THE ENERGY INDUSTRY TIMES

October 2021 • Volume 14 • No 8 • Published monthly • ISSN 1757-7365 www.teitimes.com

Special Supplement

TEI Times discusses why the grid is central the global decarbonisation effort.

Coal: an obstacle and a driver

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European governments struggle with surge in energy prices

Soaring gas prices and the knock-on effect on electricity prices, is causing some European governments to intervene in the market and re-assess a proposal to extend the Emissions Trading Scheme. **Junior Isles**

The huge rise in European gas prices is driving a number of governments to re-assess some of the proposals that underpin Europe's Green Deal.

The Green Deal comprises 13 policies designed to reduce EU emissions by 55 per cent by 2030 compared with 1990 levels, and falling to net zero in 2050. One of those proposals is an extension of the Emissions Trading Scheme (ETS) to consumer sectors such as cars and heating for buildings, including homes. Such a move would increase the price of petrol and energy for already hard-pressed households. With the recent rise in prices, some legislators in the European parliament are now considering scrapping the plan and replacing it with alternative measures such as tougher regulation.

One EU official told the *Financial Times*: "If the ETS extension is gone, it leaves a big hole that will need to be filled," said the EU official. "You can't simply replace an instrument like the ETS with a new target."

Discussions on modifications to the ETS are set to continue for months as ministers debate plans that include emissions targets for cars, an EU carbon border tax and nationally binding greenhouse gas targets.

In September, several global factors, including weather conditions and strong gas demand in Asia following the pandemic, sent coal and gas prices soaring. This sent European electricity costs to record highs and saw coal demand rise as power generators looked to avoid sky-high gas prices. With coal plants emitting double the amount of carbon dioxide as gas plants, this has in turn led to more demand and higher prices of carbon permits.

Ministers were due to meet at the end of September to discuss national responses to the surge in wholesale gas prices. A major concern is that high gas prices, which are predicted to continue, will jeopardise Europe's post-pandemic economic recovery and undermine Brussels' plans for green reforms.

In a controversial move, the Spanish government says it will recoup £3 billion over the next six months from the profits of energy companies to fund a financial package to subsidise household energy bills. Energy companies are expected to mount a legal challenge to the move.

In Spain, protests mounted against energy companies after electricity prices rose more than 200 per cent in the past year and the issue has become politically sensitive. Madrid said it was targeting €2.6 billion in "excess profits" from utilities that do not use gas but have benefitted from how rising gas prices have driven electricity prices higher. This follows a similar initiative, announced in July, to claw back about €650 million from energy companies whose income has increased because of the rising cost of carbon.

The Association of Electric Power Companies, Aelec, which represents major utility companies including Iberdrola, Endesa, Viesgo and EDP, said in a statement that the Spanish

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Gas price takes toll on UK suppliers

Soaring gas prices has led to the failure of a number of UK energy companies.

As of late September seven small suppliers had gone bust in a little over six weeks. Citizens Advice, the consumer charity, said 1.5 million households had been affected by the supplier failures. Avro Energy, which had 2 per cent of the British energy supply market with 580 000 domestic customers, was notably the largest supplier to have failed in at least the last decade.

The increase in gas price has been replicated across Europe due to low storage stocks, competition with Asia for LNG cargoes, and Russian supply concerns. In the UK, the shutdown of a key power cable between Britain and France due to a fire has caused energy prices to soar even further, heaping even more pressure on energy suppliers.

Kwasi Kwarteng the UK's Business and Energy Industry Secretary, said he expected the final number of failed retail suppliers to be fewer than the 40 or so predicted by industry consultants, a level that would leave the UK with only 10 providers. "I'd be very surprised if we got to that figure," Kwarteng said.

With wholesale gas prices in the UK having risen by 250 per cent since January, some green groups are calling on the government to commit to ending gas-fired electricity generation and give more detail on plans for reducing the nation's dependence on gas for heating.

Energy and climate think-tank Ember, said it is cheaper to generate electricity from new wind and solar than existing gas plants.

"Generating electricity from existing UK fossil gas power plants is three times more expensive than from new onshore wind and almost twice that from new solar. Even the levelised cost of electricity (LCOE) from new offshore wind is cheaper than generating electricity from fossil gas," it said in a statement.

"Continued reliance on fossil gas for power generation has caused substantial increases in electricity bills when people can least afford it. UK fossil gas prices have skyrocketed since the start of 2021, with the average day-ahead price more than doubling from 45 pence per therm in December 2020 to 109 pence per therm in August 2021."

It added that fossil gas costs account for 86 per cent of UK electricity price increases – UK power prices have tripled year-on-year from August 2020 (£36/MWh) to August 2021 (£107/MWh) – a jump of £71/MWh.

Noting that the escalation in gas prices looks set to continue as winter approaches, it said the need to switch from imported fossil gas to domestic wind and solar generation has never been more apparent or urgent.

It says that with US President Joe Biden setting the path for clean electricity generation by 2035, Canada's Prime Minister, Justin Trudeau making it a manifesto pledge, and a change in the German government, gas phase-out could become a big issue at the COP26 climate summit in Glasgow next month.

"The soaring cost of imported fossil gas is driving up electricity prices in the UK. A more rapid and committed transition to clean electricity is the only way to avoid the volatility of fossil fuels," said Sarah Brown, Senior Electricity Analyst at Ember.

THE ENERGY INDUSTRY TIMES is published by Man in Black Media • www.mibmedia.com • Editor-in-Chief: Junior Isles • For all enquiries email: enquiries@teitimes.com

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government's measures go against the efficiency of the market, European orthodoxy and create a climate of legal uncertainty.

Iberdrola, the Spanish renewable energy group, said the plan would create more problems for customers. "It will also undermine investor confidence in the country, at a critical time when Spain needs billions of euros of private investment to deliver the projects behind ambitious climate change targets," Iberdrola said.

Cingolani says Italy's retail power prices set to rise 40 per cent in the next quarter

Italy was expected to follow suit, as Energy Transition Minister Roberto Cingolani said retail power prices in Italy were set to rise by 40 per cent in the next quarter.

Discussing the surge in gas prices, Claudio Descalzi, Chief Executive of Italy's Eni – one of the world's largest oil and gas companies – said that while governments were right to try to accelerate the adoption of renewable energy, they had chosen to tackle supply of fossil fuels before demand, contributing to tightness in the market.

"This is not something that is for a limited time; it's structural," Descalzi told the *FT*. "You cannot cut supply without also reducing demand," he said, warning that growing pressure from governments, activists and investors had made it very difficult for energy companies to invest in gas supplies.

The IEA stressed that the recent increases in global natural gas prices are the result of multiple factors. "It is inaccurate and misleading to lay the responsibility at the door of the clean energy transition," said IEA Executive Director Fatih Birol. "Today's situation is a reminder to governments, especially as we seek to accelerate clean energy transitions, of the importance of secure and affordable energy supplies – particularly for the most vulnerable people in our societies. Well-managed clean energy transitions are a solution to the issues that we are seeing in gas and electricity markets today – not the cause of them."

Kadri Simson, EU Energy Commissioner, commented: "The current situation makes the case for the Green Deal policies even stronger. We need more change, not less, and faster. The only real, long-term, solution here is to increase the share of renewable energy, which is already generally the cheapest energy on the market."

Going forward, the European gas market could well face further stress tests from unplanned outages and sharp cold spells, especially if they occur late in the winter, noted the IEA. Gas storage levels in Europe are well below their five-year average but not markedly below their previous five-year lows, which were reached in 2017, it said.

China's retreat from coal seen as boost for climate talks

- China's coal retreat could wipe $50 billion from global coal plant investment
- "Essential" that China stops building new domestic coal fired power stations

Junior Isles

China's recent promise to end the financing of new coal power plants overseas has been hailed as "significant" in light of the upcoming COP26 climate summit.

The pledge made by President Xi Jinping last month in a speech to the United Nations General Assembly was welcomed by global leaders, who stressed that China needed to also phase-out the use of coal domestically.

"China will step up support for other developing countries in developing green and low carbon energy, and will not build new coal fired power projects abroad," Xi said, but he stopped short of ending coal fired projects at home.

Dozens of new coal fired power and steel plants in China announced during the first half of 2021, if built, would alone add 150 million tonnes in annual carbon dioxide emissions, according to research group Global Energy Monitor (GEM).

Ending all support for coal has become a prime goal of the UN COP26 global climate summit scheduled for Glasgow, UK, in November.

"This is an important development, as China has been one of the biggest financiers of coal infrastructure in developing countries, particularly in Asia," said Alden Meyer, senior associate at E3G, a climate think-tank. But he said it was also "essential" that China stopped building new coal fired power stations at home and moved away from the fuel to meet its climate goals.

Globally, emissions are still rising, at a time when scientists warn that they need to fall almost 50 per cent by 2030 to avoid more extreme storms, heat waves and drought.

China was the financial backbone for about half of the coal projects being planned worldwide, in countries such as South Africa, Vietnam, Indonesia and Bangladesh, according to a report by E3G.

Analysts at GEM said China's overseas coal power retreat could wipe out $50 billion of investment, affecting 44 coal plants earmarked for Chinese state financing. The country, however, is isolated as the last major provider of public finance for overseas coal plants, with over 40 GW of plant in 20 countries in the pre-construction pipeline.

The Asian Infrastructure Investment Bank also welcomed China's announcement, calling it "a bold and consequential step for China, and for the rest of the world".

The news followed New research published by Sustainable Energy for All (SEforALL) and Climate Policy Initiative (CPI) that despite environmental, economic and many other challenges facing coal, pockets of funders continue to finance additional coal fired generation capacity in South Asia and Sub-Saharan Africa.

From 2013 to 2019, $42 billion was committed to grid-connected coal power plants in the 18 countries studied. Among them, Bangladesh, India and Pakistan received the majority of finance commitments to new coal plants, while in Africa, Madagascar, Mozambique, Malawi, Niger and Tanzania all host active coal plant development.

With many economies, including South Korea, having pledged to stop investing in coal projects, activists are now turning their attention to oil and gas.

At the end of August environmental group Solutions For Our Climate (SFOC) said South Korea's public financial institutions have provided more than $127 billion for global fossil fuel projects over the past decade. South Korea is the second-biggest public financier of oil and gas projects worldwide, after China, according to SFOC.

Panama calls for regional approach on road to COP26

Panama's National Energy Secretary Dr. Jorge Rivera Staff has called for a regional approach to tackling climate change on the road to the UN's COP26 climate summit in November.

In the leadup to the High-Level Dialogue on Climate Action in the Americas, co-hosted by Panama, last month, Dr. Rivera Staff, said Latin America was one of the most vulnerable areas to climate change but is one of the lowest contributors to greenhouse gas emissions. He explained that it was important to voice this as a unified regional message at COP26.

"The countries that contribute the most greenhouse gases have different responsibilities to those that are low emitters, like us. At COP26 we want to stress the different responsibilities and commitments. Right now, we are taking a regional approach to align the strategies of the stakeholders in each [Latin American] country in order to put climate change at the top of our agenda as we drive a green recovery. The high level dialogue is seen as a milestone in this regional approach that we are working on," he told *TEI Times*.

According to Dr. Rivera Staff, one of the most pressing issues at COP26 will be how to get promised financing flowing to developing countries. In the meantime, he said Panama was ensuring it has a "comprehensive and well structured plan" for utilising those resources when they are unlocked.

"We have to use those resources in the most efficient way, so we are aligning our climate initiatives with the economic recovery so we will be ready to invest once we receive the money. We are also exchanging best practices with other countries."

He added: "We are very confident about a positive outcome at COP26. We are seeing lot of specific steps being taken in the run-up that we've not seen in the last three or four years."

As one of only three carbon negative countries in the world, Panama sets a standard for other developed nations to layer over their economic growth with a commitment to sustainability. The country has established a system of incentives to foster the production of energy from renewable sources, all while creating jobs, protecting natural resources and improving the electricity matrix.

Panama has an ambitious but practical plan to move its economy away from fossil fuels and into clean energy, which will generate 70 per cent of the nation's energy needs by 2050.

To achieve its 2050 goals, last year the country approved its Energy Transition Agenda 2030 with more specific nearer-term targets. The agenda, approved in November has five specific strategies for the electricity sector and two for the hydrocarbon sector. The inputs used for the agenda formed the basis of Panama's Nationally Determined Contributions submitted in December last year.

Dr. Jorge Rivera Staff: "we are aligning the strategies of stakeholders"

Electrification not enough to meet net zero target

The world will still fall "a long way short" of achieving the 2050 net zero emissions ambitions of the COP21 Paris Agreement even if all electricity was 'green' from this day forward, says a recent report.

According to DNV's Energy Transition Outlook (ETO) 2021, electrification is on course to double in size within a generation and renewables are already the most competitive source of new power. However, the forecast shows global emissions will reduce only 9 per cent by 2030, with the 1.5˚C carbon budget agreed by global economies exhausted by then.

Remi Eriksen, Group President and CEO of DNV, said: "We've seen governments around the world take extraordinary steps to manage the effects of the pandemic and stimulate a recovery. However, I am deeply concerned about what it will take for governments to apply the resolution and urgency they have shown in the face of the pandemic to our climate. We must now see the same sense of urgency to avoid a climate catastrophe."

The report also says the pandemic was a "lost opportunity", noting that many of the pandemic recovery packages have largely focused on protecting, rather than transforming, existing industries.

"[There has been] A lot of 'building back' as opposed to 'building better' and although this is a lost opportunity, it is not the last we have for transitioning faster to a deeply decarbonised energy system," said Eriksen.

Energy efficiency remains the biggest opportunity to tackling climate change as the world drifts further away from achieving Paris. Securing significant improvement in this area is viewed as the most significant lever for the transition, according to DNV. This, it says, will see global energy demand level off, even as the global population and economy grows.

Reductions in the use of fossil fuels have been remarkably quick, says the report. These sources, however, especially gas, will still constitute 50 per cent of the global energy mix by 2050 – making the need to invest in and scale hydrogen, and carbon capture and storage all the more important. Oil demand looks set to halve, with coal use reduced to a third by mid-century.

ETO 2021 also reveals that while 69 per cent of grid-connected power will be generated by wind and solar in 2050, and indirect electrification (hydrogen and e-fuels) and biofuels remain critical, although none of these sources are scaling rapidly enough.

In a separate report, Arcadis, the global design and consultancy organisation for natural and built assets, said the global energy sector needs to halve emissions this decade to reach net zero and limit warming to 1.5˚C.

It said €6 trillion – approximately 7 per cent of global GDP – in investments will be required to realise the transition.

Brazil's hydro crisis brings on solar and wind investment

- Major consumers invited to share solar risk and reward
- Shell Brazil plans green power pivot

Janet Wood

President Jair Bolsonaro has called on Brazilians to save energy to prevent hydroelectric plants from shutting down. "I call on you who are at home. I'm sure you can turn off a light at home now. That would help save energy and water," the President said. "In most of those dams we're already at 10 per cent to 15 per cent storage."

Brazil depends on hydroelectric power, and the recent drought has forced the country to increase electricity generated by natural gas and diesel, raising inflation to more than 9 per cent. In 2021 Brazilian energy prices increased by over 50 per cent and are expected to continue to rise considerably above inflation. There are now fears that the country may have to start rationing electricity if the dry season extends beyond November.

The recent crisis has raised interest in other forms of generation. Brazil is said to be the only geographically large country with GDP over $1.5 trillion dollars where utility-scale solar penetration is below 2 per cent – even though it has exceptional solar potential. Now Solar Americas Capital wants to partner with companies in Brazil to add 2 GW of solar power by 2026. The company plans to co-fund, identify, build and manage the solar assets for commercial partners. It aims to raise $1 billion by 2026 and it will form joint ventures with each company it works with to develop the co-funded solar asset together.

The Solar Americas network will also provide an umbrella, under which its clients can access a larger portfolio of asset sale options when they are ready to sell the asset. The company has successfully completed its first funding round, secured access to growth capital from private investors and is starting the construction of its first solar farm in Brazil.

Tiago Alves, Co-Founder and Chief Executive Americas of Solar Americas said: "We are delivering a new partnership design with upside and transparency for Brazilian companies and investors while enabling them to monetise and develop a strategic asset for the future."

Meanwhile, Internacional Energias Renovaveis (IER) has signed a memorandum of understanding (MoU) with state Rio Grande do Norte to develop the 2.7 GW Ventos Potiguar offshore wind farm. IER will invest around $3.4 billion in five areas totalling 207 turbines. The facility may be used for green hydrogen production and it is about to be considered by the state's environmental agency Idema.

Shell, the largest private oil producer in Brazil, now says that it will invest $577 million over the next five years in renewable energy projects in the country, including solar and wind power plants and a natural gas fired generator.

Guilherme Perdigao, director of Renewables and Energy Solutions at Shell Brazil, said: "Brazil is a priority for Shell."

Ecuador seeks $1.9 billion in private power plant investment

Ecuador is looking for $1.9 billion in new investment from companies who will build and operate power generation plants and a new transmission system for the oil sector. New President Guillermo Lasso, wants the private sector to invest in oil as a strategic area.

"We ratify our openness to responsible investors," Energy Minister Juan Carlos Bermeo said while presenting the projects.

