will only go to scale if you clearly know the original intent and have clear criteria on why you want to expand quickly. If you don't have this clear criteria, you will be in a proof-of-concept hell where you don't know whether you will create value or not by scaling, so you will be trying repeatedly and this will drag you down. So there are positives and negatives.

"Sometimes it's easy; like the large utilities in North America. In California, for example, where there have been fires, they know they need wider visibility and control of the substations. The risk has been recognised,



Felicio: Utilities will be concentrating more and more on business optimisation

H₂ and a zero-carbon world

Progress towards net zero carbon will eventually require the end of the use of natural gas for all but a small number of critical applications. Although hydrogen is not an energy source, it is a potentially leading energy vector.

Dr Paramjit Mahi explores how to accelerate the hydrogen economy.

Hydrogen production is a possible key mechanism to a zero-carbon energy system. Currently available mature technologies for hydrogen production are electrolysis from water and reforming of natural gas. As power generation from renewable sources increases, it is possible to anticipate a time in the near future when peak output will regularly exceed demand. Surplus power can be converted to hydrogen. Hydrogen from renewables is described as 'green'. Production of hydrogen from fossil fuels, using techniques such as steam methane reforming (SMR), is termed 'brown' if by-produced CO and CO₂ are simply discharged into the environment. Marrying H production with carbon capture, usage and storage (CCUS) makes it 'blue' hydrogen, with carbon monoxide and dioxide. This too can be compatible with a net-zero carbon energy system by.

But so far, hydrogen for energy is conceptually and technically in its infancy. In the UK, some work on adaptation of domestic appliances and conversion of some industrial thermal energy applications is under way. There are limited plans for hydrogen fuel-cell vehicles and small-scale power-to-gas. Two proposals for bigger steam methane reforming (SMR) with CCUS plants are in train. However, there are no utility scale hydrogen production projects up and running anywhere, globally.

Rapid acceleration is required to develop the systems we need to meet 2050 zero-carbon commitments. More radical action by government and industry is required to drive development of a hydrogen-based energy system forward. Only by demonstrating and scaling up the systems, and guaranteeing a market, can a robust and investable hydrogen economy be created.

Clearer and more consistent policies would reduce risk for private investors. There is already a ban on internal combustion engine vehicles from 2040 in the UK. This should be accompanied by similar deadlines in

other consuming sectors, including a commitment to run all combined cycle gas turbines (CCGT) – the workhorses of the current power system – on hydrogen say by 2035. Direct state involvement may even be needed in the construction of major key elements of hydrogen infrastructure, such as new gas transmission and distribution grids.

There are signs that the system can work. Carbon taxes, market incentives, the availability of cheap renewables, and half hourly pricing that reflects variation in the power supply and demand balance, are already encouraging some hydrogen output in northwest Europe. Hydrogen is becoming more valuable at peak times due to its potential for conversion to power in CCGTs and fuel cell power plants.

Perhaps the most promising immediate opportunity for hydrogen is for energy storage. Renewables are dogged by intermittency. When supply is high, prices fall. Indeed, suppliers can be penalised for exceeding demand. Meanwhile, there are periods when renewable power output falls short of demand.

Converting surplus electricity to hydrogen and using it in a gas turbine or fuel cell to generate electricity would produce a hybrid solution capable of evening out power supply and maximising revenue. Cheap excess renewable electricity and variable power prices in Europe have led electrolysis unit manufacturers and hydrogen production advisers, including Air Liquide, Hydrogenics, ITM Power, Nel Power and Siemens to invest in such technologies.

But existing hydrogen production units based on electrolysis are small. Air Liquide's largest, used in the EU's flagship electrolysis project in Austria, is only 6 MW.

Co-ordinated planning as well as capital investment are needed in electrolysis at scale, brown hydrogen with CCUS, hydrogen utilisation, and transmission, distribution and storage.

Japan offers an interesting example of the benefit of government support. It has yet to introduce carbon penalties or price power in real-time and has less cheap renewable power available than the UK. But there have been more extensive state sponsored efforts to push hydrogen development in tandem with private companies.

