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Smoothing the energy landscape

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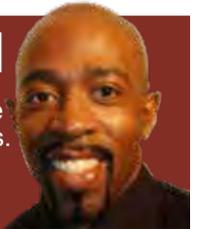
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Next 12-18 months will determine UK climate change credentials

Under scrutiny: UK Prime Minister Boris Johnson must not let climate change commitment slip

As the UK looks set to miss its CO₂ emissions reduction targets, the government's climate change advisory group says the next 12-18 months are crucial. **Junior Isles**

The UK's credibility on climate change hinges on government action over the next 12-18 months, according to the Committee on Climate Change (CCC). The warning came as there were calls for the UK to maintain its commitment to achieving net zero emissions by 2050 following a recent change in political leadership.

In its annual progress report, the statutory climate advisor said the UK's net zero target would require strengthening of the current 100 grammes of carbon dioxide per kilowatt-hour (CO₂/kWh) power industry carbon intensity ambitions. It also urged the UK government to target power sector emissions of below 50gCO₂/kWh by 2030.

The CCC's scenarios for 100gCO₂/kWh require around 270 TWh of low-carbon generation to be online by 2030. The CCC said 180 TWh has already been built or contracted and a further 75 TWh could be achieved by delivering the 30 GW ambition in the offshore wind sector deal, leaving a gap of 15 TWh.

However, a 50gCO₂/kWh carbon intensity target would add 45-50 TWh to the gap in 2030, leaving a total of around 60 TWh additional uncontracted low-carbon generation required during the 2020s.

The CCC said the forthcoming energy White Paper should aim to support a quadrupling of low-carbon electricity by 2050. The CCC also

called on the government to draw up contingency plans for delayed or cancelled low-carbon power projects.

The government has been urged to make plans for networks to be capable of meeting higher demand for electrical energy. The body found the UK has delivered just one of 25 critical policies needed to get emissions reductions back on track.

CCC chairman Lord Deben said it is time for the government to show it takes its responsibilities seriously, stressing that reducing emissions to net zero by 2050 requires real action by government now.

The UK became the first leading economy to adopt a net zero emissions target in June. However, it is set to

overshoot its carbon emissions targets and could face lawsuits for missing the country's legally binding quotas starting in 2023, warned the CCC.

In its annual Progress Report to parliament, published last month, it said the government has failed to enact policies to reach the new goal, and that action during the next 12-18 months would be critical. The report came as Boris Johnson replaced Theresa May as Prime Minister and leader of the Conservative party.

Commenting on the news, Dr Nina Skorupska CBE FEI Chief Executive at the Renewable Energy Association said: "Coming into this role, Boris Johnson has a lot of work ahead of

Continued on Page 2

New EU presidency will maintain pressure on climate change

Hopes of the EU reaching an agreement on achieving net zero carbon emissions by 2050 look more promising with Finland assuming the EU's rotating presidency at the start of July.

Finland has a national climate target of full carbon neutrality by 2035. It is also a country in which green politicians hold some of the highest offices of state, including the posts of foreign minister and interior minister. Taking on the presidency gives it considerable power to steer the bloc's work over the coming six months.

Some are hoping that Finland's strong climate change stance can help push through a EU 2050 net zero agreement.

Krista Mikkonen, the country's environment minister, said her government is committed to reforming Finnish and EU climate policies. She will, however, have to win over Czech Republic, Hungary and Poland, who refused to endorse the target at an EU summit in June, citing economic and social concerns. Estonia also withheld its support from a joint text.

Poland has since softened its position. Minister Tomasz Dąbrowski later said: "We will probably subscribe to this target, it's just we need to know what the cost will be, and in what way we can mitigate the social impact of the whole transformation."

Dąbrowski reiterated Poland's position at the *FT Energy Transition Strategies* conference in London, UK. "For Poland to accept an EU-wide net zero target would require some kind of compensation mechanism that would be equivalent to the costs we have to bear or at least very close," he said. The issue will be revisited by EU leaders at the end of the year, he added.

Carbon prices reached an all-time high in July as polluters and speculative investors scrambled for credits amid an environmental crackdown from the EU. The price of one carbon credit allocated under the EU's Emissions Trading Scheme hit a re-

cord €29.27 in July, double the level of January last year and almost 20 per cent higher than the start of this year.

The rise has come as the total issuance of 950 million credits last year is expected to drop to about 550 million this year. At the same time there is a continuing bullish political backdrop on environmental policy. Ms von der Leyen, the newly elected President of the European Commission, promised environmentally friendly policies including carbon neutrality by 2050, a new EU carbon border tax and a green deal on investment within her first 100 days in office. She will assume office on November 1st.

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him... it is crucial that the UK's commitment to achieving net zero emissions by 2050 does not slip. In order to achieve our legally binding targets and rectify the policy gap highlighted in the Committee on Climate Change's recent progress report; far-reaching, long-term policy must be at the core of the new Prime Minister's agenda."

The REA said the progress report must be "the starting gun for government to get on and deliver" the UK's legally binding ambitions to have net zero emissions by 2050.

"The report reflects the status of renewable and clean tech markets today, with a dearth of policies constraining the pipeline of power, heat and transport projects needed to deliver immediate carbon reductions," said Mark Sommerfeld Policy Manager at the REA.

Notably, the REA said bioenergy paired with carbon capture and storage (BECCS) has the potential to play a critical role in meeting net zero ambitions.

In a new report, it urged action to be taken on a number of levels to ensure progress in hard to decarbonise sectors. The paper outlines a number of possible policy options to develop BECCS, including increasing the UK total carbon price to £50/tCO₂ from 2020 and introducing a mechanism which rewards negative emissions, such as tradeable allowances under an EU-linked UK emissions trading scheme (ETS).



Stevenson: BECCS could play an important role

Samuel Stevenson, Policy Analyst at the REA and author of the paper commented: "According to the Committee on Climate Change, the UK will require CCS at scale in order to achieve net zero emissions by 2050.

"BECCS could play an important role in doing this cost-effectively and sustainably, reducing annual CO₂ emissions in the UK by around 6 per cent, whilst also providing low carbon power, heat and additional co-benefits.

"Negative emissions technologies like BECCS will be needed in order to address the projected 90-130 MtCO₂/yr 'residual' emissions in 2050 from difficult to decarbonise sectors such as agriculture, aviation and industry. It is estimated that BECCS could contribute between 24-51 MtCO₂/yr towards this residual total by 2050."

The government recently announced support for several CCS projects. In late June, Tata Chemicals Europe said it would build Britain's biggest carbon capture project in Cheshire, northwest England, after securing government funding.

The £16.7 million (\$20.7million) demonstration project will capture 40 000 tonnes of carbon dioxide a year from a gas fired plant that was installed by Tata Chemicals in 2000 to provide steam and power for its manufacturing works in Winnington, where the Indian-owned company produces high purity sodium bicarbonate used in pharmaceuticals and food. The funding is part of £26 million awarded to nine companies to accelerate the rollout of CCS.

Decarbonisation and energy transition accelerates, as clean energy investment falls

■ Tipping points to come two years earlier ■ Global energy investment down 14 per cent

Junior Isles

Renewable energy technology advances, innovation in storage and digitalisation and increased distributed energy generation are accelerating the pace of the global energy transition, according to the latest EY research in collaboration with IDC, leading global analyst house.

One year ago, EY teams and IDC mapped the major drivers to determine when three tipping points would forever change the way utilities do business and set the industry on a countdown to reinvention. The latest analysis, covering Europe, the US, Oceania, the Gulf Cooperation Council (GCC) countries, China, India and Latin America, indicates that these drivers are progressing faster than even the most ambitious estimates, bringing forward the tipping points by as much as two years.

The research identifies four key

forces creating a combination of factors that compress the timeline to a new energy world: better, cheaper technology; policy revisions and more ambitious clean energy targets; renewable and behind-the-meter generation gaining momentum, especially among corporates; and stakeholder action that is reshaping energy investment.

Benoit Laclau, EY Global Energy Leader, says: "A revolution in the power sector is driving rapid change in renewable energy supported by digital technologies, the falling cost of battery storage, and empowered consumers... As this journey to a decarbonised and electrified world accelerates, the urgency to act for energy companies, regulators and all energy stakeholders is intensifying."

The findings, however, come as figures show a notable slip in clean energy investment. Figures from BloombergNEF (BNEF) reveal that global investment in global clean energy fell

to \$117.6 billion in the first half of 2019, down 14 per cent compared to the first half of 2018.

The slide is largely attributed to a 39 per cent slowdown in renewable energy investment in the world's biggest market, China, as the country shifts this year away from government-set tariffs to auctions for new wind and solar capacity. This saw renewable energy investment fall to \$28.8 billion, the lowest figure for any half-year period since 2013.

Justin Wu, head of Asia-Pacific for BNEF, commented: "The slowdown in investment in China is real, but the figures for first-half 2019 probably overstate its severity. We expect a nationwide solar auction happening now to lead to a rush of new PV project financings. We could also see several big deals in offshore wind in the second half."

In its 'Global Wind Power Market Outlook Update: Q2 2019' released in

July Wood Mackenzie Power & Renewables forecasts a 2.9 GW quarter-on-quarter expansion in China's wind capacity, as developers scramble to build onshore projects that have to be brought online by the end of 2020 in order to receive feed-in tariff (FiT) support. Offshore developers, meanwhile, need to commission their projects by end-2021.

BNEF's figures for clean energy investment in the first half of 2019 show mixed fortunes for the world's major markets. The "big three" of China, the US and Europe all showed falls, but with the US down a modest 6 per cent at \$23.6 billion and Europe down 4 per cent at \$22.2 billion.

Japan attracted \$8.7 billion of investment, up 3 per cent on 1H 2018, and India \$5.9 billion, up 10 per cent, as it continued its drive toward its ambitious target for 175 GW of renewable energy by 2022. Brazil saw investment of \$1.4 billion, up 19 per cent.

Kenya considers environment, as Lamu coal fired plant blocked

A decision by a Kenyan court to block the construction of what would have been its first coal fired plant highlights the growing importance of lowering the environmental impact of power generation in the country.

At the end of June a tribunal ruled that the National Environment Management Authority had failed to do a thorough Environmental and Social Impact Assessment (ESIA) of the 1000 MW, \$2 billion project planned for a site near the coastal town of Lamu. The location is a Unesco World Heritage site 300 km away from Mombasa.

The government's justification for the coal plant came from its "Vision 2030" goals for development, launched in 2008. Under this strategy,

adequate, reliable, clean and affordable energy was highlighted as key to meeting the country's growing power demand.

However, much has changed over the last decade. Cleaner fossil fuel and renewable projects can now be delivered at lower cost and plant efficiency and reliability have improved. At the same time, demand has not risen as expected.