Ecuador is seeking companies to develop a new 400 MW natural gas based power plant and a 290 km transmission line to connect the nation's oil industry to the national grid. Those projects are expected to require $600 million and $386 million in investment, respectively.

It also wants to bring forward wind solar and biomass projects totalling 500 MW at an investment of around $875 million. The projects are expected to begin operating between 2024 and 2026.

The investment has been announced as state power company Celec tries to find options to replace power from hydropower plants in the Amazon region which have been affected by erosion. The region's Coca Codo Sinclair hydroelectric plant, supplies a third of the country's power and Celec has been trying to repair idle thermal power plants to provide backup power.

US offshore wind pipeline still growing

As Avangrid, Iberdrola's American subsidiary, closed financing of $2.3 billion dollars for construction of Vineyard Wind 1, an 800 MW offshore wind farm off the coast of Massachusetts, news came that the US offshore wind pipeline grew by 24 per cent over the previous year.

Vineyard, financed by a group of nine global banks and with a long-term power supply purchase agreement in place, will begin construction shortly and is now due in operation by 2023.

The Department of Energy's National Renewable Energy Laboratory (NREL) said recently that over 6.8 GW of new capacity was added to the pipeline in 2020. This includes five new wind energy areas in the New York Bight with a total capacity of 9.8 GW. Eight states have set offshore wind energy procurement goals, totalling 39 298 MW by 2040, and 15 projects are in permitting, the new report says.

But recently global players in the sector have warned that tariffs imposed on wind farm components could put a check on project development. Bill White, Head of Offshore Wind at Avangrid, part of Iberdrola, said: "We have to think carefully about how potentially protectionist impulses could inadvertently halt the progress of offshore wind."

Chile leads on virtual power plant as it adds demand-side flexibility

- Coal plants close in favour of low-carbon options
- New auction sees prices as low as $13/MWh

Janet Wood

Chile has become the site of South America's first 'virtual power plant' (VPP), after AI company Stem and Copec partnered with Chilquinta to bring together decentralised behind-the-meter (BTM) power generating sites to deliver resilience and backup power solutions by automatically aggregating and responding to spikes in electricity use.

"The energy storage market in South America represents a significant growth opportunity for Stem and our partner Copec," said John Carrington, Chief Executive Officer at Stem. "We are proud to have completed our first project under this partnership."

Chile has announced that it will not build new coal fired power plants and will align with the National Energy Policy 2050, which targets 70 per cent renewable energy electricity by 2030 and carbon neutrality by 2050. As a result the US' AES Corporation has signed an agreement with the government to retire over 1 GW of coal capacity in Chile by 2025 – around 20 per cent of the country's installed coal volume.

The country has one of the highest solar irradiances and potential for solar generation in the world, but its most recent project is Colbun SA 980 MW Horizonte wind farm in the Antofagasta region, which was recently given an environmental permit. The $700 million wind farm, funded by Colbun, will see construction begin in the second half of 2021 with operation two years later.

A recent auction for capacity in Chile saw Spain's Opdenergy Holding SA win a 15-year contract that will see it build wind and solar farms totalling over 600 MW. The Spanish power producer submitted offers for 819 GWh/year, and succeeded in placing the entire volume under contracts, it said.

The auction, which sought 2310 GWh/year, was open to all technologies, but in the end only wind, solar and storage projects were awarded 15-year power purchase agreements (PPAs). Some 29 bidders participated, with the bids as low as $13.32/MWh, with several bids in the $21-28 MWh range.

Within the new bidding law framework, CNE is responsible for designing, coordinating, and directing the public bidding process for this year. The objective of the bidding process is to help electricity distribution companies to have contracts for the long-term supply of electricity to their customers subject to price regulations.

Organisations merge as US steps up storage investment

There has been a shakeout in the US storage sector. The American Clean Power Association (ACP) and the US Energy Storage Association (ESA) will merge from 1 January 2022.

"This will enhance our ability to become a more forceful advocate for wind, solar, storage and transmission," said Heather Zichal, Chief Executive of ACP.

The merger comes as South Korean lithium-ion battery manufacturer LG Energy Solution has acquired US-based NEC Energy Solutions from NEC Corporation. LG ES will use the acquisition to grow its energy storage business in North America. The purchase also allows the company to establish itself as a one-stop energy storage system (ESS) solution provider that offers the full range of services.

In an early contract win, RWE Renewables has signed contracts with LG Energy Solution to provide an integrated battery energy storage system (BESS) co-located with US solar PV projects.

The BESS supply contract secures more than 800 MWh of energy storage capacity, deployed on over 200 MW of storage systems, and delivery of the systems is scheduled for the second half of 2022.

Commenting on the deal, Youngjoon Shin, SVP of ESS Business, LG Energy Solution, said: "We are extremely pleased to form the partnership with the RWE team to supply batteries for their two flagship projects in the world's fastest growing energy storage market."

Malaysia and Japan sign hydrogen MoU

- Petronas and Eneos to launch hydrogen supply chain study
- Companies will explore hydrogen production from petrochemical facilities initially

Syed Ali

A Memorandum of Understanding (MoU) has been signed between Malaysia's Petronas, through its subsidiary Petronas Gas & New Energy Sdn Bhd (PGNESB), and Japan's Eneos Corporation, which will help the two companies reach their net zero goals through the use of hydrogen.

The MoU will see the companies launch a technical-commercial joint-study of a hydrogen supply chain which includes hydrogen production and its transportation in methylcyclohexane (MCH) form, where hydrogen is converted from its original gaseous state into a liquid form to enable large volume deliveries.

Petronas and Eneos will also explore low carbon hydrogen production from Petronas' petrochemical facilities and in the future, green hydrogen produced by renewable energy.

The development of liquid organic hydrogen carrier (LOHC) technology such as MCH is gaining momentum due to its chemically stable nature that allows for long-term storage and long-distance transport. Moreover, the use of LOHC leverages on existing conventional oil and petrochemicals infrastructure, thus heavily reducing the need to develop new assets. This makes it a viable option for established energy players to implement.

"With emerging clean energy sources like hydrogen, innovation and collaboration with partners in technological development are key, as they contribute towards achieving cost competitiveness and scalability for wider use across businesses and industries," said Petronas Gas + New Energy Executive Vice President and Chief Executive Officer, Adnan Zainal Abidin.

In Malaysia, the development of a hydrogen-based economy is set to complement future growth as the country prepares to transition towards a low carbon economy. Petronas already produces low carbon hydrogen from its facilities and will soon explore the commercial production of green hydrogen. Petronas is well-poised to be a competitive hydrogen solutions provider due to its existing operations and expanding renewables portfolio.

Eneos has applied for funding from the Japanese government's Green Innovation Fund, which sponsors decarbonisation projects and initiatives. The company is working towards achieving its carbon neutral ambition via its Environmental Vision 2040.

Australia Offshore Electricity Infrastructure Bill "not up to scratch"

Australia has introduced its first offshore electricity legislation in parliament but the bill falls short in several areas, according to some experts.

The bill is designed to establish a regulatory framework for the offshore wind industry, paving the way for more than ten proposed projects. Academics from Macquarie University, however, have said "upon first reading one is left a little wanting".

In a written paper, Madeline Taylor, Senior Lecturer, Macquarie University and Tina Soliman Hunter, Professor of Energy and Natural Resources Law, Macquarie University claim the bill falls short due to several reasons.

"We find four reasons the bill isn't up to scratch yet, from its inadequate safety provisions to vague wording around Native Title rights and interests," they wrote.

Offshore wind is essential to help Australia cut its greenhouse gas emissions and create a sustainable and affordable electricity market.

The explanatory memorandum that accompanies the bill claims that if passed, the legislation will establish certainty that investors crave, potentially leading to billions of dollars worth of investment. Taylor and Hunter argue, however, that the bill as it stands does not go far enough.

"Upon closer examination of the bill, we find critical omissions compared to best practice in North Sea jurisdictions," they wrote. "To protect the environment, projects need to create a management plan that complies with requirements under the federal environment law. But this won't ensure marine life is unharmed by enormous, noisy turbines. The law is far too broad to deal with the unique requirements of offshore wind turbines, which Australian waters have never experienced before."

Secondly, the paper says that offshore energy project developers are prohibited from interfering with Native Title rights and interests. But the bill allows interference if it's "necessary" for the "reasonable exercise" of project rights and obligations.

Taylor and Hunter also pointed out that safety provisions under the bill are vague.

Finally, the academics say the bill contains no explicit community benefit schemes, unlike in Denmark where developers are obliged to offer at least 20 per cent of ownership shares to local citizens.

Australia's wind resources are among the world but a lack of legal framework has meant it is yet to commission its first offshore wind farm.

- The Australian Energy Market Operator (AEMO) said in a recent report that Australia's mainland National Electricity Market (NEM) states could have sufficient renewable energy resources available in 2025 to meet the cumulative power demand of consumers in certain periods.

South Korea to scale-up wind and solar

- Wind and solar production set to more than double
- New joint venture to build 1.4 GW floating wind project

Syed Ali

South Korea is set to more than double its solar and wind energy production facilities within four years as part of the government's new carbon neutrality policy.

In early September President Moon Jae-in reiterated the government's plan to increase the country's combined capacity of solar and wind energy production facilities, which reached 17.6 GW in 2020, to 42.7 GW by 2025.

President Moon underlined the need to achieve a big transition in the South Korea's economic structure and explained that achieving carbon neutrality is the goal of its Green New Deal initiative. He also said that driving carbon neutrality could provide growth opportunities for companies in the fields of batteries and hydrogen.

South Korea has been gradually accelerating its domestic renewables programme, while at the same time exploring overseas opportunities.

At the start of September a new joint venture called MunmuBaram was set up by Shell Overseas Investment (80 per cent) and CoensHexicon (20 per cent) to develop and operate a 1.4 GW floating wind project off the South Korean coast. The facility, which will cover an area of around 240 km^2, is currently at feasibility study stage. The multi-phase project is expected to generate up to 4.65TWh of electricity annually.

Meanwhile ODE, an international renewables engineering and project management company, part of the DORIS Group, announced that it has entered into a Memorandum of Understanding with Korean engineering company DongYang Engineering (DYE) to pursue offshore wind and other prospects across Korea and the global market.

ODE and DYE will collaborate across business development activities and the execution of engineering services including the joint-development of an offshore substation design specifically targeted to Korean offshore wind farms.

Jinho Paik, ODE's Korea Country Manager, commented: "This is a significant step in ODE's development in Korea. DYE has an established and respected presence in the Korean energy market; this memorandum will bring important opportunities to both companies."

David Robertson, Head of Renewables for ODE, added: "From our Seoul office, we are looking forward to drawing on our global technical expertise in offshore wind and energy transition whilst further expanding our experience in the wider APAC region."

India taps UK in effort to grow renewables

Syed Ali

The United Kingdom will invest $1.2 billion through public and private investments to support India's target of 450 GW of renewable energy by 2030.

Union Finance Minister Nirmala Sitharaman and UK Chancellor of the Exchequer Rishi Sunak also launched the Climate Finance Leader Initiative (CFLI) India Partnership to mobilise private capital into sustainable infrastructure in India, including solar, wind, and other green technologies.

The UN Special Envoy on Climate Ambition and Solutions, Michael Bloomberg, will chair the CFLI India Partnership, and several leading global financial institutions will lead the partnership.

As a part of the package, CDC Group, the UK's development finance institution and impact investor, will invest $1 billion in Indian green projects between 2022-2026. With this, CDC's existing investment portfolio in the Indian private sector stands at $1.99 billion.

Both governments will make a joint investment to support companies providing innovative green tech solutions and a $200 million private and multilateral investment into the joint UK-India Green Growth Equity Fund, which invests in the Indian renewable energy sector.

The announcement came as a new report warned that proposals for new coal plant in India amounting to 27 GW could potentially become superfluous to the overall country electricity requirements by 2030.

The report published by UK-based renewable think-tank Ember and Climate Risk Horizons said the current proposals could jeopardise the prospect of the country's ambitious renewable energy target of achieving 450 GW by 2030.

These surplus "zombie" plants are projected to lie idle or operate at uneconomic capacity factors due to surplus generation capacity in the system. Significantly, they require $33 billion of investment.

Even with a 5 per cent annual growth in power demand projection, the analysis shows that coal fired generation in FY 2030 will be lower than in FY 2020, as India achieves its renewable and other non-coal targets.

Furthermore, it says India can meet peak demand in FY 2030 even if it retires its old coal plants and stops building new coal beyond those under construction. By FY 2030, India will have a total firm capacity of about 346 GW in addition to 420 GW of variable renewables capacity to meet an estimated peak demand of 301 GW.

Denmark ready to support energy island and green hydrogen as it steps up offshore wind

- Legislature supports both investments
- Offshore wind developers offered more flexibility

Janet Wood

A tender will be launched next year for Denmark's planned 10 GW North Sea energy island hub, after terms for the project were recently confirmed by the country's legislators.

The new political agreement sets out significant parts of the framework for the upcoming tender, including terms, island construction and long-term ownership and cooperation on the energy island. It confirms a previous decision that the island will be owned by a company in which the state owns at least 50.1 per cent and one or more private companies own up to 49.9 per cent. The jointly owned company will manage the island.

Meanwhile, the Danish Energy Agency (DEA) has launched a new technology-neutral tender for renewable energy technologies, saying there is an 'open door process' for offshore wind. Applications close in October.

The open-door process allows developers to compete for a location, instead of competing on a specific location and at a specific size. It allows project developers to submit an unsolicited application for feasibility studies.

The last time the DEA held a technology-neutral tender was in 2019. This year the support model has changed from a supplement to the market price to a Contract for Difference (CfD), where the state assumes a larger share of long-term risk and developers receive a fixed price contract.

Denmark's ambitious offshore plans have sparked interest from the nascent green hydrogen production industry. Swiss energy company H2 Energy Europe has recently announced plans to use electricity from offshore wind farms in the North Sea to power a 1 GW green hydrogen production complex in Denmark.

The Danish government said it will partner with the Swiss firm to accelerate the construction of hydrogen pipelines. H2 Energy Europe has bought an 11 Ha site near Esbjerg for the offshore project that could be running in 2024. The green hydrogen output will be used for trucks and other heavy land-based transport and refuelling stations.

"Esbjerg has optimal conditions in relation to Power-to-X and green hydrogen production. First and foremost, there is a geographical advantage due to its location relative to North Sea offshore wind, just as the area has a good location in terms of export opportunities to large industrial areas in Germany and Northern Europe, where a major share of production is expected to be hydrogen-based in the future," said Clifford zur Nieden, Director, H2 Energy Europe.

Greece set to replace coal with offshore wind and solar with hydrogen

Greece has 7 GW of onshore wind power but currently has no offshore wind projects. That could change soon, after the government completed a new legislative framework. The framework is expected to focus on floating technologies because of the seabed depth in the area.

The Greek government is expected to offer specific areas for development and use competitive tenders to allocate them, according to local reports.

The government's move follows an attempt by wind industry group Eleatan to initiate work on offshore wind by publishing a draft tender and a proposal for the industry to hold auctions for contracts similar to the Contracts for Difference.

An offshore wind programme could complement a new initiative by US company Advent Technologies with the White Dragon consortium of companies, which would replace Greece's largest coal fired plants with solar energy parks, green hydrogen and fuel cell heat and power production. The White Dragon and Green HiPo projects were recently approved in a joint decision by Greece's Development and Investments Minister Adonis Georgiadis, and Environment, Energy, and Climate Change Minister Kostas Skrekas.

Advent Chairman and Chief Executive Vasilis Gregoriou said: "We are thrilled with this news that the White Dragon and Green HiPo projects have been approved by the Greek government in the first wave of the IPCEI projects. This decision demonstrates the commitment by Greece and the EU to rapidly decarbonise power production."

Poland's transition attracts investment

Real estate investment company Kajima Europe has chosen Poland to launch into the renewables sector. It has joined Griffin Real Estate in a joint venture to finance and develop renewables projects and the JV has acquired a 72 per cent stake in Polish clean energy developer PAD-RES.

The companies plan to focus on PAD-RES's solar and wind project pipeline in 2021 – 2025, and acquire new projects and greenfield opportunities.

Chris Gill, Projects & Investment Director at Kajima, said: "Renewable energy is a nascent sector in Poland, and we are hugely excited to be working with this partnership and to be among the first movers in what is set to be a key growth area for the country and the whole of the CEE region."

Meanwhile GE has expanded a long-standing investment in Poland with a Memorandum of Understanding between GE Renewable Energy and PKN ORLEN on offshore wind. GE has supplied 300 onshore wind turbines in the country.

Jérôme Pécresse, Chief Executive, GE Renewable Energy, said: "The agreement that we are signing today charts a path to take pragmatic steps that can take full advantage of Poland's substantial offshore wind resources to create win-win outcomes in terms of the environment and economic development."

UK's volatile winter power season set to be a catalyst for industry change

- First use of coal station this year
- New power stations vie with demand side to cover variability

Janet Wood

New debates have arisen around the GB energy mix as NGESO called on coal to help manage a more volatile system. Debate was also prompted by a recent spike in gas prices that has hit small suppliers (*see page 1*).