In the UK and Europe, the state could also play a key role by getting directly involved. To date, government has had to remove risk from major private energy investment projects, to attract private investors. For example, the \$20+ billion Hinkley C nuclear power project has a government-guaranteed price for power of £92.50/MWh.

One option now being considered for large energy projects is the Regulated Asset Base (RAB) model. The state, acting through the energy regulator, would ensure security of cash-flows to private sector asset owners/operators, so reducing the cost of capital. This approach is favoured for proposed SMR projects in the UK. Their backers have different motives for involvement, but all are waiting for central government to adapt the regulatory environment in line with the national policy commitment to net-zero carbon emissions by 2050.

For the biggest hydrogen projects, there may be just too much risk for a

private company or consortium, and direct state funding and ownership (as least initially) may be required. This was the case when the existing natural gas systems were established in the 1970s. Such projects might include, in the UK, a 3000 km, multi-billion-pound dedicated hydrogen national transmission grid.

So far SMR with CCUS project proposals have been far bigger than electrolysis proposals. On the drawing board are the Hynet Northwest Partnership on the Mersey estuary, backed by a consortium of gas distributor Cadent, oil and gas giant Shell, and developer/port operator Peel. In the northeast, a consortium is backing a Teesside plant that will supply Leeds. On Humber, a third SMR/CCUS hub is proposed by oil and gas company BP with energy firms Centrica, Ørsted, Equinor, Engie and Northern Gas Networks. In North Yorkshire, generator Drax, Equinor and National Grid Ventures (the transmission firm's new energy technologies arm), are aiming to develop a large-scale hydrogen demonstrator on the Drax site by the mid-2020s, combining carbon capture from SMR hydrogen production as well as from thermal power production.

Some hydrogen-only pipelines have already been built in Europe, including Air Liquide's pipeline from France to Belgium, and a 210 km network in Germany. Up to 20 per cent hydrogen can be safely blended with natural gas in existing gas transmission and distribution pipelines. Blending pilot projects are going ahead at Keele and Leeds in the UK.

In addition to SMR, several small electrolysis plants are operating at refineries, including Shell's 10 MW electrolysis plant in the Rhineland refinery in Germany (partnering with ITM Power). Shell says it aims to test the technology on an industrial scale in order to develop new business models, but its investments so far are modest. BP has a similar refinery-based electrolysis project in the Netherlands.

Blue hydrogen produced using SMR with CCUS is an attractive intermediate step in the development of a hydrogen-based energy system. It provides a near-term market for gas, helping oil and gas companies to transition their businesses from predominantly hydrocarbon-based to renewable. The storage, transmission and distribution infrastructure needed for a functioning blue hydrogen system will be the same as for green.

There are already green hydrogen plants running on tidal energy in Orkney, as well as solar and wind elsewhere. Various nuclear operators are investigating the possibility of using nuclear power to produce hydrogen when prices are low (converting low cost power into hydrogen via electrolysis would enable it to be converted back or sold on as a fuel when prices rise). Norway plans to produce hydrogen from hydropower for sale to Japan at a target price that will outcompete a rival coal-fed SMR project based in Australia.

Because hydrogen is such a low-density gas, transportation is an issue at scale. So, as well as local gas pipeline and storage networks, other transportation mediums need to be considered. Options under development include cryogenic liquefaction of hydrogen – although this has major costs and risks. A carrier process

using ammonia is more practical. Splicing nitrogen and hydrogen together to create ammonia (NH₃) is a simple and easily reversible chemical engineering process. An ammonia trading network already exists globally, serving the fertiliser industry, although existing networks would need to be expanded dramatically and modified to include conversion facilities.

Hydrogen molecules can be chemically bonded into a class of materials known as hydrogen carriers (HC), which come in both liquid and solid forms. Liquid organic HCs enable transportation in regular tankers and pipelines; solid HCs can be transported as freight. These HCs can be non-toxic and fully inert, and very cheap if produced at mass scale. HCs can be charged and depleted repeatedly. The cost comes in the process of bonding and separating hydrogen from them – hydrogenation and dehydrogenation – and from transporting the depleted HC back to source for recharging.