These developments led judges to rule that there were shortcomings in the environmental impact assessment.

While the ruling will delay project development, it does not stop the proposed plant. Amu Power can conduct a fresh ESIA and apply for a new licence, or can choose to appeal the decision.

David Obura, Adjunct Fellow, The University of Queensland speculated that vested interests were likely to be playing a role in Kenya's push for the coal plant.

Speaking to *The Conversation*, he said: "The plant is owned by Amu Coal – a consortium of Kenyan and Chinese energy and investment firms. There are reports that China has positioned itself to help drive Kenya's energy market while, in its shift to cleaner domestic energy, the country is moving its existing stock and labour abroad."

Nevertheless, China remains central to Kenya's clean energy ambitions. In July, the Nuclear Power and Energy Agency (NuPEA) said it contracted Chinese firm China National Nuclear

Corporation (CNNC) determine the most suitable location for its first nuclear plant.

But even as the agency plans to set up the 1000 MW nuclear power plant by 2027, the Energy Ministry argues that the country should only turn to nuclear power when it has fully exploited other sources of energy.

In July, Kenya unveiled what is believed to be Africa's largest wind farm, the 310 MW Lake Turkana project. Inauguration of the 365-turbine project marks an important milestone in the country's plan to move to 100 per cent renewable energy by 2020.

About 70 per cent of the nation's electricity already comes from renewable sources such as hydropower and geothermal.

IEA puts spotlight on energy efficiency

The International Energy Agency has established an independent high-level global commission to examine how progress on energy efficiency can be rapidly accelerated through new and stronger policy action.

Prime Minister Leo Varadkar of Ireland will be the honorary chair of the IEA Commission for Urgent Action on Energy Efficiency, composed of government ministers, top business executives and thought leaders from around the world.

More than any single fuel, energy efficiency has a central role to play in meeting global sustainable energy

goals. The IEA calculates that with the right policies, the global economy could double in size by 2040 while still maintaining broadly the same level of energy use as today.

Those policies alone would enable the world to achieve more than 40 per cent of the emissions cuts needed to reach international climate goals using cost-effective technologies already available, according to IEA analysis.

But policy implementation has slowed and efficiency progress is weakening. Global energy-related CO₂ emissions increased last year at

their highest rate since 2013, and air pollution continues to be linked to millions of premature deaths each year.

"It is imperative that we get global energy efficiency progress back on track," said Dr Fatih Birol, the IEA's Executive Director.

If countries implement all the economically viable energy efficiency potential available today, consumers around the world could save more than half a trillion US dollars through lower energy bills by 2040.

At the same time, greenhouse gas emissions, air pollution in cities and

dependence on energy imports could all be reduced. However, this will require firm and rapid action from governments, says the IEA.

"The IEA sees energy efficiency as critical for successful clean energy transitions," Dr Birol said. "It has huge potential to start making an immediate difference if governments act now and act decisively."

The focus of the new energy efficiency panel will be on key policy actions that can be taken by countries across the globe. It will produce a concise list of clear, actionable recommendations next year.

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Soo-Yeol, Kim
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KOREA ELECTRIC POWER CORPORATION (KOREA)

ITC extension “critical” for offshore sector

■ ITC set to expire in 2019 ■ NY selects solicitation winners

Siân Crampsie

Proposals to extend financial support for the US offshore wind energy sector have come at a “critical time” for the industry, according to the American Wind Energy Association (AWEA).

US lawmakers have introduced two bills to the US Senate aiming to extend the federal investment tax credit (ITC) for offshore wind energy, a move that will help to “jumpstart” the country’s offshore sector as it prepares the build-out of its first commercial-scale projects.

Senators Markey (D-MA), Whitehouse (D-RI), and Congressman Jim Langevin (RI-02) in June introduced the Offshore Wind Incentives for New Development Act, while Senators Carper (D-DE) and Collins (R-ME) introduced the Incentivizing Offshore Wind Power Act.

The bills would extend the ITC at 30 per cent of the project’s total value for six years and eight years, respectively.

“Without Congressional action, the federal Investment Tax Credit for offshore wind is set to phase out this year – just as the first wave of large-scale offshore wind projects prepare to begin construction,” said Tom Kieran, CEO of AWEA. “At this critical moment for a new US energy industry, policy stability is more important than ever. We appreciate and strongly support proposals that would extend the Investment Tax Credit for offshore wind, jumpstarting the projected \$70 billion build-out of America’s offshore wind infrastructure, delivering large amounts of reliable, homegrown clean energy and tens of thousands of jobs to the US economy.”

The introduction of the two bills was

also welcomed by US Wind, the developer behind the Maryland wind farm off the US east coast. “As the developer of what will be one of the largest commercial offshore wind energy projects in the nation, we applaud these congressional leaders for their vision and determination to incentivise this emerging new clean energy sector in the United States,” said Riccardo Toto, President of US Wind Inc. “There is no disputing the significant economic benefits that offshore wind represents for local economies and the environment – generating tens of thousands of high-paying skilled jobs and providing clean energy power to hundreds of thousands of households.”

The Maryland project is due to start operating in 2023 and will eventually reach 268 MW of installed capacity. It will form part of the 18 GW of offshore

wind due to be built off the US east coast by 2035.

Last month a report by Renewable-UK noted that the USA was becoming a key global offshore wind market, accounting for almost half of market growth globally in the last 12 months.

According to the report, the portfolio of global offshore wind projects in operation, under construction or in development rose from just under 105 GW to over 121 GW in the last year. While Europe is the largest single region, accounting for 66 per cent of the global pipeline, the USA has overtaken both China (12 GW) and Taiwan (8.9 GW) to become the third largest global market.

The pipeline of US offshore wind projects has more than doubled to 15.7 GW, up from 7.5 GW in 2018. In June, the US state of New York signed landmark agreements to procure 1700 MW

of offshore wind energy from two projects.

The state selected Ørsted’s 880 MW Sunrise Wind offshore wind farm and Equinor’s 816 MW Empire Wind project as winners in its first competitive offshore wind solicitation.

Equinor plans to install 60-80 offshore wind turbines in its lease area, located off the coast of Long Island. Its \$3 billion Empire project is expected to start operating in late 2024, it said.

Ørsted and its joint venture partner, Eversource, will install Siemens Gamesa 8 MW wind turbines in the Sunrise lease area, located 50 km east of Montauk Point, Long Island, adjacent to Ørsted’s South Fork and Revolution Wind projects.

Subject to contract signing and Ørsted and Eversource’s final investment decisions, the Sunrise wind farm is expected to be operational in 2024.

Peru takes first steps to reform



Peru has taken the first steps in its planned electricity sector reform programme with the creation of a new commission to review the electricity market.

The Ministry of Energy and Mines has established the Multi-sectorial Commission for the Reform of the Electricity Sector (CRSE), which will undertake a comprehensive review of the current electricity sector.

The CRSE will seek to adapt the electricity market to the integration of new technologies, to guarantee the competitiveness and efficiency of the system and to provide accessible prices, the Ministry said.

The CSRE is due to propose an

initial solution for gas prices for power generation by the end of September 2019, and by the end of the year, it should review the rules for dispatching power generation units in the electrical system and the mechanisms to promote non-conventional renewable energies such as solar PV and wind.

In a second stage, due to be completed in 12 months, it will present a new reform of the power sector.

Power vice-minister Patricia Elliot Blas heads the CRSE, which includes representatives from the energy and mines, and economy and finance ministries, as well as energy and mining investment regulator Osinergmin.

Acciona builds on Chilean investment

Acciona is expecting to reach 700 MW of renewable energy capacity in Chile by 2020, the Spanish renewables developer has said.

The company recently started construction of the 64 MWp Usya photovoltaic (PV) farm in Chile. It has a further 400 MW of renewables capacity under construction in Chile – two wind farms and two PV farms – which are due to start operating in late 2019 or early 2020.

The Usya plant will consist of 187 200 solar modules mounted on fixed structures, installed on a surface area

of 105 hectares. It is expected to be brought into service in mid-2020.

“With the start of construction work on Usya, Acciona is implementing the \$600 million investment plan we announced last year for the construction of four new clean energy facilities in Chile,” said Acciona energy division South America Director Jos Ignacio Escobar. “We are also fulfilling our commitment to make the investments to support previously signed electric power supply contracts.”

Acciona already has 291 MW of facilities in service in the country.

Georgia Power reports Vogtle progress



US utility Georgia Power says that construction work on its Vogtle 3&4 nuclear power plant project has reached a peak.

The Southern Company-owned firm has announced several key milestones at the expansion project near Waynesboro, including the placement of the middle containment vessel ring for Unit 4 and a placement of more than 930 cubic yards (711 m³) of concrete was completed inside the Unit 3 shield building.

The final containment vessel ring for Unit 4 is expected to be placed later this year, while the Unit 3 shield building is now more than 80 per cent complete. In addition, workers have also successfully set the fourth and final core make-up tank for the Vogtle 3 &

4 project. Placed inside the Unit 4 containment vessel, the 330 000 lb (149 685 kg), stainless-steel tank is part of the safety core cooling system to keep the reactor vessel cool using gravity and natural water circulation.

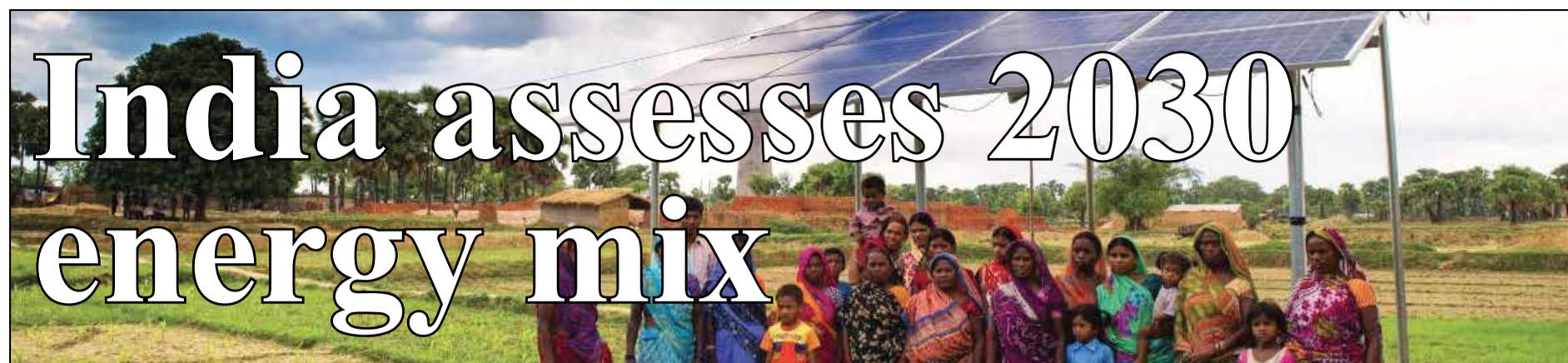
In addition, the final section of the steel floor that sits atop the in-containment refueling water storage tank (IRWST) has been set inside the Unit 4 containment vessel. The project has reached an all-time high with approximately 8000 workers now currently on site, said Georgia Power, which is also planning to expand renewable energy and energy storage capacity.