National Grid ESO's decision to call on two coal fired units at West Burton A – the first time coal has been used this year – and unseasonal low wind speeds were the signals for electricity generation sources to remind government of what they could offer. Tom Greatrex, Chief Executive of the Nuclear Industry Association said: "This underscores the urgency of investing in new nuclear capacity, to secure reliable, always-on, emissions-free power, alongside other zero-carbon sources."

Other groups placed more emphasis on storage. ILI Group recently, has sought planning permission for a new 600 MW hydro pumped storage project to follow its first 'Red John' project at Loch Ness, which won planning consent in June.

A fire at one of the UK's interconnectors with France, and consequent loss of 1 GW of capacity for the winter, also raised prices in the short term. But overall the interconnector fleet is growing and ElecLink, which will increase Great Britain's interconnection with France alone to 4 GW, has already entered the test phase.

Phil Hewitt, director of EnAppSys, said: "At Christmas GB will have 8.4 GW of installed cables from other markets, meaning that around 25 per cent of the electricity we need could come from overseas."

An alternative approach was illustrated by a new partnership between intelligent energy platform Kaluza and aggregator Flexitricity. The collaboration will allow the aggregation of domestic smart chargers, vehicle-to-grid chargers and batteries to be bid into the Balancing Market. This type of demand response is thought to be the long-term enabler of a more responsive market with less need for 'back-up' assets and more flexibility and lower costs for consumers and suppliers.

Such flexibility options are among the new solutions regulator Ofgem hopes networks will bring forward in opening a new Strategic Innovation Fund, part of Ofgem's RII02 price controls. Its initial targets are whole system integration, data and digitalisation, heat, and transport. Some £450 million will initially become available over the next five years through the fund, with the option to increase in response to need and if companies bring forward strong plans.

Dan Clarke, Head of Innovation at Energy Networks said: "Ofgem's £45 million Strategic Innovation Fund will help keep Britain at forefront of the global race to Net Zero."

UK aims to take wind decommissioning lead

The UK should see the wind sector as a huge opportunity to become a global leader in decommissioning and especially wind turbine blade recycling, according to a new report from the Energy Transition Alliance, a collaboration between the Net Zero Technology Centre and Offshore Renewable Energy (ORE) Catapult.

The Energy Transition Alliance report came as Zero Waste Scotland published its own analysis of the need to decommission 5500 wind turbines in Scotland by 2050, which it said was an "opportunity to grow Scotland's remanufacturing sector in line with NetZero ambitions."

Scotland's Minister for Green Skills, Circular Economy and Biodiversity, Lorna Slater said: "There is a huge circular economy opportunity in Scotland's already thriving renewable energy sector."

Wind turbine blades, carbon or glass fibres in a resin matrix, are challenging to reclaim and reprocess. The Energy Transition Alliance report estimated that 14 000 wind turbine blades will reach the end of their usable life within the next three years and by 2023 up to 50 000 t of composite material could be recovered and recycled for a variety of re-use applications.

Lorna Bennet, Project Lead at ORE Catapult said: "The innovation challenge to create a circular economy within the wind industry is vast, but hugely exciting."

IAEA upbeat about prospects for nuclear

For the first time since the Fukushima accident a decade ago, the International Atomic Energy Agency has revised up its projections for nuclear power capacity. **Nadia Weekes** reports

The International Atomic Energy Agency (IAEA) has published an upbeat outlook for nuclear power generation as the world charts its move away from fossil fuels to fight climate change.

In the high-case scenario of its new outlook, the 41st edition of 'Energy, Electricity and Nuclear Power Estimates', the IAEA expects global nuclear generating capacity to double to 792 GW by 2050. The estimate is 10 per cent higher than the previous year's high-case projection of 715 GW by 2050.

Although many countries are considering using nuclear power to boost reliable and carbon-free energy production, achieving the IAEA's high-case scenario would require significant actions, including innovative technologies.

Under the low-case projections, world nuclear capacity by 2050 would remain essentially the same as now, at 392 GW.

"The new IAEA projections show that nuclear power will continue to play an indispensable role in low carbon energy production," IAEA Director General Rafael Mariano Grossi said.

Commitments to reduce carbon emissions under the 2015 Paris Agreement could support nuclear power development. IAEA projections are close to the International Energy Agency's (IEA's) in its recent 'Net Zero by 2050 – A Roadmap for the Global Energy Sector' publication.

With global electricity generation expected to double over the next three decades, nuclear power generating capacity would need to expand significantly to maintain its current share of the mix.

Under the IAEA's high-case scenario, nuclear energy could represent 12 per cent of global electricity in 2050, up from 10 per cent in 2020. In the low-case scenario, nuclear power's share of total electricity generation would be 6 per cent.

New low carbon technologies such as nuclear hydrogen production or small and advanced reactors are being explored, alongside ageing management programmes. Uncertainty remains regarding the replacement of older reactors, particularly in Europe and North America.

In a separate document, the 'World Nuclear Association Performance Report 2021', nuclear reactors were found to have supplied 2553 TWh of electricity in 2020, down from 2657 TWh in 2019.

The decrease was strongly influenced by the drop in electricity demand caused by the Covid-19 pandemic, and the fact that nuclear reactors were providing load-following support to the growing amount of variable renewable generation.

At the end of 2020 there were 441 operable nuclear reactors. Their combined capacity of 392 GW has remained stable for the last three years, with new capacity additions matching nuclear capacity being shut down.

"It is vital that nuclear generation bounces back further and faster, helping displace fossil fuels, thus avoiding a sharp rise in greenhouse gas emissions," said Sama Bilbao y León, Director General, World Nuclear Association.

Russian auction allocates over 2.7 GW of renewables capacity

Russia's wholesale electricity market administrator, ATS JSC, has allocated more than 2.7 GW of capacity in the eighth round of the country's auction programme for large-scale renewable energy projects.

Wind power was awarded 1851 MW, with bids ranging from RUB 1717/MWh ($23.56/MWh) to RUB 5100/MWh. Solar photovoltaic (PV) was allocated 775 MW at prices of RUB 4327-6405 per MWh. There were also three successful bids for 96 MW of hydroelectric power at RUB 7682-7946 per MWh.

Finnish utility Fortum Oyj and Russian nanotechnology company Rusnano won the right to install up to 1.6 GW of wind turbine capacity.

The awarded projects, due online in 2025-27, will be covered by annual capacity supply agreements for a total remuneration of RUB 16.9-23.8 billion. The contracts will be valid for 15 years at an average tariff of RUB 2600-4200 per MWh.

In a separate development, Russian Energy Minister Nikolai Shulginov and Japanese Economy, Trade and Industry Minister Hiroshi Kajiyama have signed a statement of intent on cooperation in the area of sustainable energy.

Under the agreement, the two countries will cooperate on projects in the area of energy and industry, specifically production and supplies of Russian LNG and gas condensate, renewable energy sources, production of hydrogen, gas chemicals and ammonia. The ministers said they will also establish an exchange of technologies in the area of energy reliability and safety.

"We attach great importance to cooperation in the area of hydrogen energy in the context of the need to jointly promote the interests of Russian and Japanese energy companies on the global market, establishing an effective exchange of information and the joint search for points of growth to achieve global technological leadership," Shulginov said.

Untapped rooftop solar market has "massive" potential

- Up to 200 million solar generation sites generating power by 2050
- Policy and tariff design critical to unlock decarbonisation benefits

Nadia Weekes

Customer-sited solar is a major untapped opportunity that could see 167 million households and 23 million businesses worldwide hosting their own clean power generation by 2050, according to a joint report by research firm BloombergNEF (BNEF) and Schneider Electric.

The rooftop solar market has the potential to exceed 2000 GW of solar and 1000 GWh of energy storage by 2050, the report finds, but will need adequate policy and tariff design to enable deployments at scale.

The report 'Realising the Potential of Customer-Sited Solar' finds that rapidly falling costs of solar technology have already made it economical for homes and businesses to generate their own power in some markets.

In Australia, where the payback period for households investing in solar has been less than 10 years since 2013, adoption has already taken off, with more than 2.5 GW of residential solar added in 2020 alone.

"Customer-sited solar is a huge opportunity that's often completely overlooked," said Vincent Petit, SVP of Global Strategy Prospective & External Affairs at Schneider Electric. "This is vital for decarbonising the power sector and offers huge additional consumer benefits. It's time to embrace this transformation."

The report finds that solar adoption mainly occurs when there is an economic case for investing in the technology, usually in the form of high internal rates of return (IRR) or short payback periods. In regions where the economics have not yet reached such tipping points, targeted incentives are needed to create favourable market conditions.

At the early stage of market development, policy design should account for the fact that solar costs will continue to fall over time, and moderate support to reflect these changing dynamics and avoid an unsustainable boom, the report recommends.

The economic case for adding solar during construction of new buildings is particularly strong, as costs will be reduced while maintaining all the benefits, says the report.

In California, where the economic case for adding residential solar on existing homes is already good at 20 per cent IRR, the report estimates this figure to be as high as 40 per cent IRR when solar is added at the point of construction.

As solar markets develop and mature, policymakers and regulators must shift their emphasis toward unlocking flexibility by encouraging the adoption of energy storage. This allows excess solar energy production during the day to be stored for use during evening hours.

Flexibility would unlock a much higher penetration of solar, according to Yayoi Sekine, BNEF's Head of Decentralised Energy. "The most obvious form of flexibility is batteries, but energy storage will come in many forms, including shifting demand and using electric vehicles."

TotalEnergies to invest $27 billion in Iraq

French energy group TotalEnergies has signed contracts worth $27 billion for the production and exploitation of gas, oil and solar energy in Iraq.

"This is the biggest investment by a western company in Iraq," said oil minister Ihsan Abdul Jaber. "Setting up these projects is the challenge we face now." Iraq has been looking for foreign investors to boost its oil and gas output as it struggles to alleviate chronic electricity failures.

As the second-largest oil producing country in the Opec, Iraq receives more than 90 per cent of its revenues from crude sales. The sharp fall in oil demand caused by the Covid-19 pandemic hit it hard. The country's gross domestic product shrank 11 per cent in 2020, according to the IMF.

The contract with TotalEnergies is understood to cover four projects over 25 years. Two of them are for oil, one for gas and one is for the construction of a solar power plant.

Iraq has also signed a major deal with Chinese state-owned Power Construction Corporation of China to build solar power plants with a capacity of 2000 MW.

TotalEnergies recently renamed itself TotalEnergies from Total to symbolise its diversification into cleaner fuels. It is also the first oil major to end its membership of the American Petroleum Institute.

However, the company says it will continue to pursue its fossil fuel businesses to help generate the cash for green investments. The group expects its oil production to remain stable and aims to expand its gas business.

Paving the way towards a decarbonised grid

The power grid is central to the energy transition and cutting global greenhouse gas emissions. Siemens Energy discusses how the use of technologies such as HVDC transmission enables the integration of renewables on a large scale, and outlines its plans to develop a high voltage equipment portfolio that emits zero greenhouse gases. **Junior Isles**

The recent report on climate change published by the Intergovernmental Panel on Climate Change (IPCC) gives cause for great concern. Prepared by 234 scientists from 66 countries, the report highlights that human influence has warmed the climate at a rate that is unprecedented in at least the last 2000 years.

Worryingly, it shows that emissions of greenhouse gases from human activities are responsible for approximately 1.1°C of warming since 1850-1900 and finds that, averaged over the next 20 years, global temperature is expected to reach or exceed 1.5°C of warming.

As the COP26 climate talks approach, the report is a stark reminder of the need to accelerate global efforts to shift to a cleaner, greener economy.

But while much of the public focus is often on generation and the uptake of wind and solar, the grid that underpins the entire electricity system is equally important – a fact that is being increasingly recognised, partly due to the often remote location of renewable generating sources from the point of consumption.

Commenting on the importance of the grid in combatting climate change, Hauke Jürgensen, Senior Vice President High Voltage Grids, Siemens Energy, said: "It's one thing to build wind and solar plants but they are typically in remote locations – e.g. solar in a desert, wind power offshore at sea. You need the grid to connect those plants; it goes hand-in-hand. So increasing just the generation from renewables alone will not solve the problem. The exact same focus has to be on the transmission grid."

Siemens Energy has certainly been playing its part in developing and deploying transmission system equipment to enable the green transition, while reducing the global warming impact of that equipment.

Jürgensen added: "Replacing fossil fuelled power plants and rotating mass in the grid with renewables also means you lose a lot of inertia and therefore grid stability. This means we have also been installing, and will continue to provide, equipment such as FACTS (Flexible AC Transmission System) products, synchronous condensers, Statcoms, SVCs, etc. to maintain stability."

The growth in renewables generation is clearly being reflected in terms of transmission system market growth and investment.

"In the past decades there were only a handful – maybe six to eight large HVDC connections planned to be awarded per year. Today, that's probably more like the number we see in Europe alone, so the market is really expanding," said Jürgensen. "If you look at UK offshore wind and the ambitious growth plans of all European TSOs (Transmission System Operators), including future artificial power islands, it's quite significant. And some of these projects have been brought forward from 2033/35 to 2030. The EU plans to spend about €80 billion by 2030 on the transmission grid; the funds are available so it's just a question of how fast we can implement the projects. Meanwhile in the US, the new Administration has ambitious plans to build-out renewables, especially offshore wind on the east coast as well."

Building new networks and upgrading existing circuits to demanding deadlines is, however, not without its challenges – the main one being approval processes.

"There are constraints around resources – particularly engineering resources – but this is solvable. There are a lot of young people wanting to work in the field and do something for climate change," noted Jürgensen. "But when we talk to the TSOs, their biggest challenge is political approval processes."

He cited Germany as an example, where the company is currently building its seventh offshore HVDC connection platform for TenneT in the North Sea and high voltage connectors to transport wind power from the North Sea to the industrial south of the country.

Jürgensen: The focus is often on generation from renewables but the exact same focus has to be on the transmission grid

"To make it all possible, we need HV connectors or corridors to transmit the power from the north to the load centres in the south. Siemens Energy recently won awards for the converter stations for two of these connectors in the SuedOstLink and SuedLink electricity highway.

"The locations for the converter stations that we will build are finalised, but there are still uncertainties regarding the detailed cable routes. Everyone wants to have electricity… but 'not in my backyard'. And it's not just Germany; it's the same across Europe and places like North America, where there is limited space on the east coast, for example, for AC connections."

According to Jürgensen, the challenges facing transmission grids depend on the region or country, and this is driving technology trends. Currently projects take the form of point-to-point HVDC interconnectors between countries, or national high voltage corridors that could be DC or AC links. But this is changing.

Jürgensen explained: "These connectors are great; they enable energy trading, improve network stability and better load management but there's a trend towards meshed DC grids. So we will work on multi-terminal solutions, more than we have done in the past."

Siemens Energy is currently building Ultranet, the first multi-terminal application in Germany – a new 2 GW, 340 km, HVDC link between North Rhine-Westphalia and Baden-Württemberg that is targeted for completion in 2024. The project, which is being built for Amprion and TransnetBW, allows the transmission of wind power from the north to the south, solar power from the south to the west and conventionally generated power from the west to the south.

Such developments will see Siemens Energy also work on "multi-vendor approaches". Jürgensen said: "At the moment systems from different manufacturers don't have to talk to each other because we only have point-to-point connections but in the future with multi-terminal connections with, say, three or more converter stations connected to each other, you will have to connect systems from different suppliers. This will require new elements in the grid code, new software solutions, new control and protection solutions, etc. We are currently working with the various partners on these, together with institutions such as Cigré."

He adds that TSOs are also looking to use "multi-purpose" interconnections to not only trade energy, but to also increase efficiency and use cases. "This would mean that an interconnector between the UK and France could, for example, trade wind power in both directions and therefore increase the possibilities for energy trading," said Jürgensen.

The planned energy hubs in the North Sea and the Baltic are a good example, where islands that integrate wind energy with hydrogen production will be made possible with multi-terminal, multi-purpose connectors.

Looking at challenges and trends elsewhere, Jürgensen notes that in Asia in countries with ample coastlines, such as Vietnam, China, Japan and India, offshore wind could be a driver.

While some of these markets will largely use domestic suppliers, Jürgensen believes India offers opportunities for international players like Siemens Energy. The country has set an ambitious target of 5 GW of offshore wind by 2022 and 30 GW by 2030 and will need HVDC connections as these wind projects materialise.

Borwin 3: Siemens Energy is currently building its seventh offshore HVDC connection platform for TenneT in the North Sea

More notably, however, India has now begun using the technology to help improve power quality and grid stability. In March this year, it connected its first HVDC link featuring voltage-sourced converter (VSC) and DC-XLPE cable technology.

The 2 GW transmission system consists of two converter stations supplied by Siemens Energy for the ±320 kV HVDC system, which are connected via two links comprising a DC-XLPE cable and overhead transmission line. The link enables power exchange between Pugalur in the southern state of Tamil Nadu and Trichur in Kerala State in southwest India and supports transmission operator Power Grid Corporation of India (PGCIL) to counter power deficits in India's southern region and improve grid stability.

Not so far east, power from shore is expected to drive the call for HVDC technology in the Middle East for companies like ADNOC and Scandinavian players such as Equinor.

"To reduce emissions, it can make much more sense to transmit electricity from onshore power stations to power the oil platforms rather than using diesel engines on the platform," said Jürgensen.