Development of high capacity, low cost, transportation is feasible – technically no more challenging than the intercontinental transportation of natural gas is today. Overcoming that barrier would open up the possibility of producing cheap solar power in the world's deserts for consumption in remote locations.

The transition towards a renewables-hydrogen system is benefiting from the increasing number of investors acting on traditionally non-commercial priorities. A quarter (or \$20 trillion) of the world's professionally managed investments take account of environmental, social and governance criteria. Fossil fuels increasingly do not meet them.

Meanwhile, investors and insurers are looking to reduce their exposure to climate risks. The risk premium for holding hydrocarbon stocks is rising with every extreme weather event. Meanwhile, emissions-free hydrogen power is well aligned with urban transport policies that address the link between poor air quality and harm to public health.

A comprehensive hydrogen system, encompassing domestic and industrial power and heat, plus transport, would support full energy security. Building up stores of hydrogen would enable cities, regions – perhaps entire countries – to ride out inter-seasonal fluctuations in renewable energy output, reducing reliance on fossil fuels imported from abroad.

Large scale networks need to be developed by the governments, backed up by regulations based on timelines for an accelerated growth. Such projects can then be sold to the private sector. Relying on energy majors and private sector via RAB models may be a mistake in the long run as the current snail pace will continue into the 2030s.

Further the public should be made aware of the benefits of using hydrogen to the society in addition to climate change. We can continue to drive and fly and let the next generation also experience the wonders of the world. All of these milestones can be achieved. Doing so involves imparting some initial energy to the hydrogen economy, to get it ready to roll.

Dr Paramjit Mahi is Development and Innovation Director, Energy Sector, Mott MacDonald.



Dr Mahi: the public should be made aware of the additional benefits of using hydrogen to the society

Wind farm decommissioning: planning ahead

The comparatively low anticipated cost of wind farm decommissioning does not mean the industry should lose sight of the challenges decommissioning can and will pose to the wind sector.

Catherine Leaf

As elements of our offshore wind farm stock begin to reach maturity, increasing focus is being given to the challenges and opportunities posed by decommissioning. These considerations are not unique to this sector: a number of lessons can be learned from oil and gas (O&G) decommissioning, both in terms of decommissioning existing offshore and onshore wind farms, and in designing future ones.

There are circa 500 fixed and subsea O&G production systems installed on the UK Continental Shelf (UKCS) served by 5000 wells and 3000 pipelines. Approximately 10 per cent of this infrastructure has been decommissioned to date, with operators spending over £1 billion (\$1.23 billion) cumulatively each year since 2014. Indeed, Oil & Gas UK, the trade association for the sector in the UK, predicts that the O&G industry will spend in the region of £15 billion over the next decade on the decommissioning of UK assets.

It is worth noting that the cost of O&G decommissioning is heavily weighted towards well-plugging and abandonment, which accounts for almost half of the total cost. By contrast, elements that are more comparable to offshore wind, such as facilities and pipeline de-energising,

account for 3 per cent of the total cost, topside preparation and removal for 10 per cent, and onshore waste management of the structures and infrastructure for 2 per cent. Currently, there are around 2000 UK offshore wind turbines and 8000 onshore. Even when the supporting infrastructure of both is accounted for, the comparative simplicity of turbine structures and wind farm infrastructure means they pose a relatively simpler decommissioning challenge.

Considering this and other factors, such as wind farms not presenting the same hazardous waste management challenges posed by O&G decommissioning, it is reasonable to expect wind farm decommissioning to cost less. Indeed, recent estimates have put the upper cost of decommissioning the UK offshore wind stock at around £3.6 billion.

However, the comparatively low anticipated cost of wind farm decommissioning does not mean that we should lose sight of the challenges decommissioning can and will pose to the wind sector. One valuable lesson to be learned from O&G decommissioning is the need to plan for decommissioning from the beginning – for example, by considering how the structures and related infrastructure will be removed right from the design stage.