In July Georgia Power said it had received regulatory approval to expand its renewables portfolio with

2260 MW of wind, solar and biomass capacity and to also own and operate 80 MW of energy storage systems.

The Georgia Public Service Commission (PSC) has given its nod to the utility’s 2019 Integrated Resource Plan (IRP) that will see it boost its installed renewables capacity by 72 per cent and make it account for 22 per cent of its total portfolio by 2024. By that year, Georgia Power’s renewables will grow to 5390 MW, the company announced.

Under the IRP, Georgia Power will invest in improving its power system and proceed with five hydropower projects. The plan also includes initiatives for enhancing energy efficiency and retiring coal fired capacity so as to trim the utility’s coal fired assets by 50 per cent as compared to 2005.



In an optimal generation system, non-fossil fuel sources could generate almost 50 per cent of India's electricity in 2030, according to a recent CEA draft report. **Syed Ali**

The Central Electricity Authority (CEA) has released a draft report on India's optimal generation capacity mix for the year 2029-30.

The report, which was open for comments until July 31st, is a study primarily aimed at finding out the least cost-optimal generation capacity mix, which may be required to meet the peak electricity demand and electrical energy requirement of the year 2029-30 in line with the 19th Electric Power Survey.

Notably, the report points out that the capacity expansion for coal-based projects is not significant as compared

to solar and wind capacity additions. It is projected that solar and wind capacity will be 300 GW and 140 GW, respectively by the end of the year 2029-30, which is more than 50 per cent of total installed generating capacity of 831 GW.

It also said the cost trajectory for battery energy storage system is assumed to be falling uniformly from Rupees 70 million (\$1.2 million) in 2021-22 to R43 million in 2029-30 for a 4-hour battery system, which also includes an additional cost of 25 per cent due to the depth of discharge. The operation and maintenance (O&M)

cost for the battery energy storage system has been considered as 2 per cent.

The report projects that non-fossil fuel (solar, wind, biomass, hydro and nuclear)-based installed capacity is likely to be about 65 per cent of the total installed capacity and non-fossil fuels will contribute around 48 per cent of the gross electricity generation in the year 2029-30.

The report comes as India begins preparing a road map for the power sector, known as the 'Vision Document for Power Sector for the next Five Years.

In order to help India meet its targets and ensure states provide reliable and affordable electricity to consumers, the power ministry recently proposed a "power sector council". The proposal is part of the ministry's 100-day action plan for the second term of the Narendra Modi government. The council will comprise the political executive as well as the energy bureaucracy's power sector to tackle issues between the Union and state governments.

The proposal also comes against the backdrop of the ongoing crisis in distribution companies caused by their

poor financial health, which has led to delayed payments to power generation utilities.

■ In the latest budget announcement, the Gujarat government announced it plans to increase its target for power generation capacity from renewable sources to touch or surpass 30 GW by 2022. The state government has set its sights on tripling its renewable generation capacity over the next three years, and also envisions selling close to 10 000 MW of the generated power to other states. Gujarat also plans to launch a rooftop solar power generation scheme for slum areas.

S. Korea to build world's largest floating solar farm



South Korea will build the world's largest floating solar farm in a freshwater lake next to Saemangeum, a reclaimed area on the west coast, the government said in July.

The Ministry of Trade, Industry and Energy said the project to build a 2.1 GW solar farm on the lake that spans 30 km² was approved in an electricity committee meeting, with the project estimated to cost Won 4.6 trillion (\$3.9 billion).

Work on the solar farm is expected to start in the latter half of 2020 following regulatory review processes, the Ministry said. The plant will be built in two stages – a 1.2 GW first stage, expected to be completed in the fourth quarter of 2022, and a 900 MW

second stage to be completed in 2025.

If the facility is built as planned, it would be 14 times the size of the world's largest floating solar farm in China's Huainan and 1.6 times the combined capacity of the global floating solar facilities for all of last year, the ministry said.

The project is expected to bring the government closer to the goal of its renewable energy initiative, which aims to nearly triple the portion of renewable energy to 20 per cent by 2030.

The roadmap calls for adding 30.8 GW of solar and 16.5 GW of wind power to have a total renewable capacity of 63.8 GW by 2030, which would require vast spaces across the nation.

China gears up for fast EV charging and hydrogen

A strategic agreement struck between Three Gorges Power Energy Management Co., Ltd., Tianda Energy (Shenzhen) Co., Ltd., Shenshang Technology (Shenzhen) Co., Ltd. and Ideanomics Inc. last month illustrates the role China's power companies could play in broadening decarbonisation beyond their own sector.

Under the agreement, the partners will work to promote and distribute methanol, and hydrogen-based EV fast-charging solutions, into existing fuel station networks, as well as residential and industrial areas.

These new energy management solutions will be part of an integrated network access that includes large industrial and commercial compounds, as well as other areas of vehicle concentration throughout China and the ASEAN region.

The partnership's directive is to develop technology to facilitate the shift away from petrol and diesel fuelled

vehicles, while developing more convenient fuel charging areas in addition to utilising the extensive network infrastructure of fuel stations so that these assets are redeveloped over time and not simply abandoned.

Three Gorges Power Energy, the world's largest hydroelectric power company with significant cash reserves, will provide the financing capital, additional operation teams, and the technical resources for energy IoT solutions, intelligent operation and maintenance solutions, smart power solutions, comprehensive energy solutions, and financing resources that will include, but not limited to, Three Gorges Capital Group.

Tianda Energy (Shenzhen) will provide operational teams and technical resources for cold storage technology, and the resources for the external connections such as attachment and conduit technologies, as well as other channel resources.

Ideanomics, through its NECV division, will provide client acquisition, strategic sales and marketing services, as well as other advisory services.

Alf Poor, CEO of Ideanomics, said: "This latest partnership enables us to participate in the lucrative after market, including spare and replacement fuel cells, and the recurring revenue streams from the fast charging station networks we will help to develop and implement... Three Gorges is one of the world's largest energy companies, bringing tremendous expertise and resources at scale. Their Hubei division, along with the other partners in this deal will see us begin to move into EV infrastructure and the long-term revenues offered by charging networks and energy management systems." He added: "The fast charging technology that NECV is working with aims at cutting charging time from the current charge of 30 minutes to between 5-10 minutes."

Power shortages on the horizon

Vietnam could face an electricity shortage of 6.6 TWh in 2021 and 11.8 TWh in 2022. The shortage could increase to 15 billion kWh in 2023, according to the Ministry of Industry and Trade (MoIT).

The potential shortage is due to delayed progress in 47 out of 62 power projects with capacities of more than 200 MW in the Vietnam Power Master Plan VII, according to Phuong Hoang Kim, Director of the Ministry's Electricity and Renewable Energy Authority.

Deputy Minister of Industry and Trade Hoang Quoc Vuong said the main reason for the delayed progress was due to capital and contractor issues. Power projects are often on a big scale with total investment of more than \$2 billion each and long construction times. Therefore, it was not easy

to find capable contractors. In addition, the removal of the government guarantee mechanism for power projects has made it difficult to raise capital.

In addition, it took a long time for BOT projects to negotiate power prices with EVN to ensure their profits, thus causing delays. Vuong also said that prolonged land clearance and low power tariffs were not attractive enough for investors.

Although it is expected that the country will still meet its power demand in 2020, he said there would be risks of a shortage if demand is higher than forecast, water flow to hydropower reservoirs is poor, or there is a lack of coal and gas for electricity production.

To partially mitigate the problem, the Ministry said it would increase electricity imports from Laos and China. Increasing electricity imports is only a

temporary solution, however, and the Ministry stressed the need to speed up work on major power projects.

Several projects have come on line in recent weeks. The 49.5 MW Cat Hiep solar power plant was officially inaugurated in Binh Dinh's Phu Cat district on July 12, 2019, becoming the first of its kind in the south central coastal province to join the national grid. In June, Xuan Tho 1 and Xuan Tho 2 solar power plants were also inaugurated, each adding 49.6 MW to the grid. The 40.6 MW BCG - CME Long An 1 solar power plant was also started up in June.

■ Gelex Energy Ltd has started construction of two wind power plants with a total capacity of 50 MW in Huong Phung commune, Huong Hoa district of the central province of Quang Tri.

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Norway ponders offshore wind move

■ 3.5 GW development in pipeline ■ Equinor meets Norwegian suppliers

Norway's government is mulling plans to open three areas for offshore wind energy development.

The Ministry of Petroleum and Energy has drawn up proposals to open two areas for offshore wind development, and is seeking input on whether to open a third area.

The three areas combined could host up to 3.5 GW of generating capacity and include floating as well as fixed-foundation technologies.

The two areas that the ministry plans to open for offshore wind development

are Utsira Nord and Sandskallen-Sørøya Nord. It is requesting input on the Sørilige Nordsjø II (Southern North Sea II) area.

Utsira Nord lies west of Utsira and Haugalandet and is suitable for floating wind technology. The potential capacity at the site is between 500 MW and 1.5 GW. The area is large, close to shore, and provides opportunities for demonstration projects and larger projects, the ministry said.

Sandskallen-Sørøya Nord is located northwest of Hammerfest in Norway's

high north and has both shallow and deeper areas, making it suitable for both fixed-bottom and floating foundations. It is also suitable for smaller-capacity developments and demonstration projects.

The Sørilige Nordsjø II area could support between 1 GW and 2 GW of capacity and provide a connection to the European continental grid due to its vicinity to the Danish economic zone.

It could support both fixed-bottom and floating wind technology and is

situated in an area with oil and gas activities.

"I want to ensure good coordination between the offshore petroleum and renewables industries. Therefore, I am asking for feedback on whether Sørilige Nordsjø II should be opened and how we best can facilitate the co-existence of these two industries," said Kjell-Børge Freiberg, Minister for Petroleum and Energy.

Last month the Norwegian energy giant Equinor said that it had met with suppliers in Norway to discuss cost-

effective solutions for floating offshore wind farms on the Norwegian Continental Shelf.

Equinor operates the Hywind 30 MW wind farm located in Scotland – the world's only floating offshore wind farm – and is now planning to build Hywind Tampen, the first offshore wind project on the Norwegian Continental Shelf.

The 88 MW Hywind Tampen project will provide power to the Snorre and Gullfaks oil and gas platforms in the Tampen area.

Elia warns of capacity shortage

Belgian grid operator Elia says it envisages increasing capacity shortages in the country as a result of the planned nuclear exit.