Just last month [September], Siemens Energy received a contract from Aker Solutions to supply the complete packages for the electrical transmission, distribution, and power management system for Equinor's Troll West electrification project in the North Sea. A key objective of the project is to reduce NO_x and CO_2 emissions by replacing existing gas turbine-driven generators and compressors on the Troll B and C facilities with power from shore.

According to Equinor, reducing the power from the gas turbines on the Troll facilities will reduce annual carbon emissions by approximately 500 000 tonnes – an amount equivalent to about 1 per cent of all emissions from Norway. In addition, NO_x emissions from the field will be reduced by an estimated 1700 tonnes per year.

Looking at future developments and needs for HVDC technology, Jürgensen cited recent near blackouts and issues in the European grid, noting that interconnectors also play a role in achieving grid stability.

"We are still working on shortening the fault clearance time, so they can contribute to avoiding blackouts. And with the possibility to flexibly and quickly adjust the transmitted power in either direction, which you can only do with DC, they can play a big role in securing grid stability when there's a danger of a blackout. So we are also working to improve the control and protection to avoid blackouts. On the DC side, these are the main things in addition to the multi-terminal applications and DC meshed grids."

Using HVDC to facilitate the integration of wind and solar, while maintaining grid reliability and stability is crucial. But with the increasing pressure to achieve zero emissions, Siemens Energy is determined to eliminate greenhouse gas emissions right across its high voltage transmission equipment portfolio.

Ulf Katschinski, Senior Vice President, High Voltage Switching Products & Systems, Siemens Energy, explained: "There is a growing focus on the transmission grid because for switchgear in high voltage transmission grids, the whole industry is based on the use of a special insulation gas. Gas insulated circuit breakers, instrument transformers and, for more compact applications, complete gas insulated switchgear including disconnector and earthing switches, all use sulphur hexafluoride (SF_6). But although this is the ideal gas for insulating high voltages and interrupting fault currents, it's an extremely potent greenhouse gas. It has 23 500 times the global warming potential of CO_2."

Indeed fluorinated, or F-gases, such as SF_6, have come under the microscope of the EU. Under the current F-gas Regulation, in force since 2014, the EU is limiting the total amount of the most potent F-gases that can be sold in the EU from 2014 onwards and steadily phasing them out with each revision. Currently the next revision is in progress.

The EU's objective was clearly communicated in a stakeholder meeting May 2021 to meet the ambition of the EU Green Deal. The main objective is "prohibiting F-gases in products or equipment, where these gases are no longer needed" and more comprehensive monitoring for all F-gases.

In line with this EU drive and its own commitment to tackling climate change, Siemens Energy has launched what it calls its 'Blue portfolio'. The technology is available for gas-insulated switchgear (GIS), circuit breakers and instrument transformers all with absolutely zero CO_2 equivalent emissions over the lifetime of the equipment.

Explaining the technology, Katschinski said: "Unfortunately, there is no gas that insulates high voltages and interrupts fault currents as efficiently as SF_6. So our solution is to replace SF_6 in the switchgear tanks with clean air for the [high voltage] insulation function and vacuum interrupters for the arc extinguishing. So there will be no F-gases at all in our grid equipment."

NemoLink converter station: HVDC is crucial to facilitate the integration of wind while maintaining grid reliability and stability

Katschinski: Our solution is to replace SF_6 in the switchgear tanks with clean air

The move to eliminate SF_6 is spreading among a number of major equipment manufacturers, with some using clean air with zero global warming potential (GWP) and others opting for different F-gas mixtures with a GWP still above zero. Siemens Energy believes, however, that when taking the serious climate situation into consideration, zero greenhouse gas emissions has to be the goal to ensure CO_2 neutrality.

"Some are replacing SF_6 with other fluorinated gases that are better than SF_6 in terms of global warming potential but are still worse than natural clean air," Katschinski noted. "Our approach is zero global warming potential; we believe this is the only long-term alternative. It is essential to save our planet. Clean air as a natural gas and vacuum switching technology has zero toxicity, zero impact on health and the environment. It offers highest switching capability without degradation and is completely maintenance free. Another advantage is that it can be used in places that experience very low temperatures in winter. In places like Canada and Russia where you can get temperatures of -60°C, you can use SF_6 or clean air, but other F-gases are not suitable."

Clean air is a form of processed or purified air, where the humidity is removed along with some noble gases. "Humidity and the presence of noble gases reduce voltage withstand capability," noted Katschinski. "Since the voltage withstand capability is not as good as SF_6, you need a larger volume of clean air to handle the same voltage levels.

He said, however that it is possible to compensate for the size increase. With innovative technologies like digital low-power instrument transformers, the switchgear can be similar to the F-gas-insulated version with conventional instrument transformers.

"By replacing some of the conventional switchgear components with new digital technology, we can even reduce the size of the switchgear compared to conventional switchgear. The overall functionality of the switchgear is the same but some of the functions, i.e. current and voltage measurements are performed by digital devices instead of inductive transformers."

Siemens Energy has been working on its Blue technology for a number of years, initially focusing on low voltage levels, i.e. 72.5 kV. "The basic research on the vacuum interrupters took a pretty long time. They have been used for decades in the medium voltages," said Katschinski. "Within the last few years we introduced products with vacuum interrupters for voltage levels of 72.5 kV and higher. The technology is now mature up to 170 kV."

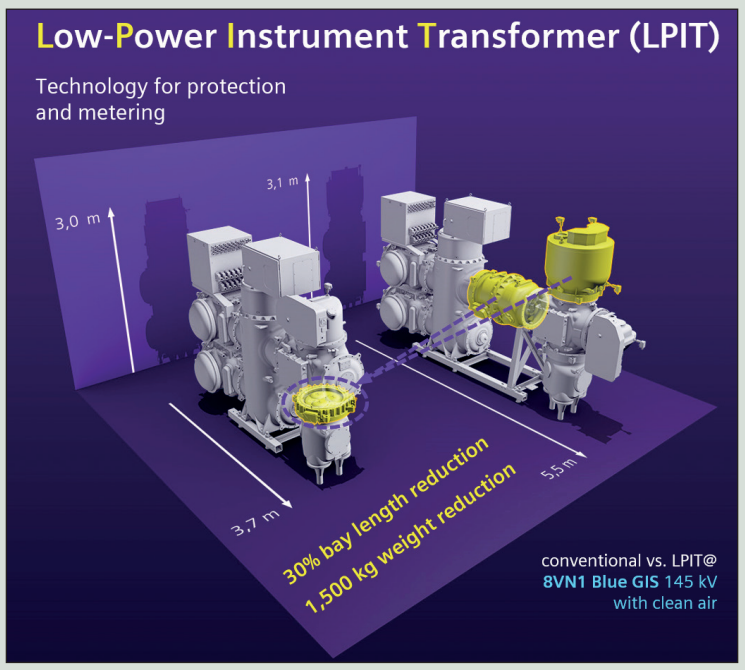
The technology is currently being rolled out across Siemens Energy's entire HV switching equipment portfolio up to the highest transmission level of 420 kV. "In urban areas, where distances are shorter, say 10-100 km, voltages of about 110 kV are used but longer distances need higher voltage to transmit the energy. For long distance transmission, voltages of up to 420 kV or 550 kV are typically used," said Katschinski.

"This means we have to develop products for different applications, voltage levels and according to different product standards. For example, in Europe all equipment is designed according to IEC standards, while in some other regions such as North America, the standard is IEEE. This means we have to replace a family of products."

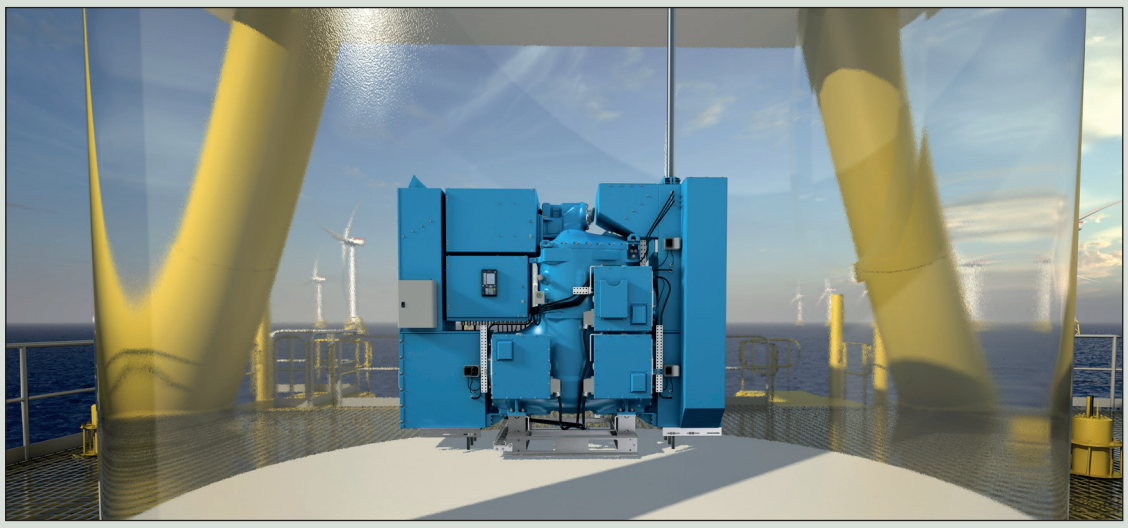
SF_6-based equipment operating at lower voltage is being replaced first, as products are already available up to 145 kV for different standards and various applications. Such applications include indoor gas insulated switchgear (GIS) and outdoor air insulated switchgear (AIS) equipment.

"We already have more than 6 million operating hours for this equipment. Air insulated substations using clean air at 145 kV have been in the field since December 2017 and the first Blue GIS for 145 kV was energised already in April 2020," said Katschinski.

The company also emphasized that switchgear with Blue technology are already being installed in wind towers. Siemens Energy sees it as a great opportunity to make a significant



With innovative technologies like digital low-power instrument transformers, the switchgear can be built even smaller than F-gas-insulated with conventional instrument transformers



Blue technology is well suited for offshore wind towers. Unlike SF_6 and other F-gases no special equipment is required on the towers to prepare clean air for use in switchgear

contribution to reducing CO_2 emissions not only in terms of power generation but also transmission.

"Big offshore wind farms currently use 72.5 kV. So we developed switchgear especially for wind tower application, and first installation started in 2017. This has a lot of advantages when operating offshore. Special equipment is required on the towers to prepare SF_6 and other F-gases for the switchgear. But with clean air it is quite simple. We have already sold more than 900 of such switchgear for wind towers," said Katschinski.

But going to higher voltages has a few challenges.

Katschinski explained: "It is known that the dielectric strength of the vacuum medium is considerably higher than that of SF_6. Vacuum switches have a very high mechanical reliability and compared to SF_6 switchgear, a longer electrical life and therefore allow significantly higher switching operations.

"Another advantage is that no toxic decomposition products occur for humans or the environment. On the other hand, there are other challenges compared to SF_6 technology. The dielectric strength between the contacts does not increase proportionally to a larger contact distance and is determined not only by the design but also by the production processes. On one hand, from today's point of view, for voltages above 245 kV, two vacuum tubes have to be connected in series for economical operation. On the other hand, the production processes for higher voltages have to be realised with corresponding manufacturing and testing equipment for larger designs."

Looking at the voltage roadmap, Siemens Energy says it is working on switchgear with a rated voltage of 245 kV. The task is to develop active components such as circuit breakers and vacuum interrupters.

"But as an interim solution the passive components – those that are not active in interrupting the current – such as bus ducts that only carry current, are already available at up to 420 kV," said Katschinski. "Some customers are already asking for clean air to be used in place of SF_6 for passive components. By doing this, they can reduce the use of harmful SF_6 already by about 60 per cent."

Siemens Energy notes that when aiming for a zero emissions grid, it is important to take a look at the products' effects on the climate over its complete life cycle taking the impacts of electricity losses in the factory, transportation, material and gas production, recycling at the products end-of-life and many other factors into consideration.

"In the end, the global warming potential of the products over the complete life cycle strongly depend on the electricity mix. In a completely CO_2-neutral economy, the global warming potential of Siemens Energy's Blue switchgear will be zero over its complete life cycle," said Katschinski.

In Berlin, where Siemens Energy switchgear factory is powered 100 per cent by renewable energy, the company produces its 145 kV F-gas-free switchgear, with a life cycle global warming potential reduced by more than three-quarters in comparison with the F-gas-insulated version.

Apart from the number one priority of bringing the global warming potential of their operations to zero, the other key concern for its customers going forward is reducing life cycle costs.

Katschinski said: "This was always a focus of our development because clean air is really easy to handle, with no preparation needed as with F-gases. Our customers have to report on F-gas because it is harmful to the environment. They have to report how much they consume to the authorities, the leakage, etc. Equipment with F-gases has to be checked frequently, so there is a lot of work that has to be done over its lifetime. All of this is not necessary with our clean air equipment. Therefore, the life cycle costs is much lower than with SF_6 and other F-gas solutions.

"Further, whereas gas mixtures degrade over time, vacuum switching technology enables a large number of switching processes with no wear to the contacts, making it almost maintenance-free."

Although Siemens Energy's customers continue to push for low cost, zero emissions products, it will be some time before equipment is available at all voltage levels.

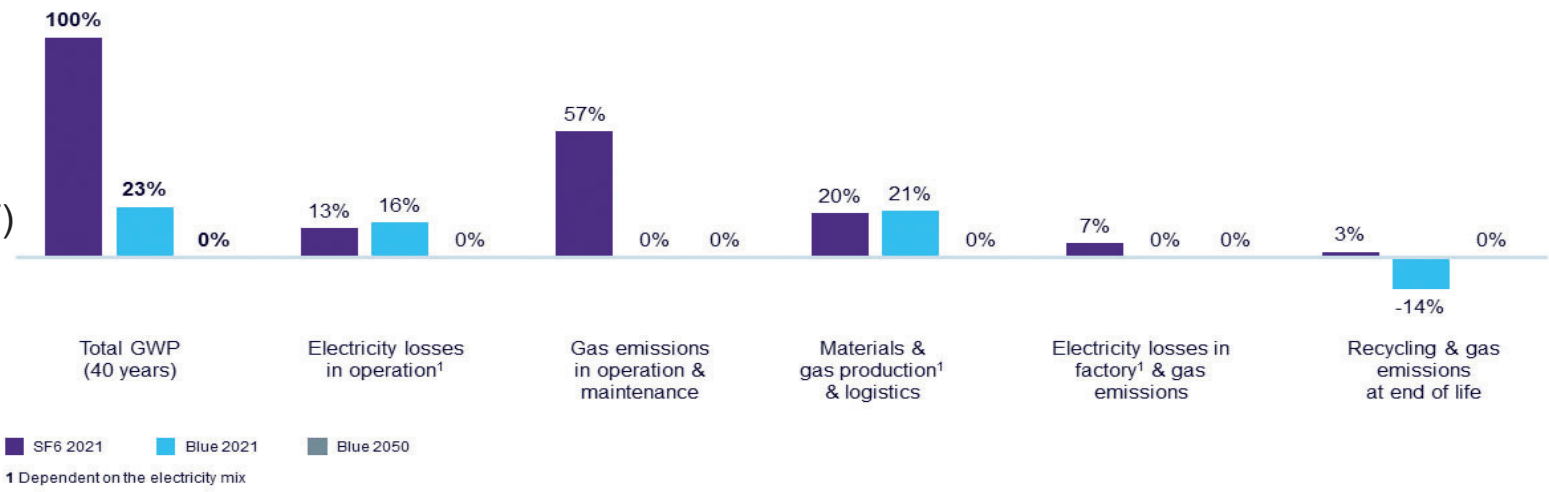
"Customers are asking for solutions," said Katschinski. "The big transmission system operators in Europe, especially, are all approaching us for equipment that has zero global warming potential, is environmentally friendly and has reasonable life cycle costs. But they recognise it will take time, as do EU regulators. The ongoing discussion by the regulators will see the restriction in the use of SF_6 and maybe even its ban after 2028. So everyone has to get prepared, and transmission system operators are therefore pushing for solutions for all voltage levels."

With work in progress on 245 kV, he believes products will be available in 2-3 years, and estimates it will take 6-8 years to have the complete portfolio of products for all applications and standards at all the necessary voltage levels.

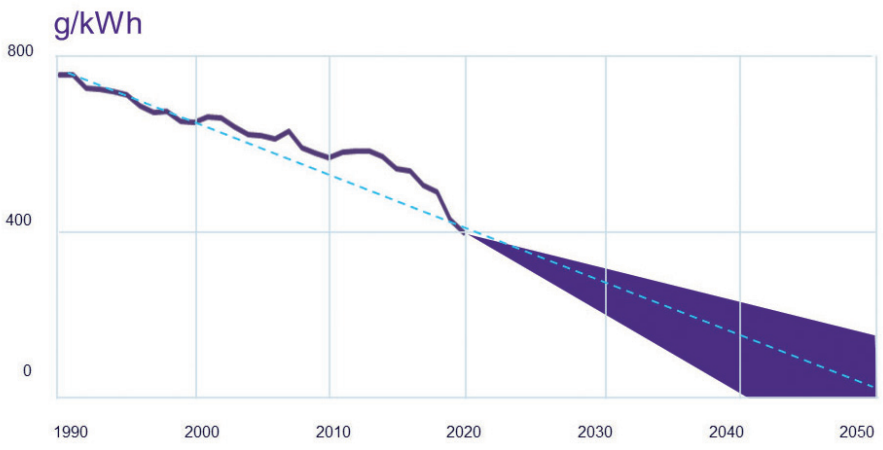
The path to zero emissions is a long and challenging road but Siemens Energy believes that it has the technology to help asset owners on their journey to what it calls "Day Zero" – where transmission systems not only have zero global warming impact, but are central to an energy system that is dominated by renewables.