Other pertinent factors, such as the circular economy and market forces, will influence the need for and ability to adhere to and promote the reuse and recycling of waste materials from decommissioning as opposed to disposal. These are important considerations that both the O&G and wind sectors may find increasingly problematic to achieve unless joined-up thinking is applied – as both sectors increase the number of decommissioning projects they undertake over the next decade, more components and materials will start to enter the reuse and recycling markets.

Fifty years ago, as the first O&G infrastructure was deployed in the North Sea, there was little thought given to how it would be removed. This now poses significant challenges to operators facing the requirements of the OSPAR Convention to leave behind a clear seabed. This obligation conflicts with the absence of technology capable of removing gravity-based structures, for example, without significant health, safety and environmental risks.

Similarly, the International Maritime Organisation's guidelines now mean that nothing should go in the water unless it can be removed. However, the industry is deploying offshore wind turbines that require installation supported by large diameter monopiles, for which the removal technology is not currently readily available.

From lessons already learned, we now have a regulatory requirement, via the Energy Act 2004 (as amended), to prepare a decommissioning programme (DP) at the development stage for offshore renewable energy installations, and via the planning system for decommissioning, restoration and aftercare strategies for onshore developments.

However, DPs are often vague and generic, and there continues to be an assumption that, when the time comes, the technology will have caught up with the engineering challenges associated with removal of these structures, especially offshore. That is not necessarily an unfair assumption, but it does not play to the principles of sustainable construction, and we risk storing up problems for the future. Given the wind sector is in its relative infancy, the need to plan for the end right from the get-go is a decommissioning lesson that can be learned and acted upon now.

During the course of the operational phase of a wind farm, which is commonly designed for 25-30 years, the infrastructure supporting the wind farm will likely be modified, upgraded and the wind farm repowered where it is possible and economically viable to do so. The wind farm may also see a change of operator during its lifetime. A key learning from the O&G sector is to ensure that robust records are maintained of all changes made, and that these are readily accessible to the decommissioning party. Those changes and upgrades should be made with a view to enabling ready removal and sustainable deconstruction when the time comes.

Similarly, the design and construction of legacy O&G infrastructure was not undertaken with a view to enabling reuse of the whole or component parts. Such things were not a consideration 50 years ago. Enabling reuse is now enshrined in legislation and reflected in best practice, with a requirement to comply with the principles of the waste hierarchy. Additionally, the ethos of the circular economy is gaining traction, seeing an increased focus on design for reuse rather than defaulting to an expectation of recycling.

The energy industry is not immune to stakeholder expectations, including expectations of investment partners, for demonstrably sustainable practices including at the decommissioning stage. Here, wind has a distinct advantage over O&G: wind turbines are simpler structures, using fewer materials, therefore have far greater potential for sustainable deconstruction and reuse.

Decommissioning onshore wind farms has already demonstrated this, with markets for the reuse of component parts already being established for regions such as Eastern Europe.

There are also examples of the reuse of whole turbines in smaller community schemes, such as that on the Isle of Gigha, off the west coast of Scotland, which bought three second-hand Vestas machines in 2004.

This is an encouraging start, but thought should be given to the longer-term. As is the case for the O&G industry, many wind decommissioning and/or repowering projects will likely occur over a similar period. That has an impact on the availability of the plant required to decommission the structures and infrastructure, on the capacity of yards capable of managing the wastes, and will see a greater volume of materials entering the market that can reduce uncertainty in supply and increase uptake, but also lower the value of the materials.

In recognition of the need to consider bigger picture market forces, a few years ago, the O&G decommissioning sector organisation, Decom North Sea (DNS), commissioned a study to assess the options for steel resulting from O&G decommissioning. The study found that the default solution was to send steel for recycling, which, although preferable to disposal, still has a high energy demand and, in the UK at least, delivers little benefit to the economy because of a lack of UK-based steel mills.