In a new report focusing on system adequacy and flexibility for 2020-2030, Elia has warned of the "urgency" of the situation the country could face as coal plant in neighbouring countries is retired and Belgium closes its nuclear capacity. It has called on the government to continue work on the planned capacity remuneration mechanism (CRM) to ensure that the country has a "robust safety net".

The replacement capacity required in Belgium to cope with the changes has risen from 3.6 GW to 3.9 GW,

according to Elia. "The new report confirms and reinforces the conclusions of previous Elia studies from 2016 and 2017," Elia says in the report. "Elia notes that the need for replacement capacity to cope with the nuclear exit ... is now becoming even greater than before, with the new added factor of neighbouring countries bringing forward their coal exit set to make it harder for Belgium to import electricity when it has shortages."

Belgium has pledged to close its nuclear capacity by 2026. Even if this plan is partially reversed or delayed by keeping reactors open for longer, there will still be a systematic need for new capacity, Elia says. In addition, coal

fired and nuclear power plants with a total capacity of around 100 GW will be shut down in other parts of Europe, having an adverse impact on Belgium's ability to import power.

"Additional measures will be required as of winter 2022-2023 to maintain security of supply in this changing context, given that the current strategy reserves mechanism has only been approved until winter 2021-2022," Elia says. "The general capacity remuneration mechanism (CRM), with the support this will give the market, will only be introduced in 2025, meaning that additional measures will be needed in the meantime to bridge the period 2022-2025."

OL3 set for 2020 operations

Operation at the under-construction Olkiluoto 3 (OL3) nuclear power plant in Finland will start in mid-2020, according to an updated schedule from the Areva-Siemens supplier consortium.

Finnish power company Teollisuuden Voima (TVO) says that under the new schedule for the delayed power project, nuclear fuel will be loaded into the reactor in January 2020, and the first connection to the grid will take place in April 2020. Regular electricity production will start in July 2020.

According to the commissioning programme, the unit will produce 1-3

TWh with varying power levels during the test programme, which will start when the unit is connected to the grid and end when regular electricity production starts.

The Siemens-Areva consortium is responsible for building the 1650 MW OL3 plant for TVO but the project is 10 years behind schedule and over budget.

Earlier this year the consortium reached an agreement with TVO over the completion of the project, with Areva-Siemens agreeing to pay €450 million (\$502 million) to compensate TVO, and TVO agreeing to drop lawsuits relating to OL3.

Energia outlines €3 billion investment programme

Irish energy group Energia is to invest €3 billion (\$3.34 billion) in energy generation and related systems over the next five years, it has announced.

The 'Positive Energy' investment programme will be implemented across a range of major renewable energy projects including onshore and offshore wind farms, solar power, hydrogen fuel generation, bio-energy facilities and the smart grid.

It will align the company with the Irish government's recently announced climate targets, Energia Group CEO, Ian Thom said. "To date we have invested over €1 billion in the Irish energy market, driving developments to meet the needs of a high performance economy and society, north and south.

"Our decision to invest over €3 billion in renewable technology and energy infrastructure in the coming years is a clear signal of our intent to build on our continuous commitment to Irish communities, the economy and the sustainability of Ireland's energy supply while contributing decisively to decarbonisation and the protection of our domestic and global environment."

The investment will be supported by Energia Group's owners, the global infrastructure investment group I Squared Capital. Energia Group anticipates that it will add up to 1.5 GW of renewable generation to the grid over the five-year programme.

Energia Group currently supplies over 1.2 GW of green power to the market, including electricity from 22

owned and invested wind farms on the island. It also operates two major gas fired power stations in north County Dublin.

"This substantial investment by Energia Group in Ireland will contribute to the clean and efficient production of renewable energy, the long-term security of a sustainable energy supply, as well as the economic competitiveness and the wellbeing of communities across the island," said Dr Gautam Bhandari, Managing Partner and Co-Founder of I Squared Capital. "It will also further position Energia Group as a European leader in renewable technologies, flexible generation and customer solutions across an extensive customer base in residential and business markets."

Nationalisation plan spooks investors

The threat of electricity sector nationalisation in the UK is affecting investor confidence in the sector, energy companies say.

The UK's opposition Labour Party first outlined intentions to nationalise the electricity sector in 2017 and earlier this year announced it would bring energy networks back under state ownership if it won a general election.

UK power company SSE says that the pledges have made it difficult for the company to attract new investors and that they could also have affected its share price, which have lost 20 per cent of their value since 2017.

A suggestion that Labour would also not compensate shareholders at market value in the event of nationalisation has also been disruptive, SSE's CEO Alistair Phillips-Davies told the *Financial Times* last month.

"We are in a situation where you

have... an event that appears unlikely but could have quite nasty effects and so it's difficult for us to get new investors to buy into the stock," Phillips-Davies said.

Last month a planned auction for Electricity North West, which owns infrastructure responsible for distributing electricity in northwest England, was hit by Labour's energy networks announcement.

Electricity North West was put up for sale last year by JPMorgan Asset Management and Australia's Colonial First State. Final bids in the auction, run by Citigroup, were due in early June, but the status of the auction is now unclear.

Bidders in the auction are thought to have included Spanish utility Iberdrola and Hong Kong businessman Li Ka-shing's Cheung Kong Infrastructure fund.

Saipem targets Saudi for floating wind

■ Partners target 500 MW ■ Onshore wind kick-starts Saudi wind goals

Siân Crampsie

Saudi Arabia could emerge as a key market for floating offshore wind energy after Saipem and Plambeck Emirates signed a deal to build 500 MW of capacity in the Kingdom.

Italy-based engineering firm Saipem has signed a memorandum of understanding with Riyadh-based Plambeck

to design and build the floating wind farm, with an initial planning phase due to start in the “coming weeks”.

The planning phase will be carried out by Plambeck and will be followed by finalisation of financial agreements, Saipem said. The partners will then sign a contract to carry out engineering, design, construction and installation of the wind farm.

Francesco Balestrino, Renewables and Green Tech Product Manager at Saipem’s Xsight division commented: “We believe that the wind market in Saudi Arabia can be supported by innovative solutions for the construction of offshore wind farms, such as the Saipem technology Hexafloat, with an accelerated programme and reduced costs.”

“Initiating the new market in Saudi Arabia is an important opportunity to be seized and we are ready with Plambeck for this new challenge.”

The project would form a key part of Saudi Arabia’s Vision 2030 renewable energy programme, under which it plans to install 7 GW of wind capacity within five years, and 16 GW by 2030. The country recently kick-started its

onshore wind energy sector with a concession for the 415 MW Dumat Al Jandal wind farm – the country’s first commercial-scale project – awarded to a consortium of EDF Renewables and Masdar earlier this year.

EDF and Masdar recently placed an order with Vestas for the construction of Dumat Al Jandal and supply of 99 V150-4.2 MW wind turbines.



Senegal PVs reach financial close

Construction of two solar photovoltaic (PV) farms in Senegal have advanced to the construction phase following financial close.

The two 60 MW ac plants – located in Kahone, in the Kaolack region, and in Touba-Kaël, in the Diourbel region – are part of the World Bank’s Scaling Solar initiative and attracted “significant international investor interest”, according to the International Finance Corp (IFC).

The total investment cost for the projects amounts to €47.5 million, with debt provided by the European Investment Bank (EIB), the International Finance Corporation (IFC), the Finland-IFC Blended Finance for Climate Program, which helps spur private sector financing for climate change solutions in emerging markets, and Proparco. Engie and Meridiam hold a 40 per cent shareholding in the project

company. FONSI, the Senegalese sovereign fund, is a shareholder with a 20 per cent equity stake.

Scaling Solar is a World Bank Group programme that offers competitive bidding and streamlined procurement for grid-tied solar photovoltaic power in emerging markets. The programme is supporting the development of more than 1 GW of solar power across Africa.

The Senegal projects drew six bids for each project, with the October 2017 tenders resulting in tariffs of 3.80 and 3.98 Euro cents per kWh – one of the lowest prices for electricity in West Africa – from Engie.

“In an extremely competitive context, Engie reaffirms its commitment to be a long term player in Senegal and to bring clean and affordable energy to the country while creating sustainable jobs,” said Yoven Mooroooven, CEO of

Engie Africa. “These projects are perfectly in line with the strategy of the Group to become a leader in the zero carbon transition “as a service” for our customers in Africa.”

In Senegal, Engie is already involved in the Senegy project, a 30 MW solar photovoltaic plant in the town of Santhiou Mekhé and in Ten Merina, a 29.5 MW solar photovoltaic plant in the region of Thiès, near Dakar. In 2017, it signed a partnership with ANER, Senegal’s National Renewable Energy Agency, which focuses on accelerating the development of renewable energy in the country.

Engie is also implementing solar energy solutions for rural households in Côte d’Ivoire and in Senegal through partnership agreement signed with L’Agence Sénégalaise d’Électrification Rurale (ASER).

Oman launches solar tenders



Oman is looking to solar energy technologies in a bid to boost generating capacity.

The Oman Power and Water Procurement Company (OPWP) has issued a Request for Qualifications (RfQ) for the construction of two new solar photovoltaic (PV) Independent Power Producer (IPP) projects with a combined capacity of 1000-1200 MW.

It is also mulling development of a concentrating solar power (CSP) plant in Duqm in lieu of a planned clean coal fired power plant, and two wind farms.

The power plant proposals have been developed in response to rapid growth in electricity demand, which could reach 23 per cent per annum in some areas due to strong investment inflows, OPWP said in its recent seven-year statement. Peak demand is expected to grow at five per cent per year up to 2025, OPWP said.

The solar PV RfQs are an invitation to international developers to participate in a competitive tender for PV schemes in Manah Wilayat in the interior of the country.

Dubbed Manah Solar I IPP and Manah Solar II IPP, the projects will be sized at between 500 MW and 600 MW each. The contract award for Manah Solar I IPP and Manah Solar II IPP will include the development, financing, design, engineering, construction, ownership, operation and maintenance of the solar farms, OPWP said.

“The Manah Solar I IPP is expected to be commissioned and the contracted capacity made available by November 1, 2022. The Manah Solar II IPP is expected to be commissioned and the contracted capacity made available by February 1, 2023,” OPWP said, adding that both IPPs are expected to be located adjacent to each other at a site in Manah.

Oman’s maiden solar PV project – a 500 MW capacity scheme – is currently under construction at Ibri Wilayat in the far west of the Sultanate, and is due to come into operation in 2021.

In addition to solar PV based renewables capacity, OPWP also plans to procure two wind based IPPs towards the end of 2020 with the goal of bringing them into commercial operation in 2023. Expected locations are Duqm or areas within the North Oman (MIS) grid. The combined capacity is estimated at 300 MW.