Life cycle assessment (LCA) according to ISO 14040

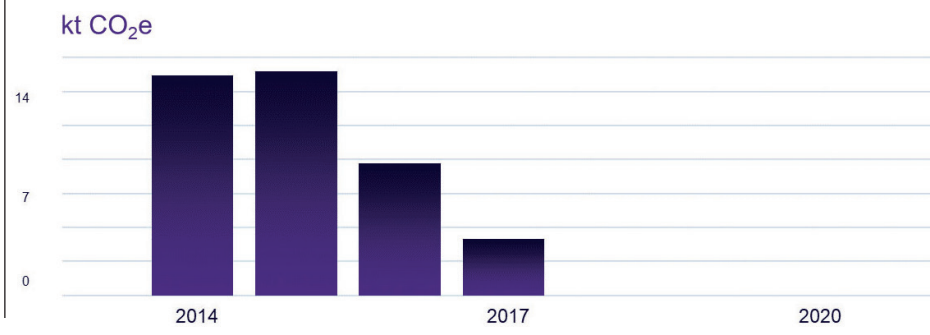
LCA carbon footprint for a 145 kV GIS example (conventional IT)



Electricity CO_2 impact, Germany example. Reduction by use of more renewables



Electricity impact for switchgear factory, Berlin



It’s Day Zero for Bergen Port

Cruise ships used to power up in the harbour using their diesel engines. Now, thanks to BKK Nett and Blue switchgear technology from Siemens Energy, they use only clean power. Zero greenhouse gas emissions, zero F-gases and zero health impact. It’s their Day Zero. Let’s plan yours.

LET’S MAKE TOMORROW DIFFERENT TODAY

siemens-energy.com/blue

Global alliances formed ahead of COP26

- New global alliance will ensure sustainable renewables
- Investment advisory firms join forces to drive net zero

Junior Isles

A group of global leaders from across the renewable energy value chain and the sector's innovation ecosystem have launched a new organisation to ensure renewables are wholly sustainable and lead a just transition away from fossil fuels.

Known as 'The Global Alliance for Sustainable Energy', the organisation brings together several utility companies from diverse geographies, major equipment manufacturers in the wind power and solar PV supply chains, as well as sector associations and innovation partners.

The 17 founding alliance members are 3M, Adani Green Energy Ltd., EDP, Eletrobras, Enel Green Power, Global Solar Council, Global Wind Energy Council, Goldwind, Iberdrola, JA Solar, Nordex Group, NTPC Limited, Politecnico di Milano, Politecnico di Torino, ReNew Power, Risen Energy and Trina Solar.

They start their collaboration by focusing on four key areas: net-zero emissions and CO_2 footprints; circular economy and design; human rights; and the water footprints. The initiative is fully aligned with the 2030 agenda set out in the UN Sustainable Development Goals (SDGs).

The Alliance aims to redefine the meaning of 'sustainable energy' and embrace all those working in and impacted by renewables, joining efforts with civil society, end-users, policymakers, academic institutions, materials suppliers, original equipment manufacturers and like-minded utilities to interface with governments and investors.

While wind and solar have distinct characteristics as renewable technologies, they are highly complementary and share both similar growth trajectories and similar challenges to their sustainable deployment. Closer alignment between wind and solar is therefore critical for accelerating the energy transition.

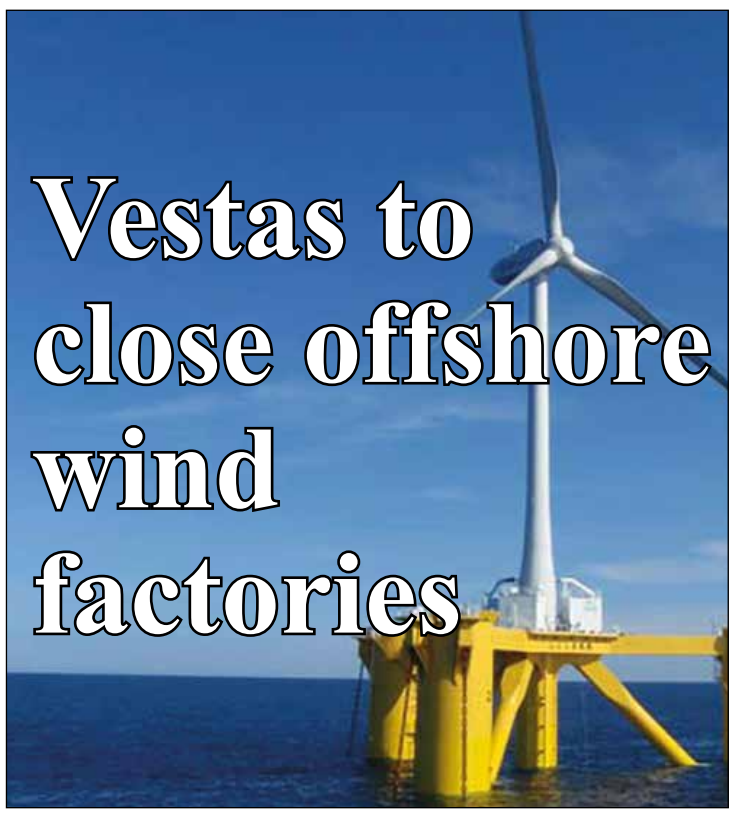
Gianni Chianetta, CEO of the Global Solar Council (GSC) said: "What is key is a joined-up effort. It's no longer enough for any one technology, industry or organisation to lead the way: we need to lead together, with collaboration and joint action."

The launch of the Alliance comes at a critical time for climate action and the energy transition, less than two months ahead of the United Nations' COP26 climate summit due to take place in Glasgow in November.

Its formation was followed by the launch of another global initiative set up to support the COP goal agreed in Paris 2015 of limiting climate change to 1.5°C.

In late September, 12 investment consulting firms, responsible for advising institutional asset owners on assets of approximately $10 trillion, launched the Net Zero Investment Consultants Initiative (NZICI). Through nine specific action points, they commit to supporting the goal of global net zero greenhouse gas emissions by 2050 or sooner.

The initiative, which has been led by some members of the Investment Consultants Sustainability Working Groups in the UK (ICSWG-UK) and US (ICSWG-US), is endorsed by the United Nations Race to Zero campaign and supported by the Principles for Responsible Investment (PRI). The 12 investment consultants are: Barnett Waddingham, bfinance, Cambridge Associates, Cardano, Frontier, Hymans Robertson, JANA, LCP, Meketa, Redington, Willis Towers Watson and Wilshire.



Vestas to close offshore wind factories

Danish wind turbine manufacturer Vestas says it will stop production at factories in Viveiro, Spain, and Esbjerg, Denmark, as well as at its onshore wind factory in Lauchhammer, Germany.

The move is part of the company's integration of its onshore and offshore business started after Vestas acquired a 100 per cent stake in MHI Vestas from Mitsubishi Heavy Industries.

Explaining the closures, Executive Vice President and COO Tommy Rahbek Nielsen, said: "Today's fast-moving energy transition, rapid introduction of new products and recent integration of our onshore and offshore business require us to further mature and evolve our supply chain network and manufacturing footprint.

"While Vestas will sustain a strong footprint in Europe across manufacturing and service activities, it's always hard to make decisions that negatively affect our good, hardworking colleagues at Vestas. I would like to emphasise that we are deeply committed to explore opportunities to relocate our colleagues, who unfortunately will be impacted by the cease of production at our factories in Lauchhammer, Viveiro and Esbjerg."

Where required by local law, Vestas says it will initiate legal proceedings and negotiations with worker's representatives and the local work councils for all affected employees.

Based on current plans, Vestas expects to finalise production in Viveiro end of 2021 and will offer opportunities to relocate employees currently working in Viveiro to other Vestas sites in Spain. It expects to conclude the production of power conversion modules in Esbjerg during the first half of 2022 and will explore opportunities to relocate employees to other Vestas sites in Denmark.

The total cost of this adjustment of Vestas' manufacturing onshore and offshore footprint will depend on specifics related to the outcome of negotiations with work councils, sale of buildings, etc.

GE in talks with EDF over sale of nuclear turbine division

US conglomerate General Electric is in talks with France's state-owned electricity utility EDF over the potential sale of its nuclear steam turbine business, in a move that would streamline its operations and cut debt.

Specifically, the two sides are in "exploratory talks" for the sale of GE Power's Arabelle nuclear steam turbines, which are used in all French nuclear power stations. This unit is separate from GE Power's nuclear fuel and reactor business.

EDF said that it is in the process of analysing the possible conditions under which a deal would be in the French company's interests but cautioned that there are no guarantees that the talks would result in a transaction.

"GE being one of EDF's key partners in the nuclear business, EDF is currently analysing conditions under which the interests of the EDF Group would be best served," the French state-controlled utility said in a statement. "There is no certainty regarding the outcome of this work and of these exploratory discussions."

The purchase would give EDF greater oversight over maintenance and turbine supply in the construction of nuclear plants in France and abroad. GE is EDF's main supplier of steam turbines and electrical components for nuclear power plants such as France's Flamanville-3 and Britain's Hinkley Point C.

French Finance Minister Bruno Le Maire welcomed a possible deal. "It shows our support to nuclear power and our will to reinforce our national (energy) independence", Le Maire told a media conference held after a weekly cabinet meeting.

For GE Power, which specialises in steam power plants, steam plant services, steam turbines, boilers, generators and air quality control systems, the sale of the business would help it focus on gas turbines and renewable energy. The company also said last year it planned to stop selling equipment to new coal fired power plants.

GE acquired the nuclear division of its Steam Power unit in 2014 from France's Alstom, which developed the widely used Arabelle turbines that equip nuclear power plants including the next-generation EPR reactors. But since then GE has shed thousands of jobs in France and elsewhere, and GE Steam Power recently announced plans to cut 144 French jobs.

While the sale, which reportedly could fetch around $1.2 billion, looks like a like a relatively small deal, some experts argue it is important in turning around profitability and free cash flow (FCF) and gives GE investors cause for optimism.

On exiting the coal business, GE plans to shift Steam Power's revenue toward higher-margin services and nuclear business. GE selling its nuclear turbine business would leave the steam power business primarily a steam services business. Notably, during the last earnings call, when asked what steam power services' margin could be in 2023, CFO Carolina Dybeck Happe, replied: "Service margins are always expected to be strong, and we expect them to be strong, probably slightly lower than gas."

Writing in *The Motley Fool*, Lee Samaha said: "…. the sale of the nuclear (steam turbines) business would leave steam power (and the Power Portfolio) as a high-single-digit FCF services business. Together with the recovering Gas Power business (which is expected to have a high-single-digit profit margin in 2021 alone), GE Power would be well set to hit GE CEO Larry Culp's target of $1 billion to $2 billion in operating profit by 2023."

ADNOC, bp and Masdar to expand partnership

Abu Dhabi National Oil Company (ADNOC), bp and Masdar have signed strategic framework agreements to expand on the UAE and UK's bilateral partnership in sustainability, including the potential development of clean hydrogen hubs in both the UK and UAE.

Under the terms of the framework agreements, ADNOC, bp and Masdar will seek to collaborate on UK and UAE clean hydrogen hub development at an initial scale of 1 GW in the UAE and 1 GW in the UK, building on the UAE's position as a major investor in the UK's offshore wind projects.

The hydrogen agreements also align with the UK's recently announced commitment to achieve 5 GW of low-carbon hydrogen by 2030 and the UAE's Nationally Determined Contribution of reducing greenhouse gas emissions by 23.5 per cent compared to business as usual for the year 2030.

ADNOC and bp will also, as part of the agreements, jointly identify areas for potential partnership in greenfield carbon capture and storage and best-in-class methane detection platforms. Further, Masdar and bp will together explore opportunities to develop, build and operate sustainable energy and mobility solutions in urban population centres.

The initiatives envisaged by the strategic framework agreements would be subject to the relevant regulatory approvals.

Americas

Vestas wins 240 MW repowering project

Vitol Wind has awarded Vestas Wind Systems a contract to repower the 240 MW Big Sky wind farm in Illinois, USA. Vestas will supply and commission 104 units of V120-2.2 MW turbines and five units of V110-2.0 MW turbines in 2.2 MW operating mode for the project.

The turbines will replace 109 Suzlon turbines.

Turbine delivery is due to begin in Q1 2021, with commissioning scheduled for Q2 2022.

Gas engine plant for City of Lakeland

MAN Energy Solutions will provide six 18V51/60G engines, along with the major balance of plant equipment, to the City of Lakeland, Florida, USA, for its municipal utility Lakeland Electric. Lakeland Electric and MAN Energy Solutions will build a new 120 MW RICE (Reciprocating Internal Combustion Engine) plant on a brownfield site in the city.

The new facility will run on natural gas and replace a recently retired, coal fired plant.

All equipment is scheduled to be delivered to site by July 2022. MAN Energy Solutions will maintain the plant for 10 years.

Doosan Heavy to design X-energy's SMRs

Doosan Heavy Industries and Construction has signed a deal with US SMR maker X-energy to design a small modular reactor (SMR) based on high-temperature gas-cooled reactor (HTGR) technology.

Under the terms of the deal, Doosan Heavy will design an 80 MW SMR known as the Xe-100, and construct a prototype of it, for X-energy.

X-energy said it plans to build a 320 MW nuclear power plant consisting of four Xe-100s.

Asia-Pacific

Vestas secures 50 MW Taiwan order

Vestas has secured a 50 MW order with the German developer and operator of renewable energy projects, wpd, for three projects, Chuangwei 2, Leadway 2 and Hsinyuan wind farms in Taiwan.

The Hsinyuan wind farm includes six V136-4.2MW wind turbines with 112 m towers, featuring the largest onshore turbine rotors in Taiwan. Chuangwei 2 and Leadway 2 wind farms will be installed with four and two V117-4.2MW turbines with 91.5 m towers, respectively.

The order includes a long-term Active Output Management 4000 (AOM 4000) service agreement for the wind farms.

Deliveries are expected to begin in the second quarter of 2022, while commissioning is planned for the fourth quarter of the same year.

Toshiba to supply hydro turbines to Indonesia

Toshiba Hydro Power (Hangzhou), a Chinese subsidiary of Toshiba Energy Systems and Solutions, and PT Toshiba Asia Pacific Indonesia (TAPI), an Indonesian subsidiary of Toshiba Energy Systems and Solutions, have won an order to manufacture four 105 MW hydro turbines for the Kerinci Merangin Hydro Electroc Power Plant on Sumatra Island, Indonesia.

Delivery of the equipment will start from September 2023.

The Kerinci hydropower plant has a head greater than 400 m, therefore requiring special technology to meet the high head and rotating speed for the turbines.

Siemens Energy to supply HL-class GTs to Taiwan

Siemens Energy has announced that it has won a contract for the region's first HL-class gas turbine. In conjunction with its consortium partner CTCI Corporation, which will build the Sun Ba Power Phase II combined cycle power plant for the IPP Sun Ba Power Corporation. The 1100 MW Sun Ba II project will be built in Tainan, southwestern Taiwan, and will be fired with regasified LNG. Siemens Energy will also provide long-term service for the plant's core components.

Sun Ba II will be a multi-shaft combined cycle power plant, with two gas turbines and one steam turbine each driving its own electrical generator. Siemens Energy's scope of supply includes the plant's power island, consisting of two SGT6-9000HL gas turbines, one SST-5000 steam turbine, three SGen6-2000P generators, two HRSGs, and the SPPA-T3000 control system.

The contract includes long-term service over 25 years for both gas turbines, the steam turbine, the generators, and the HRSGs. It also includes an option for digital service solutions. CTCI is responsible for construction and installation, and the EPC work for the balance of plant.

Indian solar contract for Tata Power

Rewa Ultra Mega Solar has awarded a contract to Tata Power's unit TP Saurya for the construction of a 330 MW solar project in the Indian state of Madhya Pradesh.

The facility will be constructed in Neemuch Solar Park, and will consist of two units, one of 160 MW and one of 170 MW. Output from the facility will be supplied to the Indian Railways and the Madhya Pradesh Power Management Company under a 25-year PPA. The project is scheduled to be commissioned within 19 months from the date of execution of the PPA.

Europe

Nordex turbines for Rywald wind farm

The Nordex Group has received an order from KGAL Investment Management for nine N131/3000 wind turbines for the 27 MW Rywald wind farm in Poland. The 3 MW units will be mounted on 134 m tall towers. In addition to installation and commissioning, the order also includes a 15-year service and maintenance contract with a double extension option for a further five years.

The Rywald wind farm will be built around 200 km northwest of Warsaw. Construction is scheduled to start in mid-2022.