One of the key findings was the requirement for collaboration across the decommissioning industry and others to produce a more joined-up approach, which stands a real chance of stimulating effective reuse and recycling markets. Earlier this year, DNS was awarded funding from the Scottish Government Decommissioning Challenge Fund to develop a plan for a design competition aimed at reuse of steel from decommissioned O&G assets. The wind sector should watch with interest to see how this develops and factor the findings of the resulting competition into the design and installation of future turbines.

Of course, with an increasing emphasis on the need for renewable energy sources, the focus when developing wind farms has, to date, been on getting them operational. However, as we've seen with the O&G sector, a focus only on design for operation results in significant challenges when it is time to decommission.

By designing for sustainable deconstruction, developing effective decommissioning programmes, keeping robust records of structural or operational changes, and planning reuse of structural elements rather than recycling them, wind farm operators can ensure that the removal of on and offshore structures is not only done sustainably, but efficiently and effectively too.

Catherine Leaf is Senior Managing Consultant at Ramboll



Leaf: the need to plan for the end right from the get-go is a decommissioning lesson that can be learned and acted on now

Superconducting HVDC passes the test

A superconducting HVDC cable has passed qualification testing for the first time, heralding the first real step in demonstrating the technology could be a viable option for transmitting large amounts of power over long distances in the not too distant future. **Junior Isles**

Dr Bruzek sees superconductors as part of an overall solution alongside conventional overhead lines and underground cables in the short term

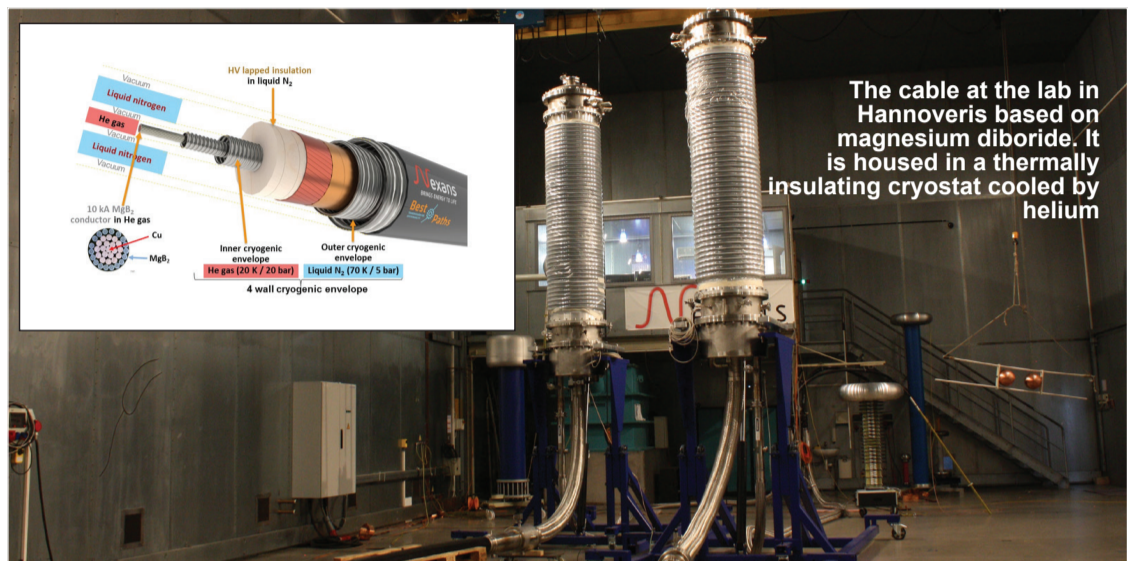
Superconducting cables have the ability to transfer power without the losses associated with traditional resistive cables. While it is still early days for the technology, there are already several superconducting cables operating in alternating current (AC) networks. Perhaps the most notable of these is the AmpaCity project in Essen, Germany, which has been operating since 2014. With a length of 1 km, this 10 kV, 40 MW, cable is the longest superconducting cable in the world.