OPWP said in July that it is mulling development of a concentrated solar power (CSP) plant in the Special Economic Zone (SEZ) at Duqm as an alternative to a proposed coal fired power plant.

OPWP carried out a feasibility study and initiated the procurement process for the 1200 MW Duqm coal IPP in 2018, but the project has not yet been approved. It is therefore developing plans for a 600 MW CSP plant as an alternative, it said.

Cameroon moves on with 1 GW hydro plant

Development of a 1000 MW hydro-power plant in Cameroon has taken a step forward with the signing of a letter of intent by its developers and the country’s government.

The GrandEweng hydropower project is one of sub-Saharan Africa’s largest private sector power projects and will be located on the Sanaga River between Yaounde and Douala in the eastern Littoral Region.

Last month developers Hydromine and Eneo Cameroon signed a letter of intent with Cameroon’s Ministry of Water and Energy, setting out a framework for development of the project on a build, own, operate, and transfer

(BOOT) basis. The parties agree to finance and begin construction of the project within three years, with electricity generation starting in seven years.

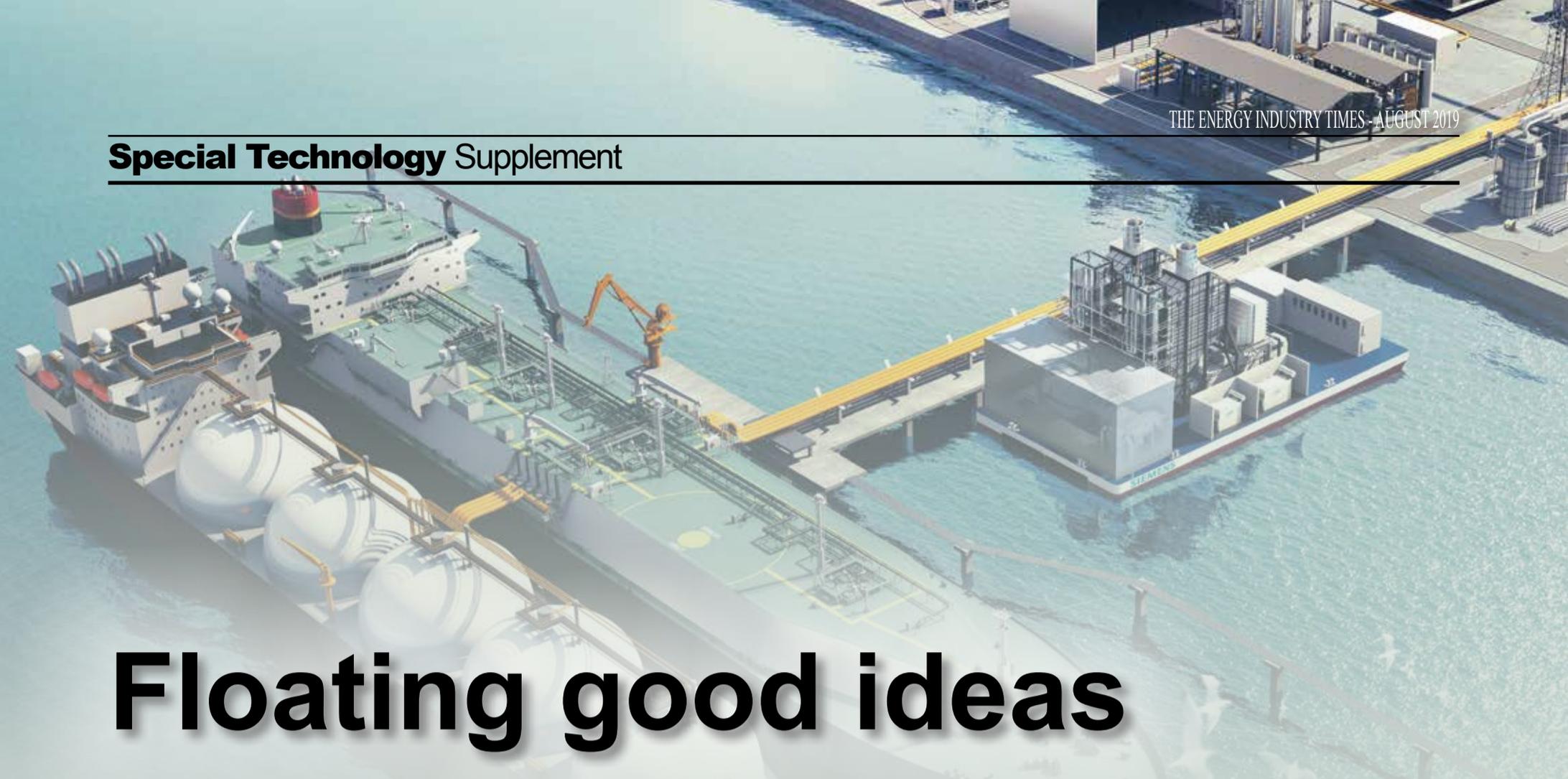
The project will be developed in phases, starting with 1000 MW in the initial phase, potentially reaching 1800 MW later on, the developers said.

Its energy will make a significant contribution to Cameroon’s electricity demand, which is expected to be more than 3300 MW by 2030 and may reach 4000 MW in a high growth scenario. The project will also help Cameroon reach its goal for economic

development, employment and living standards.

USA-based Hydromine is the original sponsor and developer of Grand Eweng since signing an exclusive letter of intent with the Republic of Cameroon in 2009, a memorandum of understanding in 2012, and a project development agreement in 2015 that was extended in 2018.

Hydromine financed and undertook detailed project technical studies and will shortly begin public consultations related to the environmental and social studies for the sustainable and transparent implementation of the project.



Floating good ideas

Having a power plant that can be moored near-shore or on a river has many advantages. With its new SeaFloat concept, Siemens has resurrected the idea of floating power plants but this time with the possibility of putting almost any of its high efficiency land-based gas turbine plants on a barge. Already, the first order has been secured for the Dominican Republic – a project that will also feature battery storage. **Junior Isles**

The idea of floating gas fired power plants is not a new one. But rising global population, many of which are moving to live in megacities, where land is limited and expensive, could see the resurgence of these mobile power plants. Certainly Siemens sees this as one of the key drivers behind the development of a new floating combined cycle power plant concept it calls SeaFloat.

According to Siemens, SeaFloat technology combines state-of-the-art combined cycle power plant technology with the mobility and flexibility required by the current and future energy market.

Explaining why he thinks the market is now right for SeaFloat, Hamed Hossain, Business Owner SeaFloat Power Plants, Siemens Gas and Power, said: “In the mid 90s, floating power plants were becoming popular. At the time, Westinghouse (later bought by Siemens) was building floating power plants with gas turbines operating in open cycle. However, we saw an increase in oil and gas prices, which meant it was not worth building these plants anymore because of their low efficiency.”

“Now it’s different. We are building state-of-the-art combined cycle power plants with really high efficiency,

which means if oil and gas prices increase even more then it’s still worthwhile, economically. And if prices fall, we can use open cycle plants. So we have all the technology that’s available for land-based power plants on a floating structure. This allows flexibility on plant configuration, since installations are less affected by fuel price.”

The real impetus to re-boot the idea of floating power plants, however, came about three or four years ago in response to market demand. Hossain said: “Customers were asking: ‘can you supply your technology on a floating device?’ So we decided to do it again. Two and a half years ago, when we saw that the market was really pushing for it, we set up an entity within Siemens to specifically focus on it.”

Hossain sees SeaFloat as a technology that essentially gives customers more options when it comes to locating power plants, i.e. they can be built on water when land is too expensive or unavailable, and in locations where there is a high country risk.

The technology has numerous applications, such as: powering up remote areas like islands; development of industrial areas on shorelines or major rivers (for example, chemical and desalination plants); the replacement of out-dated plants, allowing the existing plant to continue operating until the new one is in place and ready to be connected to the grid.

SeaFloat power plants, which can provide from 145 MW up to 1.3 GW, can also be used as emergency backup for existing power plants during peak loads or outages and to provide power supply in the event of a humanitarian disaster.

Another area where Siemens anticipates great demand is in the oil and gas sector. “We are in contact with all the oil and gas majors. Our portfolio is to put our power plants on FSRUs (floating storage regasification units),” said Hossain. “Looking at FPSOs (Floating Production Storage and Offloading vessels), traditionally they all use open cycle plants, which have higher emissions relative to power output compared to

combined cycle plants.

Installing a power plant for this application has its challenges, however. Although the SeaFloat power plant is compact and has a high power density, for an oil and gas platform, the weight and footprint has to be reduced even further. For a platform it should also be easy to install and have a high degree of modularisation.

“This is how we came up with the ultra-light floating combined cycle power plant, which is part of the SeaFloat portfolio,” said Hossain. “It’s a major game changer; we have reduced the weight and footprint of the power plant by more than 50 per cent compared to combined cycle power plants already installed on existing platforms.”

Installing a SeaFloat plant would certainly help oil and gas majors improve their green credentials and lower the cost of emitting carbon. In a country or industry where CO₂ prices are high, of the order of €50/t, the savings can be significant.

“Putting a combined cycle plant on an oil and gas platform or FPSO could reduce CO₂ footprint by 80 000-110 000 t/annum. This translates to high single digit millions of euros in savings from CO₂ taxes and certificates each year,” said Hossain.

Siemens currently offers SeaFloat power plants based on three main gas turbine technologies – the SGT-800, SGT-A65 and the SGT-8000H series – but says it is not limited to these machines. “In addition to these, we also have the SGT-750, SGT-A35 (formerly the RB211), which will be for the oil and gas market,” noted Hossain.

With the three initial technologies on offer, Siemens says it can address the majority of the market requirements it has seen so far. The turbines were selected following careful market analysis, an examination of the advantages of each turbine and according to feedback from customers and developers that have contacted Siemens.

Each of the three gas turbine solutions has its own benefits. Hossain explained: “The SGT-800 solution is our frontrunner. Two thirds of the

market is desperately screaming for the SGT-800, not only because it is a technology frontrunner but because of the various configurations that are possible. You can use it for new power generation installations based on LNG, and expansion of industrial applications in remote coastal areas.

“For a peaker, or fast-start plant; i.e. start-up in less than five minutes in cold conditions or less than two minutes under hot conditions, the SGT-A65 is the right solution.”

Because of its size, the SGT-8000H would be best deployed in situations where a large amount of bulk power is needed, and space is limited but the grid is stable. Hossain said: “It’s not possible to take an H-class unit capable of 620 MW or 1.3 GW in a 2-on-1 configuration and feed it into a weak grid in a developing country but in these cases we could offer our transmission grid stability solutions. And the H-class would have advantages. If for example, you want to replace a large coal fired power plant in a region that has a more stable grid, with a more efficient, lower emissions plant, here the H-class is the right fit.”