HVDC to link Ireland and Great Britain

Siemens Energy and Sumitomo Electric have signed a contract with Greenlink Interconnector Limited to deliver HVDC converter technology for the 190 km Greenlink interconnector. The 500 MW HVDC link will connect the power grids of Ireland and Great Britain. Work will begin at the start of 2022 following financial close.

James O'Reilly, CEO of Greenlink, commented: "We will be looking to maximise local supply chain benefits during the three-year construction period. We look forward to working with Siemens Energy and Sumitomo Electric towards successful commissioning in 2024."

Siemens Energy will be responsible for the overall system design and construction of two converter stations located in County Wexford (Ireland) and the Pembroke transmission substation in Pembrokeshire (Wales). Both converter stations will use Siemens Energy's HVDC Plus technology with modular multi-level arrangement (VSC-MMC) to convert AC to DC and vice versa. Linked via an HVDC XLPE (crosslinked polyethylene) cable system by Sumitomo, the stations will enable transport of energy at 320 kV. Siemens Energy's scope of supply also includes a Service and Maintenance Agreement with an initial duration of seven years.

GHS electrolysers for green hydrogen project

Under a supply deal, Green Hydrogen Systems (GHS) will provide three Hy-Provide A90 alkaline electrolysers for a green hydrogen manufacturing plant in Bremerhaven, Germany. This project is led by Wenger Engineering and will be powered by onsite wind turbines. The electrolysers have a total capacity of around 1.3 MW.

GHS will provide remote monitoring and support, as well as on-site maintenance under a three-year service deal.

The complete test field will consist of GHS' pressurised alkaline electrolysis equipment, compression unit, a PEM electrolyser, fuel cells and storage system for systematic comparison of PEM and alkaline electrolysis.

RTE awards Gruissan floating wind farm contract

A consortium of Prysmian Group and Asso.subsea has signed a contract with RTE, Réseau de Transport d'Électricité for the development of an export submarine power cable system for the Gruissan floating offshore wind farm located in Southern France.

Under the terms of the €30 million contract, Prysmian will design, supply, test and commission a 66 kV three-core 25 km export submarine cable with EPR insulation, and another 66 kV submarine dynamic cable to connect a floating substation to the shore.

Asso.subsea will undertake the installation services of the project. The company will design and perform all marine works required for the project, such as cable loading, route preparatory works, cable installation and protection and HDD works at landfall.

International

Kaylon selects GE solar inverters

Kalyon has selected GE Renewable Energy to deliver its FlexInverter solar power station technology for the 270 MW Karapinar phase II-A and the 810 MW Karapinar phase II-B solar plant in Turkey. The scope of work includes design, engineering, project management, site management, and commissioning. The project is located in Turkey's Konya Karapinar province and is scheduled to start commercial operation by December 2022.

GE Renewable Energy has already completed the commissioning of the FlexInverter solar power station technology for the 267 MW Karapinar phase I solar plant.

The Karapinar solar power plant is part of the first Turkish solar YEKA tender launched in 2017 by the Ministry of Energy. It will help Turkey commission 10 GW of solar capacity between 2017-27.

Wärtsilä to supply 120 MW plant to Gabon

Wärtsilä and Gabon Power Company (GPC) have signed an agreement with the government of Gabon for the development, supply, construction, operation and maintenance of a 120 MW gas fired power plant. Wärtsilä will build the plant under a full EPC contract and will then operate and maintain the plant under a 15-year O&M agreement.

The plant will be located at the industrial site of Owendo, close to Libreville, the capital of Gabon. When commissioned, the plant will supply electricity to Société d'Energie et d'Eau du Gabon (SEEG) under a 15-year PPA.

The project is being developed under a Public Private Partnership framework, with the asset to be transferred to the Gabonese authorities at the end of the concession agreement.

ACWA Power wins Uzbekistan wind farm

The government of Uzbekistan has announced that Saudi Arabia's ACWA Power has won a contract to develop a 100 MW wind farm in the Karakalpakstan region of Uzbekistan. It is expected that the wind farm will generate around 350 GWh per year.

The wind farm is scheduled to be operating commercially within two years.

Sherzod Khodjaev, Uzbekistan's Deputy Minister of Energy, said: "Uzbekistan is making huge strides towards producing and providing green energy for its economy, decreasing the country's dependence on fossil fuels and reducing overall CO_2 emissions. This project is a key component of our ambitious, wider energy strategy to develop environmentally friendly renewable sources of energy to meet growing electricity demand."

Bids received for Saudi-Egypt grid interconnection

Contractors have submitted bids for a 900 km 500 kV overhead transmission line (OHTL) connecting Saudi Arabia and Egypt. The OHTL will pass through Medina and Tabuk to the Gulf of Aqaba.

The project is valued at $1.6 billion, with Egypt set to fund $600 million of the total cost. The interconnection is expected to be able to deliver up to 3000 MW daily.

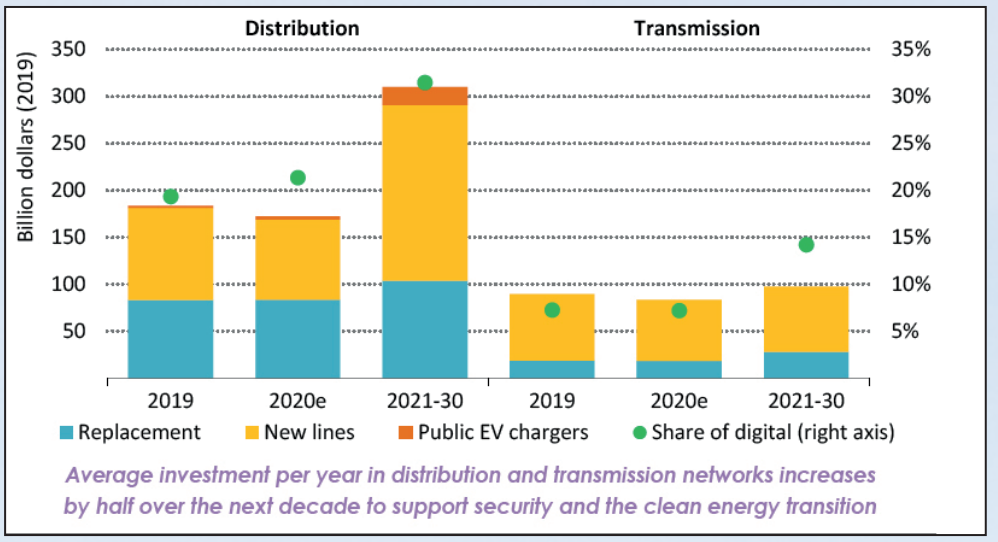
The lowest bid of $446.8 million was submitted by South Korea's Hyundai E&C. The local National Contracting Company submitted the second lowest bid of $449.4 million, with Saudi Services for Electromechanical Works submitting a bid of $463.5 million, the only other bid of under $500 million.

Sungrow equipment for Egypt solar/storage project

China-based Sungrow has secured a contract from juwi to supply equipment for a 36 MW off-grid solar-plus-storage project in Egypt. Under the contract, Sungrow will provide a 1.5 kV, 6.25 MW photovoltaic inverter and a 7.5 MW battery energy storage system for the facility, which will be located at the Centamin-operated Sukari Gold mine.

The project is scheduled to be operation in the first half of 2022.

Annual investment in electricity networks by sector in the Stated Policies Scenario



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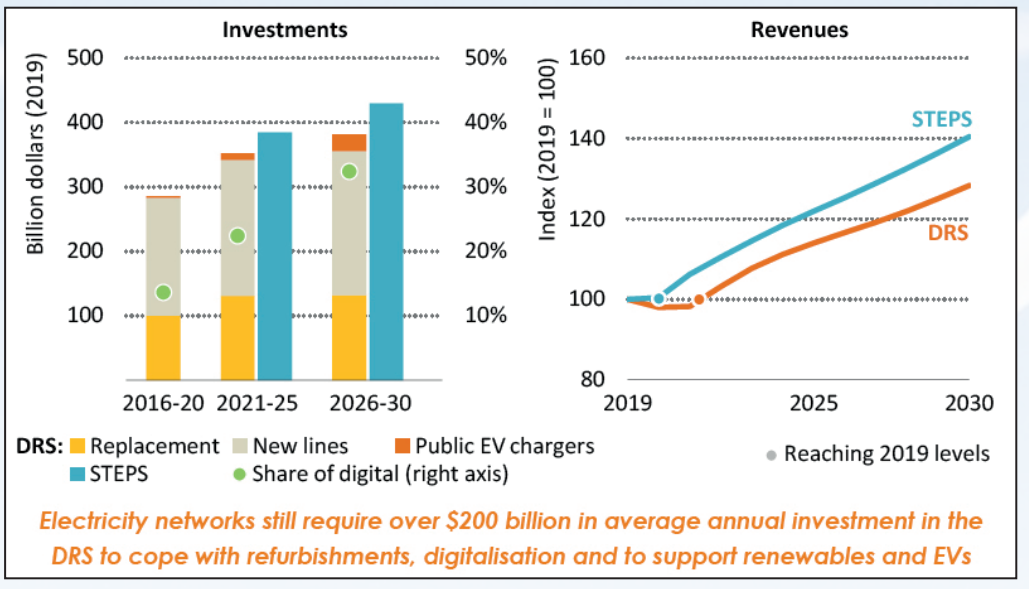
Impact of a longer pandemic on global grid investments and revenues



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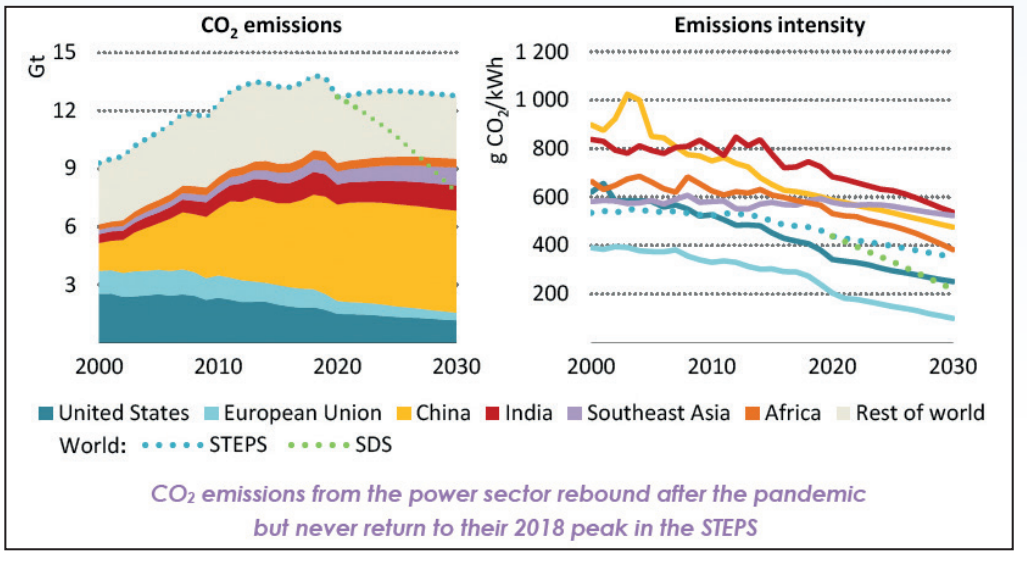
CO_2 emissions and carbon intensity in the power sector in selected regions in the Stated Policies Scenario



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Hydrogen

Hydrogen poised to gather support at critical COP26

Hydrogen stands to gain further opportunity as a result of the COP26 conference and as technical advances in its use proves its reliability.

Gary Lakes

It will be mid-November before we know if the upcoming UN Climate Change Conference, or COP26, will be successful in establishing further measures the world must take in order to avert drastic changes in the Earth's climate.

Billed as one of the most consequential climate events since the 2015 Paris Agreement, the meetings in Glasgow between November 1-12 are meant to create the circumstances for a more sustainable, resilient and zero-carbon future, according to the COP 26 website It states: "[We] need a whole economy transformation in which non-state actors will play an increasingly vital role."

Indeed. How the world will shift to a net zero carbon economy in the next 30 years – and a zero-carbon economy by the end of this century – is going to be a daunting task. Virtually every action, industry, and leisure moment that the human race engages in is linked to the production, processing, distribution and reliance on hydrocarbons, oil and gas and their byproducts.

Over the last few years we have begun to hear the term "hydrogen economy" frequently, and increasingly there appear announcements and news stories that entrepreneurial companies, as well as long-established energy companies, are making advances in hydrogen-related technology. A good many companies are claiming to take action to reduce their carbon footprint, but as Brooke Masters wrote in the *Financial Times* recently, companies that are truly green are redesigning their products rather than buying offsets or planting trees.

Masters writes that a lot of the low-carbon steps companies are taking is actually smoke and mirrors. "Stunts and pious pledges won't save the planet," she said. "Manufacturers and retailers must rethink their entire design, manufacturing and sales processes. Those that have are discovering that change is either very expensive or an unglamorous, iterative process that involves thousands of tiny improvements."

As the mode of energy production is firmly rooted in hydrocarbons the move to a hydrogen economy is going to create trauma. In recent weeks, oil and gas producers have been reasoning that the recent increase in energy prices stems from the transition to renewables. This argument will very likely be heard often during the COP26 climate gathering.

Hydrogen is already being used in transport and some governments are implementing policies designed to encourage its eventual use for industries such as cement manufacture and steel production, as well as heating.

Earlier this year US President Joe Biden set a target of 2050 for the US to reach a net zero emissions economy. To achieve this goal, the US will need to undergo a massive economic transformation that will require the construction of new infrastructure and changes to the manufacturing and marketing. In June, Department of Energy Secretary Jennifer Granholm announced the 'Hydrogen Earthshot,' the first priority of which is to reduce the cost of producing hydrogen from the current rate of some $5/kg to $1/kg, a move that would accelerate innovations and spur demand for clean hydrogen.

In April this year, the government of Boris Johnson, which will host COP26, announced its first hydrogen 'strategy' which has a target of producing 5 GW of low-carbon hydrogen by 2030. Italy, Scotland and Germany have also announced similar targets. The UK plan supports the production of green and blue hydrogen with funding amounting to £900 million by 2030 and £13 billion by 2050. The strategy forecasts hydrogen covering 20-35 per cent of UK consumption by 2050.

But western governments continue to provide subsidies to the oil and gas industries, a habit that is hard to set aside for those politicians who have close relations with the industry. How firm, how adamant the delegates to COP26 remain to setting the terms of the energy transition will determine the success or failure of the conference.

Hydrogen stands to gain further opportunity as a result of the conference and as technical advances in its use proves its reliability, it will gain respect as a sustainable fuel. Finance will be crucial. Some companies are already moving their investments out of hydrocarbons and into renewables.

German car manufacturers BMW and Audi are developing not only battery-driven passenger vehicles but cars that operate with hydrogen fuel cells. Germany is also moving to use hydrogen to fuel the steel and chemical sectors. Meanwhile, Japanese and Australian companies signed last month a memorandum calling for the creation of a green hydrogen supply chain that would produce 100 t/day by 2026.

Japan has also set a net zero target by 2050 that many Japanese firms are working towards. Japan's Iwatani, Kawasaki Heavy Industries, Kansai Electric Power, and Marubeni Corporation signed the accord with Australia's Stanwell Corporation and APT Management Services to create the Central Queensland Hydrogen Project. The joint venture will produce green hydrogen using renewable energy and then export the hydrogen to Japan from the Port of Gladstone.

Gas

Rise in gas prices demonstrates need for commodity's continuing presence

- Renewables creating "transition premium" will play a role in energy prices
- Saudi Aramco seeks foreign investors for non-associated Jafurah gas field

Gary Lakes

Surging gas prices in world markets have made it clear that despite the intentions of many countries to begin transitioning to low carbon emitting energy systems, natural gas is going to continue to play a role in meeting world energy demand for a considerable time.

During late September, Dubai hosted Gastech, the number one event for gas producing countries and companies. This is the first time that the usually annual event has been held in-person since the start of the pandemic. While the three-day agenda included numerous panel discussions on transitioning to a net zero emissions energy industry, it was clear that the demise of natural gas and LNG has yet to begin and that investment would be needed in the gas industry despite calls that no further financial commitments be made to fossil fuels.

Speaking at Gastech, Opec Secretary General Mohammad Barkindo said that even during the energy transition predictable investment in the oil and gas sector is required to address increasing global energy needs. He said the jump in gas prices was the gas market's reaction to the move towards renewables and added that renewables are creating a "transition premium" that would now play a role in energy prices.

Qatar's Energy Minister Saad al-Kaabi, who is also CEO of Qatar Petroleum, the world's largest LNG producer, said the recent surge in gas prices was the result of under investment in the industry.

As the energy industry looks to renewables and hydrogen, there are questions about whether further fossil fuel investment will only just perpetuate the fossil fuel industry and thus thwart efforts to reduce global warming and climate change. But a lack of investment isn't the only reason for the price surge. Lower stored supplies, bottlenecks in the delivery of Russian and Norwegian gas to Europe, increased demand for LNG in Asia and weather impacting wind energy supplies in northern Europe have also played a role. And while there is clearly a jump in gas prices now, it remains to be seen if the high prices will continue.