Over the last decade, however, work has also been ongoing to develop a superconducting cable suitable for high voltage DC (HVDC) transmission, in order to allow bulk power to be transmitted over much longer distances – of the order of hundreds of kilometres with almost zero losses.

In June this year Nexans helped to bring these innovative high power links a step closer to reality with the successful completion of qualification tests on a superconducting cable developed specifically for HVDC. The qualification marks a major milestone in the programme, with the cable passing all the tests without any failures.

The work is part of the EU-funded 'Best Paths Project', aimed at overcoming the challenges of integrating renewable energies into Europe's energy mix. The project unites expert partners around five large-scale demonstrations to validate the technical feasibility, costs, impacts and benefits of the tested grid technologies.

The focus of the demonstrations is to deliver solutions to allow for transition from HVDC lines to HVDC grids, to upgrade and re-power existing AC parts of the network, and to integrate superconducting high power DC links within AC meshed networks.



The cable at the lab in Hannover is based on magnesium diboride. It is housed in a thermally insulating cryostat cooled by helium

Best Paths Demo 5 focuses on superconducting cables for very high power transmission, setting out to design, manufacture and test a superconducting cable system operating at 320 kV and 10 kA. This project was led by Nexans working together with nine other industrial and academic partners.

Summarising the qualification test, Dr. Christian-Eric Bruzek, Project Manager at Nexans, said: "The cable was tested according to Cigré recommendations for high voltage polymer insulation cables. We maintained the test voltage for quite some time. We also tested switching modes, with around 100 switching tests being executed for various voltage evolutions versus time. And we kept the cable at low temperature for nearly two months."

The Best Paths cable is based on magnesium diboride (MgB_2), a simple compound based on raw materials that are abundant in nature. The compound is easy and inexpensive to manufacture – providing a cost benefit compared to other relevant superconductor materials with the need to cool at a lower temperature. The cable is housed in a thermally insulating cryostat cooled by helium gas.

The cable was installed at the Nexans lab in Hannover, Germany, and set out to energise the cable up to 1.85 times the 320 kV rated voltage of the cable, i.e. 592 kV. The superconducting loop comprises two terminations and a 30 m length of cable.

Going to longer cable lengths of hundreds of kilometres will require a bigger cryogenic system and jointing of the cable. "The cryogenics will need to be twice as big but we know how to do this; it's not a big step. The temperature will be exactly the same," said Dr. Bruzek. He added: "We did not have a joint in the programme, so this would have to be installed and fully tested. But again, we know how to do it and already have a basic design. For a cable of, say, 100 km we might have 100 joints."

Although this will increase the cost of a system designed for the field, it is expected that a superconducting HVDC link will overall still be cheaper than a traditional resistive

cable installation.

The main advantage of superconducting cables in HVDC applications is their capability to carry high currents so that they can transfer very large amounts of power with minimal losses. This high power capacity results in a very compact installation footprint in the range of 1 m in width for a dipole carrying 6.4 GW. In contrast, a traditional circuit based on XLPE insulated copper cables would typically be 10 m wide. This footprint reduction provides significant cost savings as well as making it easier to obtain permits for rights-of-way.

Dr. Bruzek commented: "The superconducting system itself costs a bit more, due to the cable itself and the cryogenics but the smaller footprint saves three or four times on the installation."

He also noted that when the tools needed to build installations for actual field deployment are up-scaled, there will be significant cost reductions in capex. Higher volumes will also drive costs down further.

"Today, the superconducting system is already 10 per cent less expensive than an existing system, in terms of capex, for a 500 km link," he said. "And in the future, we believe we can reduce the cost by a further 30-40 per cent once we have production lines developed for the cryogenics."

Even when considering any running costs or maintenance of items such as the cryogenic station over the lifetime of the installation, Dr. Bruzek says the economics are still better.

"The cryogenic cooling station only represents about 5 per cent of the capex plus net present value [NPV], or lifetime cost, of the system," he noted. "LNG tankers have been using similar cryogenic systems for years and they have been very robust. So we would imagine having some maintenance every five or six years to perhaps repair or replace filters or circulation pumps. But these are not expensive. Further, we don't expect any thermal degradation of the cable and there will be no loss in performance over time; we did some thermal cycling and found no degradation of the superconducting material."