He noted that customers in countries with labour challenges or those wanting to avoid the time and effort involved in obtaining permits to install land-based plants, are interested in installing SeaFloat plants.

Project risk resulting from brown-field activities such as demolition works, site levelling activities, relocation of existing structure, etc., can be avoided when replacing old plants. As the barges are built at modern shipyards, the project schedule does not depend on availability of qualified labour and infrastructure at the final location. According to Siemens, this can cut construction time by 20 per cent.

Siemens believes it is the simple plug and play, connect and go, possibility that makes SeaFloat plants so attractive.

The concept allows fast and easy installation at shipyards. A SeaFloat plant, with the SGT-800 in particular, has a high degree of modularisation, where delivery of pre-assembled and pre-tested plant modules minimises

Hossain: Customers were asking, ‘can you supply your technology on a floating device?’



Special Technology Supplement

the manpower required at the construction yard and the hook-up time at place of operation.

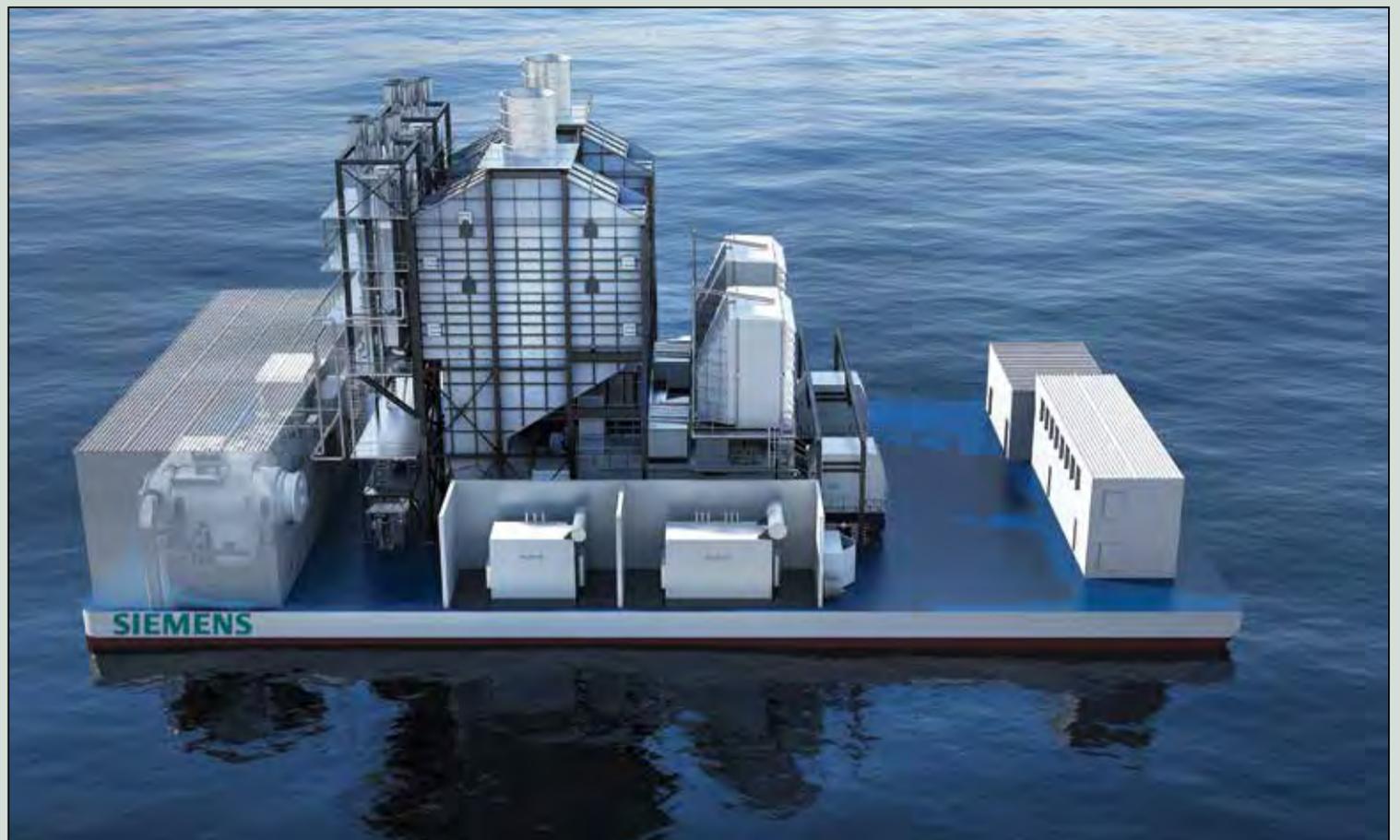
The SGT-800 combined cycle SeaFloat can be provided in SCC-800 2+1, 3+1 or 4+1 configurations to produce 150-450 MW. The SCC-800 2x1 has a length of 55 m and width of 30 m. According to Siemens, these plants are an excellent choice for providing baseload power to public or industrial grids, as well as for oil and gas applications. They offer broad flexibility in fuels, operating conditions, maintenance concepts, package solutions, and ratings.

The plant is designed to withstand near-shore conditions, with equipment intended for on-board installations based on international codes and standards valid for power plants. Certain modifications are implemented to suit the marine environment with respect to, but not limited to air intake filters, materials, surface treatments and protection against water ingress and corrosion. Movements and deflection are addressed by particular technical modifications.

Hossain noted: "SeaFloat is not re-inventing the wheel; it's not rocket science for the Gas and Power business. It is the same technology we use on a land-based plant that has been optimised for a floating device. You could look at it as a power plant with a moving foundation. This means it has roll, pitch and acceleration; and the hull of the floating device has deflections. When you want to build a power plant on top of a foundation that is bending and moving up and down, you have to ensure your equipment can withstand the roll and pitch, acceleration, as well as the deflection."

As an example, he noted that the SGT-800 comes as a single-lift package on a 3-point mount frame, consisting of turbine, mechanical auxiliary systems, gearbox, generator and generator switchgear. It has a weight of about 265 t and comes pre-assembled and system tested with a dedicated electrical and control module.

"This means the solution stands on three legs, designed as a foundation to withstand the deflection of the hull. The gas turbine is almost the same [as



the land-based machine]; it's just the connection point to the foundation needs some smart solutions to really make it happen," noted Hossain. "Deflection must not be transferred to the gas turbine, so it has to be decoupled. For roll and pitch and acceleration, you have to address the lube oil systems. If the barge moves in one direction as a result of roll and pitch, you have to ensure the gas turbine bearings remain lubed."

The single-lift package concept enables 48 h core engine exchange for plants with highest requirements on availability. The easy 'roll-out' capability of the gas turbine core engine enables on-board maintenance and overhaul, with turbine inspections/overhauls, hot gas path inspection

(HGI) and major overhaul (MO) at every 30/60 000 equivalent operating hours (EOH).

The SST-600 steam turbine (ST) is also provided as a pre-assembled and system tested single-lift package on a 3-point mount base frame. It has a weight of about 475 t. The steam turbine single-lift package consists of steam turbine, condenser with evacuation systems, generator and generator switchgear. It has a size of 25 m x 7.0 m x 5.5 m (length, width, height).

The Once Through Steam Generator (OTSG) will be provided as a package with maximum modularisation. This modular approach has been applied in dozens of units worldwide and, says Siemens, results in safer and better quality fabrication

under optimised shop conditions. The arrangement enhances faster and smoother installation at the shipyard. The steel structure for the OTSGs is designed as one combined block, so a rigid structure is formed to withstand marine environment conditions.

The OTSG package has a weight of approximately 665 t. The SCC-800 2-on-1 plant configuration has a size for the OTSG combined structure of 14 m x 23.6 m x 28 m (length x width x height).

The entire power plant can be installed under various commercial models, including straightforward sale and various lease options. "We are open to all options," said Hossain. "At the moment the market is asking more for sale options, where the

SeaFloat gives owners more options when it comes to locating power plants



The SGT-800 gas turbine will be provided as a single-lift package and 3-point mount installation, consisting of turbine, mechanical auxiliary systems, gearbox, generator and generator switchgear

Special Technology Supplement

Types of SeaFloat plants

	Length (m)	Width (m)	Area (m ²)	Net power output (MW)	Efficiency (%)
2x SSC-A65 (50/60 Hz)	~50	~22	~1.100	147/151	55/55.3
SCC-800 2x1	~55	~30	~1.650	149.4	56.6
SCC-800 3x1	~65	~40	~2.600	224.4	56.6
SCC-800 4x1	~75	~40	~3.000	299.3	56.7
SCC5-8000H 1x1 (50/60 Hz)	~170	~60	~10.200	665/460	61
SCC5-8000H 2x1 (50/60 Hz)	~170	~90	~15.300	1330/930	61

Note: SSC = Siemens simple cycle; SCC = Siemens combined cycle

power plant is sold to the customer. Some are also asking for Siemens to operate the plant; so we can add an O&M contract to the sale. Others ask for a special purpose vehicle to be set up to own and operate the project and ask if Siemens is willing to take a share in the project as a stakeholder if a project is viable. We have done it for land-based plants – where we bring in equity or financing – and can also do it for sea-based applications.”

The economics of SeaFloat projects appear to be sound. According to Siemens, the SeaFloat concept completed in a shipyard will provide the customer with “a quality proven power plant” at a potentially 20 per cent lower CAPEX than a similar land-based plant.

A SeaFloat power plant could operate as a baseload power plant with the aim of selling electricity but with the owners also being paid a premium for having the ability to always stay

connected to the grid, providing frequency control when needed. This is made possible with a battery storage system. Here, Siemens can also deliver its hybrid SIESTART solution, combining a flexible (gas turbine) combined cycle power plant with a battery energy storage system.

The SeaFloat concept is already beginning to bear fruit. At the end of November 2018, Siemens and the marine arm of ST Engineering in Singapore jointly secured the first order for a project for a SCC-800 2x1C SeaFloat power plant from Seaboard Corporation subsidiary Transcontinental Capital Corporation (Bermuda) Ltd., an independent power producer (IPP) with operations in the Dominican Republic.

Under a turnkey plug and play concept, Siemens as consortium leader will provide a 145 MW SeaFloat combined cycle power plant known as Estrella del Mar III, along with its

SIESTART solution. ST Engineering will be responsible for the engineering design, procurement and construction of the floating power barge, the balance-of-plant and the installation of the floating power plant.

ST Engineering will receive the gas turbine as a pre-installed package, the steam turbine as a separate package and the boiler in three modules, where it will be erected and pre-installed at a controlled, highly skilled shipyard. It will then be towed to the final destination and connected to the grid.