Qatar has embarked on a multi-billion dollar investment to nearly double its current LNG production capacity of 77 million tons annually in the coming years. The UAE also intends to keep natural gas as a key part of its economy for the next 50 years, Sultan Ahmed Al Jaber, the UAE Minister of Industry and Advanced Technology and Group CEO of Adnoc, told Gastech.

Jaber said natural gas will support the UAE's plan for future economic growth. He said gas will play a pivotal role in the county's economic growth scenario as an essential fuel stock for the downstream hub at Ruwais and the TA'ZIZ petrochemical venture. Blue hydrogen and blue ammonia, products produced with natural gas, will play a major role in the country's future.

The minister said that the UAE will achieve gas self-sufficiency as Adnoc uses advanced technology to expand into unconventional gas, tap into gas caps and unlock new reservoirs. "At the heart of this goal, is the expansion of our producing assets," he said, adding that the new projects would result in the delivery of "more than 3 billion ft^3/day, enough to power several million homes."

Jaber concluded his remarks my extending an open invitation for partnerships in the UAE gas industry.

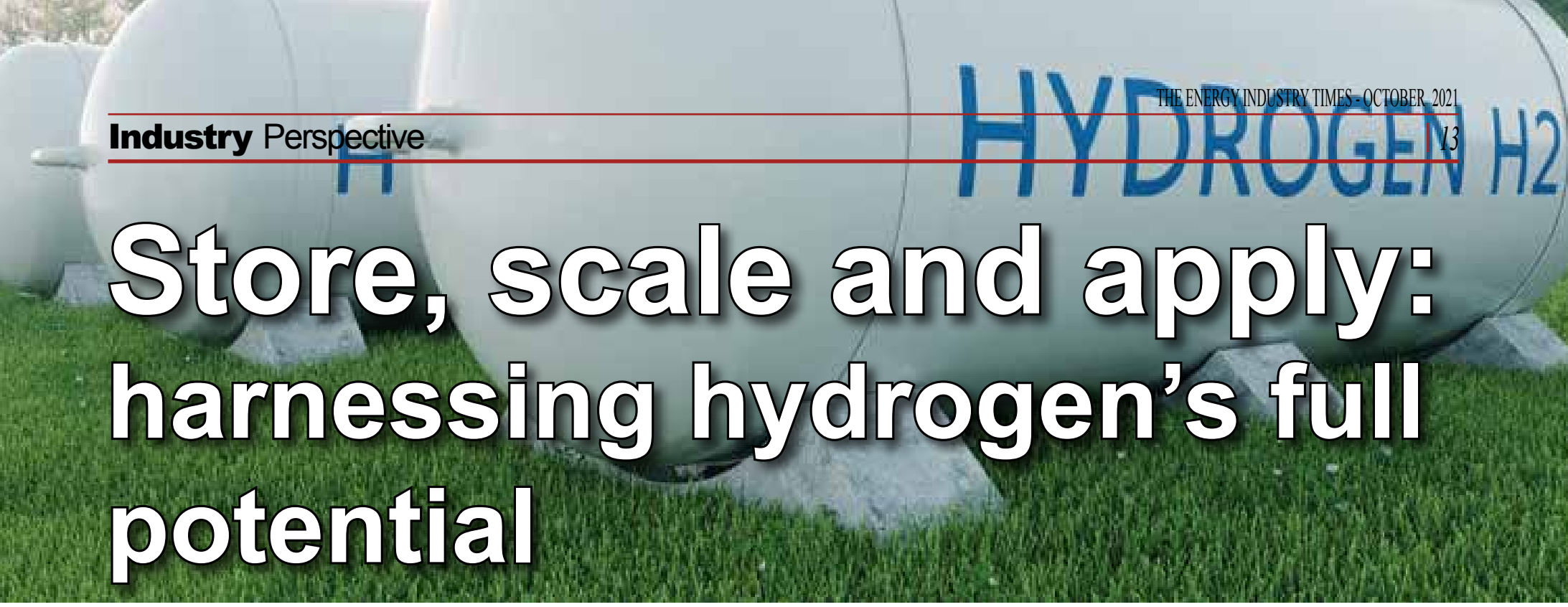
Meanwhile, Saudi Aramco is looking for foreign upstream investors for its $110 billion non-associated Jafurah gas field, the largest in the country. The project was due to get underway before the pandemic forced its postponement. Aramco is reported to have started negotiations with potential foreign investors. Gas production was due to begin in 2024, but a new target date for the start of gas output has yet to be established.

Iraq is also taking steps to bring its gas resources under control with the help of foreign investors. It is already engaged with several major oil firms to boost production and tackle its gas flaring problem.

In September it signed an agreement with French major Total worth $27 billion to develop oil fields, natural gas and a water injection project. Among the projects is one to build a gas processing hub that would capture associated gas from five southern oil fields, and a project to build a 1000 MW solar power plant.

Iraq relies almost entirely on the sale of crude oil to finance its budget, but some 16 billion m^3 of gas is flared, causing the loss of millions of dollars in potential revenue. The Total project would capture the gas and channel it to power stations that would enable Iraq to improve its supply of electricity to its population and reduce the country's dependence on neighbouring Iran for gas and electricity. It would also reduce the highly polluting practice of flaring gas.

Industry Perspective



Store, scale and apply: harnessing hydrogen's full potential

With the ability to develop hydrogen at scale and storage now part of the equation, Mitsubishi Heavy Industries' **Emmanouil Kakaras** believes the hype around hydrogen is justified.

Hydrogen has been used by humans for more than a century and its potential as a clean energy source has been recognised for many years. But historically it has always disappointed expectations, most recently in the early 2000s. This has fundamentally changed in the last five years, however, as technology has developed to the point where hydrogen can now be developed, at scale, not only as a carbon-free energy carrier but also as a storage vector.

This was the missing factor. Now that storage is part of the equation, we can unleash the full potential of this versatile gas to achieve – over time – a complete decarbonisation of our energy system and our hard-to-abate industrial and transport sectors. That is why the current wave of "hydrogen hype" is justified and why I truly believe it will be possible for the world to achieve net zero carbon emissions by 2050.

The challenges remain considerable, of course. But now that the political will exists – over 30 countries have released hydrogen roadmaps, $70 billion of public funding has been committed and the industry has announced over 200 projects to invest some $300 billion through 2030, notes McKinsey – the roadmap we need to follow is relatively straightforward.

Kakaras is watching the UK's recent hydrogen policy with great interest

The first step is to build demand through new applications. Today's annual global hydrogen production of around 80 million tons – just 4 per cent of the energy mix, according to the International Energy Agency (IEA) – is mostly used in a few industrial processes, such as refining and petrochemicals. The IEA's models suggest that global consumption will have to more than double to over 200 million tons by 2030 if the world is to attain its climate change goals. It would then have to more than double again to reach 530 million tons globally by the time 2050 arrives.

We must therefore greatly expand hydrogen's utilisation, for example by replacing natural gas in steel making; building fuel-cell trucks, buses and trains for long-distance transport; blending it into the gas pipelines and boilers that heat buildings; and using it to store renewable electricity.

At the same time, we must replace 'grey' hydrogen which contributes to carbon emissions because it is produced from natural gas and which constitutes the bulk of today's production, with carbon-free versions: either 'blue' (or 'turquoise') hydrogen, where these emissions are captured at source; or 'green' hydrogen, which is produced via electrolysis powered by renewable power. Cleaning up today's hydrogen output is low-hanging fruit.

More difficult and capital intensive will be building a complete hydrogen value chain, but this is something we must tackle in the coming decade. We can start with large projects, such as the Hamburg Hydrogen Hub in which Mitsubishi Heavy Industries (MHI) Group is involved, that plans to decarbonise the city's port, shipping infrastructure and local gas pipelines with green hydrogen.

Such clusters can be supplied either by onsite hydrogen production or be connected to pipeline networks, say from the North Sea or North Africa in the case of Europe. Alternatively, hydrogen can be shipped in from low-cost production centres like Australia or the Middle East, perhaps in the form of ammonia, via 'zero-carbon' carriers powered by synthetic fuels.

Meanwhile, the rapid deployment of solar and wind power means some countries now have a surplus of renewable energy currently being curtailed in most cases, which can be stored as green hydrogen, for example in salt caverns, as MHI Group is planning to do in Utah in the US. Hydrogen allows much longer-term storage than batteries, so the electricity can be fed back into the grid when needed. It is true that the conversion (or 'round tripping') of electricity into hydrogen and back again results in substantial energy losses. But critics forget that this surplus energy that renewables produce intermittently would otherwise be simply wasted.

It is also true that carbon-free hydrogen is still too expensive and reducing the cost from the $4-5/kg that it currently costs to produce it in Europe to a competitive $1.50/kg will be hard. Supportive regulation and perhaps even subsidies can take us some of the way, but we cannot expect the extensive financial incentives that fostered the development of renewable energy.

For a start, it would be just too costly to replicate that for hydrogen, particularly on the relatively short-term time scale that policymakers have in mind. And we also have to take care not to create affordability issues for end consumers, whose utility bills in many countries, including much of Europe and Japan, already today include a surcharge for developing cleaner energy sources.

Instead, we should turn to market mechanisms, like contracts for differences, as well as encouraging open competition between hydrogen and other energy sources. The development of carbon pricing and trading markets, which are starting to set a realistic price for carbon emissions will also encourage utilities and industrial companies to wean themselves off thermal energy and switch to newer fuels, including hydrogen.

But the main and most obvious solution to the cost problem is scale. We must scale up – and massively so – every part of the hydrogen value chain described above, from production to transport to storage. This is the important lesson from the successful expansion of the renewables industry and it is what will bring prices down most effectively.

This is why MHI Group welcomes the UK's recent pragmatic and market-based hydrogen policy, which we have been watching with great interest – and this is certainly a public debate in which we intend to participate.

One aspect where MHI can help is that we already have available tools to quantify the true carbon footprint of all the various so-called 'carbon free' energies, across their entire life cycle. It is something we have already done for biomass and we think it will be a valuable contribution to the conversation.

On the basis of these calculations, blue hydrogen has a place in the energy mix. The precise colour does not matter: right now we need every kilogram of carbon-free hydrogen that we can produce at competitive prices. So, prioritising cheaper blue hydrogen makes a lot of sense, as long as it is coupled with coherent management of the resulting carbon dioxide. Again, I would point to the UK, as well as the US, Norway and some others as countries where the storage and/or industrial use of CO_2 is being actively promoted.

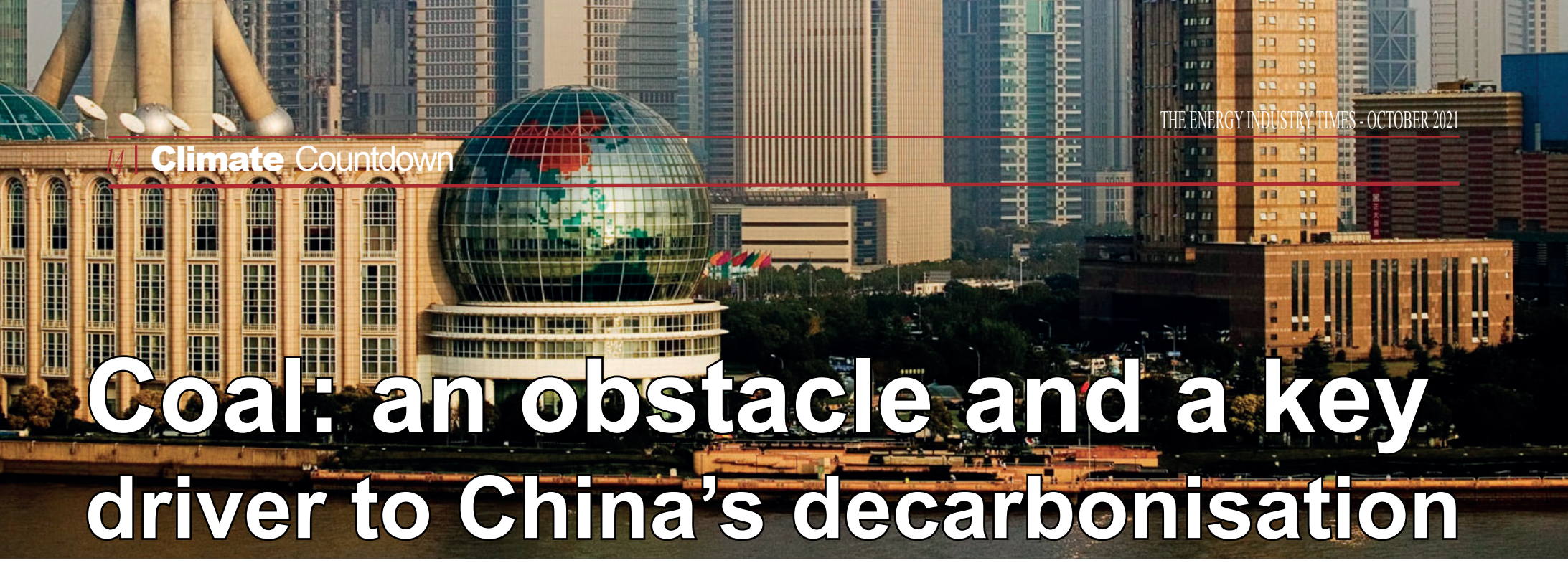
Well-thought-out public policy not only provides a framework within which energy providers and industrial companies can plan and act; it also gives confidence to investors – and their money is needed to develop new applications and reach markets and achieve the scale we are talking about. After all, production capacity and infrastructure will only be built when there is documented and committed hydrogen consumption that it can supply.

MHI is working on both carbon-based products, such as synthetic carbon-free fuels, for use in shipping and aviation as well as carbon black, which can be used to strengthen rubber tyres and in a range of plastics and coatings. The advantage of the latter is that, as a solid, it can sustainably store large volumes of CO_2 very efficiently and even store them permanently with a minimum footprint if no other use is found.

We are also seeking to improve the efficiency of converting hydrogen into other carriers, such as ammonia and seeing if we can improve the yield from the 'round trip efficiency' of hydrogen back to electricity. This would require an increase in the efficiency of electrolysers from 65-70 per cent into the 80s or 90s in percentage terms, which would also help to rapidly bring down the cost of hydrogen.

As someone who has conducted research and lectures on mechanical engineering, I feel privileged to witness research results turning to practice at a great speed. I am excited that we are able to attract bright young engineers and motivate them to use modern skills in electro-chemistry and artificial intelligence for the new energy business. It gives me real hope that we will achieve the 100 per cent decarbonisation that the world so badly needs.

Emmanouil Kakaras is Executive Vice President NEXT Energy Business, Head of Duisburg Branch at Mitsubishi Heavy Industries EMEA.



Coal: an obstacle and a key driver to China's decarbonisation

China's recent announcement that it will no longer build overseas coal plants is seen as significant in the run-up to COP26.

Joseph Jacobelli looks at the country's approach to the coal power sector and explores how its continued domestic use might actually drive other forms of clean generation.

Xi Jinping, the President of the People's Republic of China, announced net zero targets (NZT) in 2020. The nation targets to peak CO_2 emissions before 2030 and achieve carbon neutrality before 2060. President Xi then announced in September 2021, that the country will no longer build new coal fired power projects abroad. When the words 'China' and 'decarbonisation' hit headlines, the focus is often on the nation's massive coal fired installed capacity and the emissions it produces. The NZT drive must address overcoming the coal power obstacle, but China is likely to beat the NZT it set given its strong execution track record. This will probably take the form of more clean energy generation than currently planned, plus newer zero-carbon solutions.

For the last three decades thermal coal generation has powered the Chinese economy. In the past, coal was the logical and easy choice to power the astonishing economic growth for several reasons. The fuel is plentiful domestically. Highly efficient supply channels exist. Equipment suppliers built a know-how in manufacturing high quality and cost competitive boilers and turbines. Plant owners have become proficient and effective in plant construction. These factors have meant a low production cost per kWh versus other fuels; the national average coal power tariff was approximately Yuan370–380 ($57–59) per MWh in 2020. These factors drove coal capacity to leap to a massive 1080 GW, about 49 per cent of the nation's total, in 2020.

Beijing's NZT for CO_2 to peak before 2030 and achieve net zero carbon before 2060 is known domestically as the '30-60 Target'. After the 30-60 Target was broadcasted, the scarce action points disappointed many observers abroad. Even the shorter-term 14th Five Year Plan (2021–2025) was light on specifics. This is because of the under-promise-but-overdeliver culture. An example of this is when witnessing the stupendous growth in variable renewable energy (VRE) construction in the past decade, for example. Apart from the cultural factor, it is likely planners felt they needed more time to evaluate all available options. What is certain is that when it comes to clean energy the nation has consistently beaten targets in the past decade. In fact, clean energy goals were raised several times in the past decade, which led to over 535 GW of solar and wind generation by the end of 2020 and over 570 GW as of August 2021, mostly commissioned in the past decade.

Coal generation is an obstacle to China's NZT but this obstacle is also a motivation factor for the planners to aggressively address what to do about it. The challenge with China's coal fired generation is one of time and timing. Electric power demand growth is still very robust and additional generation capacity will be needed in the coming decades. The demand should grow at 2 per cent to 4 per cent per annum in the next 20 years. By 2050, it should rise to between 14 000 and 22 000 TWh based on estimates from various domestic and overseas institutions, from about 7600 TWh; the higher end of the forecast range is more likely. Shutting down almost 50 per cent of the nations' total capacity overnight is no viable option.