He also noted that economics over the lifetime of the installation depends on loading of the cable. "At 100 per cent load, the superconducting cable is 10 per cent less expensive over the lifetime of the installation. When there is no current on a resistive cable, there are no losses. A superconducting cable still needs to be kept cold even when there is no current, so money will have to be spent on the energy required for this even if the cable is not in use. Our calculations show that the economics become favourable at loads of 70 per cent and above.

"So it has to be used at a high rate of current or it is better to use copper cable. But you would not build a big expensive cable if you are not going to use it – a 500 km cable costs about €5 billion."

With a strong economic case, good predicted reliability and now successful qualification testing, the next step will be a field test. This would be on a 100-200 m cable, including a joint, that would be tested for about one year.

"We would need to find somebody willing to install it on their grid, allowing the TSOs (transmission system operators) to gain confidence in the cooling system. And then we will need some standards for testing superconducting HVDC cables," said Dr. Bruzek. "People will then become confident in the testing programme, and then we can first have several tens of kilometres and slowly move to longer lengths."

If all goes to plan and markets like Germany, where there is a need to transport large amounts of power from the north to the south, can get the necessary regulations and authorisations in place, superconducting HVDC could see their first commercial long distance installations within 10 years.

Dr Bruzek concluded: "In the longer term we expect HVDC superconductor cables to carry power over hundreds of kilometres. But in the short term we see them as part of an overall solution alongside conventional overhead lines and underground cables, helping to create corridors in challenging installations such as when crossing rivers, in congested urban areas or where environmental impact must be minimised."





Junior Isles

Must try harder

With the number of school children demonstrating globally and taking to the stage at the recent UN Climate Change Summit in New York, many adults must be having flashbacks to school days. But this time with roles reversed.

The scowl of teenage climate activist Greta Thunberg as US President Donald Trump made a fleeting visit to the summit was that familiar look your English teacher might have given that perpetually disruptive kid in class.

Heads of government, commercial organisations, cities and municipalities gathered in the 'Big Apple' at the end of September knowing that they have to take a huge bite out of carbon emissions to stand any chance of avoiding catastrophic climate change.

Last year a report from the Intergovernmental Panel on Climate Change found that limiting warming to 1.5°C would require cutting emissions to net zero by the middle of the century.

A report issued by DNV GL just a couple weeks ahead of the New York gathering highlighted the extent of the task. Its forecast indicates that for a 1.5°C warming limit, the remaining carbon budget will be exhausted as early as 2028, with an overshoot of 770 Gt of CO₂ in 2050. Limiting global warming to well below the 2°C target of the Paris Agreement would call for even greater acceleration of solar and wind, as well as other technology measures, it said.

According to the company's 'Energy Transition Outlook 2019', solar power would have to increase by more

than ten times to 5 TW and wind by five times to 3 TW by 2030, meeting 50 per cent of the global electricity use per year. There would have to be a 50-fold increase in production of batteries for the 50 million electric vehicles needed per year by 2030, alongside investments in new technology to store excess electric energy and solutions that allow electricity grids to cope with the growing influx of solar and wind power. Global energy efficiency improvements would need to increase by 3.5 per cent per year within the next decade.

To address sectors outside electricity, the report said green hydrogen would be needed to heat buildings and industry, fuel transport and make use of excess renewable energy in the power grid. It also noted that rapid and wide deployment of carbon capture, utilisation and storage installations would also be critical.

Commenting on the outlook, Ditlev Engel, CEO of DNV GL Energy, said: "Our research shows that technology has the power to close the emissions gap and create a clean energy future. But time is against us. Those technology measures can only be successful if they are supported by extraordinary policy action. We are calling for government policies to expand and adapt power grids to accommodate the rise of renewables, economic stimulus for energy efficiency measures and regulatory reform to accelerate the electrification of transport. Governments, businesses and society as a whole need to change the prevailing

mindset from 'business-as-usual' to 'business-as-unusual' to fast-track the energy transition."