For the SIESTART solution, Fluence Energy, a company jointly owned by Siemens and AES, is providing a 5 MW/10 MWh battery energy storage system to be integrated as part of the power plant for frequency regulation control. This will allow the plant to operate at full capacity with highest fuel efficiency.

The Estrella del Mar III plant will replace existing power barges based

on reciprocating engines at the customer’s location in the capital city Santo Domingo. Using combined cycle gas turbine technology will increase efficiency and lower emissions, which is especially important in built-up areas.

Due to site constraints with limited free land and Seaboard’s experience with previous power barges, the plant owner selected a SCC-800 2x1 SeaFloat concept with two Siemens SGT-800 gas turbines and one SST-600 steam turbine.

This first SeaFloat project is advancing smoothly. Power plant equipment is expected to leave Siemens’ manufacturing facilities shortly so that erection at the shipyard can begin soon after. The plant will be connected to the grid of the Dominican Republic in the spring of 2021.

And with the first order secured, Siemens expects others will follow soon. “We are involved in many activities all around the world. There could be orders from any country – from the US to Asia, where we are currently supporting customers. We are not limited to any specific country; there are a lot of opportunities.”

Siemens will also continue to develop the technology. As Hossain concluded: “Siemens always takes an evolutionary approach as opposed to a revolutionary approach. So we are continuously checking our design, receiving feedback from execution teams – both land-based and those that will be in the Dominican Republic – and feeding it back into our team. This will allow us to continue improving our solution, so that each customer can expect the highest quality SeaFloat application based on the experience of our fleet.

The SCC-8000H SeaFloat can replace a large coal fired power plant in a region with available grid capability





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Companies News

RR builds on partnerships

Rolls-Royce is strengthening agreements with established partners in a bid to strengthen the global reach and technological depth of its business.

Siân Crampsie

Germany-based company Rolls-Royce has signed a deal with GETEC to "intensify" an existing agreement on the design and supply of decentralised energy systems in Europe, and has also pledged to step up another agreement with China-based Guangxi Yuchai Machinery Company covering the construction and sale of engines.

Rolls-Royce will act as a technology partner to GETEC to supply and

operate efficient and environmentally friendly decentralised energy systems, such as CHP plants and on- and off-grid microgrid solutions, in addition to energy-related services and energy-efficient solutions in contracting. Both partners will also jointly develop new solutions for the supply of energy to industrial companies.

"The energy world of tomorrow is decentralised, efficient and innovative. These are characteristics that both GETEC and Rolls-Royce with

its MTU Onsite Energy brand embody to the same degree. With this cooperation agreement, therefore, we intend to provide our joint customers with optimum economic and sustainable solutions and in this way reduce their carbon footprint," said Thomas Wagner, CEO of the GETEC Group.

In China, Rolls-Royce is partnering with Guangxi Yuchai Machinery Company in a joint venture, MTU Yuchai Power, to manufacture MTU S4000 diesel engines in the southern

city of Yulin.

"The successes we have had so far are a good basis for working together to develop further areas of collaboration for the benefit of all involved," said Tobias Ostermaier, President, Greater China at Rolls-Royce Power Systems, at the signing of the agreement.

"In Rolls-Royce Power Systems, we are happy to have found a globally successful partner and a technology leader. Combining this with the local market knowledge and production

capability of Yuchai Machinery is an ideal way to address the future together," emphasized Yan Ping, Chairman of the Yuchai Machinery.

"It is a great pleasure for me to see the partnership between a Chinese and a European company growing and thriving," said Chen Wu, Chairman of Guangxi Zhuang Autonomous Region. The region has a population of almost 50 million and is home to both Yuchai Group and the MTU Yuchai Power joint venture.

Vestas settles GE dispute

Vestas and GE say they have reached an "amicable" settlement in a legal dispute over patent infringements in the US.

GE's Renewable Energy business filed legal complaints against Vestas Wind Systems and Vestas-American Wind Technology in 2017 claiming infringements on two of its US patents relating to wind turbine technologies.

According to a statement from Vestas, the settlement has brought an end to all of the pending legal cases against the company, and includes a cross-license to the patents-in-suit and their family members, as well as a confidential payment from Vestas to GE.

The cross-license applies globally to the parties' and their affiliates' respective onshore and offshore wind businesses and ensures that they can use the technology covered by such patents.

The patent dispute covered technologies that enable wind turbines to manage grid faults, Vestas said. Following GE's filings in July 2017, Vestas filed a number of counter-claims against GE, alleging infringement of patents covering its own wind turbine technologies.

■ GE Renewable Energy has announced that it will open a new offshore wind factory at Jieyang Offshore Wind cluster in the Chinese province of Guangdong and will establish a new Operation and Development Center in the city of Guangzhou. The new centre will perform research and development activities focused on regional needs. Its Saint-Nazaire assembly site in France, currently manufacturing the Haliade-X 12 MW prototype wind turbine, will continue to serve all its other international projects.

Total ties up CCUS partnership

Total has scaled up its partnership with IFP Energies Nouvelles (IFPEN) to advance the development of carbon capture, utilisation and storage (CCUS) technologies.

The five companies have signed a strategic R&D partnership worth €40 million that will examine ways to reduce technology costs. It will also fund a chair at the IFP School to help train a new generation of international researchers and experts on low carbon technologies.

The year-long partnership builds on an existing collaboration between IFPEN and Total and will focus its research on fields related to new materials, process scale-up, underground carbon storage in deep saline aquifers, technical and economic feasibility studies and the quantification of environmental benefits for the entire CCUS chain.

Didier Houssin, Chairman and CEO of IFPEN, commented: "IFPEN has

been actively researching carbon capture, utilisation and storage technologies for nearly 20 years.

"Our strengthened partnership with Total will allow us to combine our teams' skills and know-how with Total's and thus to accelerate the deployment of CCUS technologies, which are a key solution for drastically cutting CO₂ emissions."

According to the International Energy Agency's (IEA) Sustainable Development Scenario, which corresponds to a less than 2°C rise in the global average temperature, it will be necessary to capture and store 6 billion tons of carbon by 2050. This will require developing viable, cost-competitive CCUS technologies.

Patrick Pouyanné, Chairman and CEO of Total, said that the partnership would pool the two companies' innovation capabilities "to reduce the cost of CCUS technologies and improve their efficiency".

CorPower and Simply Blue target ocean energy

- Wind-wave combination investigated
- CorPower technology at heart of collaboration

CorPower Ocean and Simply Blue Energy are to investigate opportunities for commercial-scale ocean energy development around the coasts of the UK and Ireland.

The two companies have signed a strategic collaboration agreement to develop wave energy projects and say that projects could be on line as early as 2024.

They will also investigate the possibilities of combining floating wind and wave energy farms.

The agreement follows work carried out by Simply Blue Energy to identify the most viable emerging wave energy technologies and identify development areas suitable for commercial wave energy project development.

Under the agreement, Simply Blue has exclusive rights to use CorPower's

technology in the development areas identified. The company will also investigate the feasibility of combining offshore wind with wave energy as a means of reducing costs and increasing the output of project sites.

"We have worked with the team at CorPower over the last two-and-a-half years and they have, during this time, convinced us that they have the ability to bring their technology to the required levels of technical readiness within the timeframes we have agreed," said Sam Roch-Perks, CEO of Simply Blue Energy. "We are also excited to explore the possibility of combining floating wind and wave energy to bring balance to the grid which is so important if we are to increase the reliability and viability of renewable energy."

CorPower says that its wave energy

converter device can achieve five times more energy per ton of device compared to previously known technologies, allowing a large amount of energy to be harvested using a small and low-cost device.

"We are very excited about the collaboration with Simply Blue Energy which is a dedicated blue economy developer with strong vision and execution capabilities," said Anders Jansson, Commercial Director, CorPower Ocean. "These commercial projects line up as the next step following our ongoing product verification and certification programme. Having a commercial developer investing in projects based on our technology is a significant milestone for CorPower and the wave energy industry as a whole."

Tractebel leads innovative offshore PV drive

Floating offshore solar photovoltaic (PV) farms could be the next step in offshore renewable energy technology, according to a new international consortium.

Tractebel, JanDeNul Group, DEME, Soltech and Ghent University have joined forces to investigate the feasibility of and opportunities for offshore solar technology. They believe that offshore solar farms, co-located with offshore wind energy and other offshore resources, such as aquaculture, is the next logical step in the energy sector.

The companies will develop new concepts and perform laboratory and field testing to take the first steps towards the commercialisation of offshore PV technology. The €2 million has been set up in the framework of the Flemish Blue Cluster and is led by Tractebel.

According to the partners, development of offshore PV technology is a natural step after floating PV farms on lakes, lagoons and other sheltered environments. Factors such as land scarcity, large scale standardisation and "not in my backyard", or NIMBY,

thinking impact could also drive the uptake of offshore PV, they said in a statement.

Their ambition is also to be the first to realise offshore solar farms in the Belgian North Sea. One of their main challenges will be to adapt solar PV technology for the rough offshore environment so that it is able to withstand salt water, waves and strong currents.

A cost-competitive concept for a floating structure needs to be designed, while ecosystem integration of the floating PV panels will be investigated from the start, the partners say.

10 | Tenders, Bids & Contracts

Americas

Hyundai bags Guam CCGT deal

A consortium comprising Korea Electric Power Corp. (Kepco) and Korea East-West Power Corp has awarded Hyundai Engineering Co. a \$534 million deal for the construction of a 200 MW power plant in Guam.

Under the contract, Hyundai Engineering, the construction arm of Hyundai Motor Corp., will build the combined cycle gas turbine (CCGT) plant in Dededo, northern Guam.

The Kepco-led consortium was named the preferred bidder for the project by the Guam Power Authority in June.

The project is expected to take 30 months to build.

SGRE wins 1.7 GW order for US offshore wind projects

Siemens Gamesa Renewable Energy (SGRE) has received a record condition order for the supply of just over 1.7 GW of wind turbines for three offshore wind farms in the USA.

The wind turbine manufacturer has signed a conditional contract with Ørsted and Eversource to equip the 880 MW Sunrise wind farm, the 704 MW Revolution Wind project, and the 130 MW South Fork project.

The conditional contract is the largest US offshore wind power order to date. The contract encompasses the supply, delivery, and installation of SG 8.0-167 DD wind turbines including service agreements in federal waters off the northeastern coast of the US.

The projects expected to be online between 2022-2024 subject to a final investment decision by Ørsted and Eversource.

Highview Power plans giga-scale storage

Highview Power has contracted Tenaska Power to identify, model, optimise and provide energy management services for up to four giga-scale cryogenic energy storage plants in the United States.

Highview is planning to develop the long-duration energy storage facilities based on its proprietary CRYOBattery cryogenic storage technology, with the first project expected to be developed in the ERCOT market.

The projects are expected to help the US grid integrate large quantities of renewable energy capacity as well as increase reliability, improve power generation economics and balance the grid.