	Capacity (GW)	Breakdown	Output (TWh)	Breakdown
Coal	1,079.1	49.0%	4,629.6	60.7%
Gas etc.	167.1	7.6%	547.4	7.2%
Hydro	338.8	15.4%	1,321.8	17.3%
Pumped Storage	31.5	1.4%	33.5	0.4%
Nuclear	49.9	2.3%	366.2	4.8%
Wind	281.7	12.8%	466.5	6.1%
Solar	253.6	11.5%	261.1	3.4%
Total	**2,202.0**	**100.0%**	**7,626.1**	**100.0%**
(Wind + Solar)	*535.2*	*24.3%*	*727.6*	*9.5%*

China's electric power capacity and output in 2020
Source: Author calculations, September 2021. Data sourced from: 'China Electricity Council issued the annual development report of China's power industry 2021', China Electricity Council, 8 July 2021. Accessed at http://www.chinapower.com.cn/xw/zyxw/20210708/86506.html

While details are lacking for now, domestic experts' consensus is that coal generation will peak within the next five years. It will then progressively decline as a percentage of the total energy mix. The number bandied around is that by 2025 the amount of coal generation capacity will be close to what it is now – about 1100 GW by 2025 versus about 1080 GW today – despite the fact that some plants are still being built. It is highly likely that once the nation has a clearer picture of which other clean energy it can quickly ramp up in the short to medium term, only then will it aggressively address the existing coal fired capacity. Early coal plant closures are likely.

To illustrate the size of the problem we can look at output. Looking at the composition of China's electric power capacity and generation in 2020, one can easily conclude that in order to offset all of the nation's coal fired generation, enormous amounts of clean energy capacity will be needed. Coal capacity and output accounted for 49 per cent and 60.7 per cent of the total. The combined capacity and output of wind plus solar was 24.3 per cent and 9.5 per cent, respectively. This is because the utilisation rates are lower than for coal. Put simply, based on existing wind and solar utilisation rates, which themselves of course vary depending on location, in 2020 about 6.35 times of the solar and wind capacity would have been required to offset that of coal. That's a mind-boggling 3747 GW or so. And that would be for just 2020!

Of course, wind and solar are not the only forms of zero-carbon emission generation. There are other main forms of generation, including hydro, pump storage, and nuclear. A massive expansion in the generation capacity of these also faces massive challenges. For hydro there are resources limitations given that the easier to access, and thus cheaper, resources have largely been exploited already. For pumped storage the challenge is that it cannot be built everywhere; it is topology specific. There is indeed an enormous amount of upside for nuclear (see *TEI Times*, *June 2021, page 14*) but China first needs to identify newer generation reactors, which it feels are safe and reliable. Something which is most likely to happen but will be a decade or more out, these issues and more are discussed and evaluated in greater detail in the book *'Asia's Energy Revolution'*.

The likely scenario is that in the 2020s VRE additions, especially offshore wind, will be higher than expected. The speed will depend on cost reductions which can be achieved with energy storage systems. The issue on China's next clean energy surge is not one of 'if' but one of 'when'. There are a variety of forecasts as to the percentage of non-fossil fuel in the generation mix by 2050. One is from think-tank Global Energy Interconnection Development and Cooperation Organization (GEIDCO). It puts coal at 403 GW out of 6010 GW total by 2050. This may prove to be far too high.

Apart from more VRE, the amount of nuclear could be at least 70 per cent higher than GEIDCO's expectations, or about 300 GW, for example. Also, solar and wind should easily surpass the 2248 GW and 1967 GW expected by GEIDCO. It will be in part driven by significant additions in energy storage systems, as they get cheaper, as well as the massive investments in digitalisation, which will help manage VRE, the integration of battery-powered electric vehicles into the grids through bi-directional charging, newer clean energy technologies including floating solar and floating wind, and carbon capture and storage.

Joseph Jacobelli is a well-respected clean energy business executive, analyst and author, with over 30 years' experience in Asia. He runs a direct investments advisory firm Asia Clean Tech Energy Investments. He is author of the recently published: 'Asia's Energy Revolution: China's Role and New Opportunities as Markets Transform and Digitalise'.

Injecting inertia into the energy transition

As grid operators attempt to increase renewables penetration without disrupting system stability, it is crucial for them to gain better visibility of network conditions. Reactive's GridMetrix service is claimed to be the first and only service to accurately measure system inertia in real-time.

Marc Borrett

With COP26 fast approaching, governments and industries across the globe have been ramping up their announcement of ambitious decarbonisation commitments and investments. However, whilst clean energy capacity continues to grow at record pace, there is a growing acknowledgement of the significant challenge facing the electricity system on which these key energy transition milestones must be underpinned by. For many grids, replacing heavy spinning coal and gas fired power stations with the wind and solar capacity needed to meet their decarbonisation ambitions will require significant investment and advanced changes to grid infrastructure and blackout events in Texas and the United Kingdom over the last few years are a stark reminder of the challenges faced by grids as they struggle to keep pace with the speed of the renewable energy rollout.

With Europe in the midst of an energy supply crisis exacerbated by soaring gas and power prices, many countries are already looking to boost their renewables capacity as a means of protecting security of supply going forward. It is therefore more vital than ever for grid operators to prioritise grid infrastructure to enable clean energy to be delivered reliably and cheaply to customers.

Inertia is defined as an object's tendency to continue in its existing state of rest or motion. This is a key concept in the functioning of power grids. Many generators producing electricity have spinning parts which rotate at the same frequency, keeping the grid stable and protecting power plants and equipment from tripping. Inertia provides resistance to fluctuations in grid frequency caused by power supply and demand, leading to a lower rate of change of frequency (RoCoF).

Systems that rely primarily on fossil fuels, nuclear or hydro plants have traditionally benefitted from high and predictable levels of inertia. The inertia provided by the spinning turbines of those plants connected to the grid slows changes to their rotation speed and as a result stabilises the frequency of the grid. However, the introduction of renewable energy generation has complicated the picture significantly. Solar and wind plants, two of the most prevalent forms of clean energy generation, are typically connected to the grid through inverters and hence have control loops which 'follow' the frequency of the grid rather than contributing any inertia.

GridMetrix utilises an ultracapacitor to send pulses of power through the grid

The rapid dissemination of intermittent renewable capacity is posing new challenges for transmission system operators (TSOs), whose primary role is ensuring the stability of frequency of the power grid. TSOs do have a number of tools to combat this, such as curtailing renewable generation or bring conventional power plants online on demand. In the longer term, the development of rapid balancing services and the installation of synchronous condensers or flywheels to the grid will also help support these efforts. However, whilst these are all technically viable options, they often come at a higher cost which is only increasing as the complexity of the grid demands more management with every passing day.

In a traditional power system, there is limited need for TSOs to know exactly what is going on across the grid. Previously, operators would simply monitor the input and output of electricity and balance it by mobilising large, centralised plants. This management model is based on the idea that the operator is already in full control of what goes in and out of the system. However, this becomes obsolete once you begin introducing forms of distributed generation such as rooftop solar, batteries and EVs that are generally "hidden" and out of the operator's control.

While we see transmission-connected inertia decrease, inertia in the distribution network from pumps, fans and motors remains. This distributed inertia is around 10-30 per cent of the total in most power systems. Estimates and models which ignore this distributed inertia and make assumptions of transmission connected inertia can lead to system operators walking blind towards a cliff edge as they try to manage the grid. It is therefore crucial to gain better visibility of network conditions to enable TSOs to "see the edge of the cliff" and walk as closely to it as is safely possible as they attempt to increase renewables penetration without disrupting system stability.

Reactive's GridMetrix service is the first and only service to accurately measure system inertia in real-time. The technology was developed in Finland by Reactive's team of ex-Nokia engineers, who re-deployed their telecommunications expertise to successfully enable the transmission of signals through a power grid for the first time anywhere in the world, allowing for inertia to be directly measured for the first time. Comprised of both a hardware and cloud software element, GridMetrix utilises an ultracapacitor to send pulses of power through the grid – like the underwater sound waves used in sonar. These pulses are measured by a series of 'XMU' measurement units recording at extremely high levels of granularity placed at various points at the edge of the grid network and processed by the GridMetrix cloud computing platform.

In August 2019, Reactive Technologies signed an agreement with system operator National Grid ESO (NGESO) to deploy GridMetrix in Great Britain. The implementation process involved the creation of the world's largest grid-connected ultracapacitor (5 MW). The device is currently under construction and will allow, once completed, for information to travel directly into the NGESO control room. This will be a world's first, providing National Grid with the data required to accurately map any deviations in level of inertia and electrical frequency to respond instantaneously and balance the gird in real-time.

The ultracapacitor is being built at Wilton International on Teesside, a major industrial site managed by Sembcorp Energy UK and right at the heart of one of the UK's emerging low carbon hubs, across the water from Dogger Bank, the world's largest offshore wind development project. Once implemented, the project will help to further the UK's ambitions to become an environmental leader globally, enabling National Grid to deploy more renewable energy safely and cost-effectively as it works towards its goal of operating a net zero carbon energy system by 2050.

The United Kingdom has undertaken a significant decarbonisation drive over the past 10 years, outpacing most of its G20 peers and providing an important case study for the challenges and hurdles other nations embarking on their energy transition journey. The window of opportunity for global power systems to implement the technological developments needed to manage this change is shortening as the pace of renewables deployment continues at speed. However, there is also an increasing acknowledgment of the investments needed to support these advancements. According to the IEA's 'Net Zero 2050' report, the annual spend on electricity grids will need to total $820 billion and whilst a significant amount of this will come from governments, the private sector is increasingly aware of the role it will play in catalysing investment in the sector.

Reactive Technologies is a recent recipient of this interest having recently concluded a $15 million funding round which included Bill Gates' clean energy venture fund, Breakthrough Energy Ventures. The fund's impact-focused screen criteria mean it only invests in technologies with the potential, at scale, to reduce greenhouse gases by at least half a gigaton every year (about 1 per cent of global emissions), a key validation of Reactive Technologies' approach to furthering the energy transition through innovation grid solutions.

The backing of Background and Reactive's other strategic investors will enable the company to export its world-first technology beyond the UK into other markets facing similar challenges on their decarbonisation journey. Given the high costs of retrofitting energy infrastructure, such technologies will play an important role, especially for countries such as the US or Australia where diffused grid models are more likely to emerge as a result of their vast geographical areas.

The eyes of the world will be on Glasgow as global leaders come together for COP26 to announce the high-level actions they will be pledging to take to tackle climate change. However, the decarbonisation of the global energy system can only be achieved through investment in the grid technologies that will unblock existing challenges to grid flexibility and renewables penetration, enabling us to accelerate the push to a 100 per cent renewable energy power system as fast as is possible.

Marc Borrett is Co-Founder and CEO, Reactive Technologies Limited.

Borrett: While we see transmission-connected inertia decrease, inertia in the distribution network from pumps, fans and motors remains

Junior Isles

Time to hold your nerve

There is a saying: "Burn not your house to rid it of the mouse." In times of crisis a knee-jerk reaction can create a bigger problem. As several European countries struggle with the effects of astronomical increases in energy prices, there is a danger governments will be swayed by arguments that might ultimately jeopardise climate goals that are already hard to meet.

Last month saw natural gas import prices for the EU skyrocket – up by more than 440 per cent compared to a year ago. The reasons for the current high prices are several. As economies bounce back from the worst effects of the Covid pandemic, demand has risen sharply while supply has tightened. At the same time, weather-related factors including a particularly cold and long heating season in Europe last winter and lower than usual availability of wind energy, have compounded the problem.

The International Energy Agency, noted that European prices also reflect broader global gas market dynamics. There were strong cold spells in East Asia and North America in the first quarter of 2021. These were followed by heatwaves in Asia and drought in various regions, including Brazil. This all added to the upward trend in gas demand. In Asia, gas demand has remained strong throughout the year, and increased demand and prices in the region resulted in liquefied natural gas (LNG) shipments being delivered there rather than to Europe. On the supply side, LNG production worldwide has been lower than expected due to a series of unplanned outages and delays across the globe and delayed maintenance from 2020.

Some blame has also been levelled at Russia. Think-tank Ember noted that fossil gas imports from Russia via Ukraine "have not stepped up to meet the increase in European demand". In a proposal for the EU to centralise natural gas purchases to counteract vendors' market power and build up strategic reserves, the Spanish government said: "Gas producers are behaving strategically to maximise their profits. We should act together to avoid being at their mercy."

The IEA offered a more measured response, pointing out that "based on the available information, Russia is fulfilling its long-term contracts with European counterparts" but also noted that exports to Europe are down from their 2019 level. In a press statement, the Paris-based organisation said: "The IEA believes that Russia could do more to increase gas availability to Europe and ensure storage is filled to adequate levels in preparation for the coming winter heating season. This is also an opportunity for Russia to underscore its credentials as a reliable supplier to the European market."

Meanwhile, Gazprom, Russia's state-backed monopoly gas exporter said it fulfilled all of its long-term contracts to customers but has not made additional top-up sales available through Ukraine this year, while allowing its own storage facilities in Europe to fall to low levels.

Whatever the reasons, the result has seen European electricity prices climb to their highest levels in over a decade in recent weeks, rising above €100/MWh in many markets. In Germany and Spain, for example, prices in September were around three or four times the averages seen in 2019 and 2020, according to the IEA.

Since the gas price rises across Europe and the knock-on effect on electricity prices, the propaganda machines and spin-doctors of the various fuel/technology proponents and political/environmental lobby groups have certainly gone into overdrive.

UKOOG seized the opportunity to once again call on the British government to increase domestic gas production to reduce reliance on imports. Specifically, it asked the government to reassess its position on high volume hydraulic fracturing in England.

Meanwhile the Nuclear Industry Association claimed new nuclear is "the only reliable, low-carbon and British form of power generation" that can stabilise the UK's energy system over the long-term.

This is all heaping pressure on governments to act, fearing a backlash from struggling households.

The EU is now reconsidering plans proposed under the Green Deal to strengthen the European Emissions Trading Scheme (ETS). Pascal Canfin, a French MEP and Head of the European Parliament's Environment Committee, which must approve the commission's green package, said his Renew Europe group was working on plans to "recalibrate" the ETS.

"I'm not convinced by the need to extend the ETS," said Canfin.

Yet taking action to protect the end consumer and at the same time curry favour with voters, politicians are in danger of threatening energy transition goals. Spain, Italy and France have all announced support packages for households, with Spain also saying it will divert a portion of utilities' profits to consumers.

Europe's politicians generally accept the need to move away from fossil fuels but that acceptance is likely to be balanced against the cost of losing votes and this balance often results in unintended consequences. The actions of the Spanish government could stymie the incentive for utility companies to invest in green energy. Its plans to suspend taxes tacked on to consumer electricity bills, which partly help to pay for Spain's energy transition will also not help the already difficult path to net zero.

In a crisis, governments are always tempted to intervene in the operation of energy markets. In the UK, there is even talk of temporarily nationalising failing energy companies to stop them collapsing as a result of the surging gas prices.

Kwasi Kwarteng, Business, Energy and Industrial Strategy Secretary indicated he would be prepared to appoint a "special administrator" that would see the firms taken under government control, effectively nationalising them on a temporary basis.

While this is unlikely to have any significant permanence, the issue of high gas prices is expected to continue for some time, and it will be interesting to see how the UK and other governments handle what could be a drawn-out crisis.

Pressed on whether he saw more gas storage as a solution, Kwarteng said storage is "a bit of a red herring". He stressed that no amount of storage would mitigate the effect of the quadrupling of the gas price in the last six months. Instead he said "the answer to this is to get more diverse sources of supply, more diverse sources of electricity through non-carbon sources."

Giving evidence at a Parliamentary Members Committee meeting on the UK gas market, Kwarteng, stressed the importance of nuclear but admitted it would not help the situation now.

"When I say that nuclear is the answer, clearly it's not the answer next week because it takes time to get nuclear facilities up and running. But as far as 2050 is concerned all of the modelling I've seen suggests quite a large degree of nuclear… I'd guess something like 15 per cent of capacity could come from nuclear."

Green lobbyists and others, however, are convinced that the crisis should not be used as a reason to undermine the energy transition efforts that are gaining momentum. Commenting on Kwarteng's remarks, Rebecca Newsom, Head of Politics at Greenpeace UK, said: "The only way to protect against volatile gas prices is to reduce our reliance on gas altogether. But the Energy Secretary only has half a plan for making this happen.

"He's right about the vital role of renewables but his emphasis on nuclear is completely out-dated given continual cost escalation and project delays. His failure to mention energy efficiency is the major oversight, given this is one of the fastest and cheapest ways to reduce gas demand and boost job opportunities across the country.

This was echoed in Brussels. "The current situation makes the case for the Green Deal policies even stronger. We need more change, not less, and faster," Kadri Simson, EU Energy Commissioner, told the *FT*. "The only real, long-term solution here is to increase the share of renewable energy, which is already generally the cheapest energy on the market."

This is encouraging. There will be some tough decisions in the coming months but with the climate at risk, politicians will need to hold their nerve; take the long term view rather than roll-out temporary fixes that will be regretted later.

As my mother used to say: "Act in haste, repent at leisure."

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