The report also demonstrates that the energy transition is affordable, as the world will spend an ever-smaller share of GDP on energy. "Technology keeps giving us more for less," said Ditlev, noting that the UK now gets "much more bang for the buck" for its offshore wind projects compared to 10 years ago.

DNV GL's report looks at the market's needs from a cost perspective, so all of its forecasts for technology requirements are based on what it sees as the most cost-effective technologies that can be deployed during the outlook period.

Which technologies will ultimately come through in the race to decarbonise will indeed likely come down to cost, although some will argue that we need to use everything that is available.

But not all agree with this thinking. Speaking during a recent panel debate on innovations to tackle climate change, held at the Finnish Ambassador's Residence in London, Michael Liebreich, Chairman, CEO of Liebreich Associates and Founder of and Senior Contributor to Bloomberg New Energy Finance said: "Don't do stupid things."

He stressed that firstly, money should not be put into "stupid ideas", such as solar roads and hydrogen cars. "Hydrogen cars are a really stupid idea. It's really inefficient. If you gave me free hydrogen, I would probably use it to generate electricity and put that in a battery [powered] electric vehicle. So there are really stupid things you can avoid doing."

The second thing he advised is to put money into areas "that are not stupid." Using decarbonisation of the steel sector as an example, he said: "Although you don't want to pick winners, that's the sort of area where governments probably have to push lots of R&D into. Saving money on the stupid things means you would have money to put into lots and lots of other things,

which you throw over the fence to the private sector to turn into products and applications and services."

Liebreich added: "Direct air capture is one of those stupid things; we should be doing some R&D there but very little. Thermodynamics says it's a really stupid way to try and get hold of CO₂." There is some obvious sense in his belief. As one climate change commentator recently noted: "we already have such devices, they are called trees".

Those responsible for the massive fires in the Amazon rainforest would do well to take note. Such actions only make the task of reversing climate change all the more difficult.

Speaking at the same event at the Finnish Ambassador's Residence, Professor Petteri Taalas, Secretary General of the World Meteorological Organization said their data showed that CO₂ levels in the atmosphere were the highest they have been in 3 million years and that the planet had warmed by 1.1°C between 1850 and 2019. He also said sea levels had risen 26 cm since 1800 and would rise by between 0.5 and 2.5 m by the end of the century.

These are worrying figures, highlighting the need for even faster action. Speaking on the sidelines of UN Climate Week in New York, Mathias Lelievre, CEO of Engie Impact, which was created to accelerate the sustainability transformation for corporations, cities and governments, said: "What I have been hearing here has been really consistent: let's accelerate. These conversations are really important because they create momentum... it's about reminding everybody about the level of priority at which the transformation should be."

Clearly it is not only the power and energy sector that needs to double its efforts; it is everyone – from municipalities and corporations down to the everyday citizen. SaveMoneyCutCarbon, a consultancy firm, which has helped several global bodies shave energy expenses while reducing their carbon footprints, recently noted that data showed that simply reducing fossil fuel consumption is not enough and that governments must find ways to persuade the general public to do more.

Commenting on recent statistics that showed many Britons are failing to even make a dent when it comes to reducing CO₂, Mark Sait, CEO of SaveMoneyCutCarbon, said the government needs to meet the British public halfway if it is to meet its targets. "The government will continue to set hopeful targets, and will continue to show its homework, but the way they are appealing to the public is dampening their chances of success. The fact of the matter is, everyday people are having negligible impact on these figures because of the societal and personal pressures they are facing."

Governments may have done their homework in setting targets and policies and the energy sector has responded, but the science shows it is not enough. The wider public needs to be shown how to make practical changes that can help the environment without overtly disrupting their daily routines – otherwise we will fail.

We have made good progress but there is much more to do. If our children were writing our school report card on how we are doing, the summary would no doubt be: "Must try harder."

'Must try harder?!' You've obviously been wasting your time! And ours!