Asia-Pacific

Wind turbines ordered for No. 5 Thanh Hai

Tan Hoan Cau JSC has placed an order with Siemens Gamesa Renewable Energy (SGRE) for the supply of seven SG 4.5-145 wind turbines for the first phase of the No. 5 Thanh Hai wind farm project in Vietnam.

The 32 MW project is a near-shore wind farm due to be built 2-5 km off the coast of Vietnam's Ben Tre province. Siemens Gamesa's contract with Tan Hoan Cau JSC, a Vietnamese independent power producer, includes a conditional order for seven more SG 4.5-145 for the second phase of the project.

SGRE has adapted its onshore wind turbines for the near-shore environment, it said, and is coordinating the discussions with the financing parties, which includes the

Danish Export Credit Agency, an international bank and one of Vietnam's largest banks.

The wind farm is due to start operating in mid-2020.

Goldwind to supply NSW wind turbines

Goldwind Australia Pty Ltd has won a contract to deliver and install turbines for the 108.5 MW Biala wind farm in New South Wales, Australia.

Goldwind will equip the wind farm with 31 of its GW140/3.57MW wind turbines at a site close to Grabben Gullen, in the state's Southern Tablelands. Construction is due to start shortly at the wind farm, which is owned by Beijing Jingneng Clean Energy (Australia) Holding Pty Ltd.

Biala wind farm is due to start operating in the first quarter of 2020.

SFW CFB selected for Taiwan mill

Cheng Loong Corp (CLC) has awarded Sumitomo SHI FW (SFW) a contract to supply a circulating fluidised bed (CFB) boiler for the Chupei Mill in Taiwan.

SFW will design and supply the 19 MWe CFB steam generator and auxiliary equipment and also provide technical advisory services for erection and commissioning. It is the second CFB boiler that SFW has supplied to CLC.

The CFB will be designed to burn paper mill rejects as primary fuel and paper mill sludges and coal as secondary fuels. It is due to start operating in 2021.

BHEL bags floating solar order

India's Bharat Heavy Electricals Limited (BHEL) has received an order for the construction of a 25 MW floating solar power plant in India's Andhra Pradesh state.

The \$14.57 million order was placed by National Thermal Power Corporation Ltd. (NTPC) and is BHEL's second order for a floating solar power plant.

The floating solar plant will be located on a raw water reservoir at NTPC's Simhadri thermal power project.

LS Cable inks deal for Taiwan power grid

Ørsted has placed an order worth \$100 million with LS Cable & System for the construction of a submarine power grid in Taiwan.

Under the contract, LS Cable will supply and install submarine cables connecting 900 MW of offshore wind farm capacity in Changhua, Taiwan, to the grid. The project is due to be completed by 2022.

CEO Myung Roe-hyun said: "LS Cable & System has now secured global competitiveness since it first jumped into the submarine power grid business in 2009. We expect continued growth in the industry as offshore wind farms have been growing in Europe and Asia."

Europe

GE wind turbines for Turkey

GE Renewable Energy has been selected to supply 49 of its 3 MW platform onshore wind turbines for five wind farms in Turkey.

The US company has been selected by Trkeler and RT Enerji to supply equipment for the Kirazli, Meryem, Sile, Pamukova and Mahmut Sevket onshore wind farms, which have a combined total capacity of 158 MW.

Its contract includes a ten-year servicing agreement.

The wind turbines' blades will be manufactured at GE's LM Wind Power factory in Bergama, Izmir, Turkey.

GE also recently received an order from Borusan EnBW Enerji to provide 27 Cypress units for the 138 MW Saros wind farm in Turkey.

The Cypress units are from GE's 5.x MW platform and have a 158 m rotor diameter.

The order is the first for GE's Cypress units in Turkey, the company said.

Vestas to add 41 MW to community wind park

Vestas has secured an order to expand a citizen-owned wind farm in Germany.

The company has received an order to add 41 MW to the existing Brgerwindpark Reuenkge wind farm in northern Germany, bringing its installed capacity to 210 MW. It will use its V112-3.45MW hardware for the project, it announced.

Vestas will be responsible for the supply, installation, and commissioning of the turbines as well as for VestasOnline Business SCADA solution. Delivery of the wind turbines is expected to begin in the third quarter of 2020, with commissioning slated for the fourth quarter of 2020.

Brgerwindpark Reuenkge Managing Director Dirk Ketelsen said: "We started this journey in 1989 with our first turbine and we plan to expand this citizen wind park to up to 300 MW in the coming years. With the 12 new turbines, Vestas will have provided 63 V112-turbines for this wind project."

ABB to provide predictive maintenance for EGP

ABB is working with Enel Green Power (EGP) to deliver innovative predictive maintenance solutions that will lower maintenance costs and transform the performance, reliability and energy efficiency of its hydropower plants throughout Italy.

The three-year contract will enable 33 of Enel Green Power's hydroelectric plants, comprised of about 100 units, to move from hours-based maintenance to predictive and condition-based maintenance, using ABB's Ability Asset Performance Management solution.

The two companies have been collaborating since early 2018 to develop and test predictive maintenance and advanced solutions (PresAGHO) via a pilot on five Enel plants in Italy and Spain, including Presenzano, a 1000 MW plant near Naples.

The new contract includes digital software solutions and services that will provide analysis of over 190 000 signals and the deployment of about 800 digital asset models, aimed at improving plant operational performance, reducing unplanned failures and enabling more efficient planned maintenance practices through predictive maintenance. The integration is expected to yield savings in fleet maintenance costs and increase plant productivity.

Voith to revamp Ritom

Voith has received an order from Ritom SA to refurbish the Ritom pumped storage hydropower plant in Switzerland.

Voith will be responsible for design, fabrication, installation and commissioning of new high-performance generating units at the 176 MW power plant, which started operating in the 1920s. The plant's energy output is critical for the operation of the rail network by Swiss

Rail (SBB) and for supplying power to the Ticino region.

Voith will supply two 60 MW Pelton turbines and a 60 MW storage pump to the plant, replacing its existing four 44 MW Pelton turbines.

The first machine unit will supply power for the 16.7 Hz Swiss Rail network and the operation of its trains. The second will feed the electricity it generates into the 50 Hz public grid.

The third unit, a 60 MW capacity pumped storage unit with a delivery head of more than 700 m, will pump the water for reservoir management and provide balancing power (operating reserve).

The CHF250 million (\$251.5 million) project is due to be completed in mid-2023.

International

Vestas seals Dumat Al Jandal deal

A consortium of EDF Renewables and Abu Dhabi Future Energy Company (Masdar) has awarded Vestas a contract for the construction of the Dumat Al Jandal wind farm in Saudi Arabia.

The 415 MW project, the first utility-scale wind farm in Saudi Arabia, is a key part of the country's steps to boost its installed renewable energy generating capacity. Vestas will be responsible for engineering, procurement and construction (EPC) and supplying 99 of its V150-4.2 MW machines.

Vestas has also signed a 20-year service agreement for the project, which was awarded to the EDF-Masdar consortium by Saudi Arabia's Renewable Energy Project Development Office (Repdo).

Once operational, the Dumat Al Jandal plant will produce electricity under a 20-year power purchase agreement (PPA) with Saudi Power Procurement Company.

MHPS signs service MOU for Uzbek plants

Mitsubishi Hitachi Power Systems, Ltd. (MHPS) has signed a memorandum of understanding (MOU) with the Ministry of Energy of Uzbekistan and Mitsubishi Corporation to develop a comprehensive service and maintenance plans for thermal power plants in the country.

The service plan would be applied to the Navoi plant, which is operated by Thermal Power Plants of Uzbekistan, and two under-construction plants: Navoi-2 and Turakurgan. Under the plan, MHPS would provide parts supply for the gas turbines in use at the power plants concerned, assign engineers to the sites to perform regular inspections, and train Thermal Power Plants of Uzbekistan's engineers in O&M using IoT.

Siemens bags Iraq combined cycle order

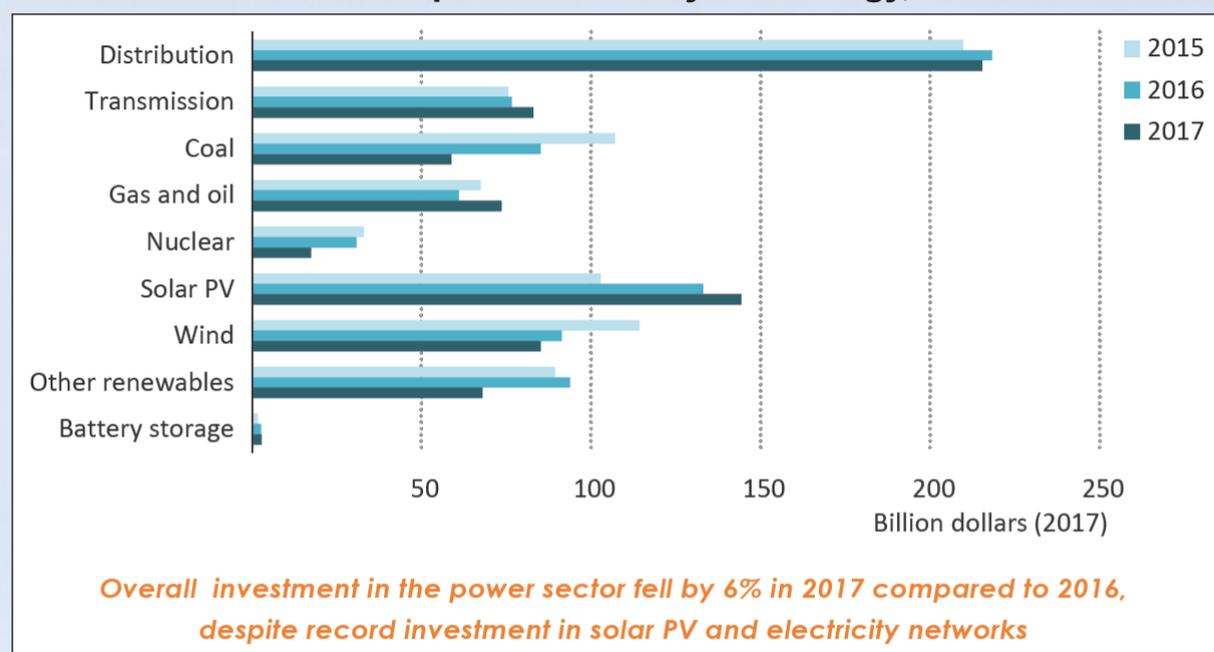
Siemens has received an order to supply the key components and long-term power generation services for the 840 MW Maisan combined cycle power plant in Iraq.

Under the €280 million order, placed by CITIC Construction Co., Ltd., and Iraqi developer MPC, Siemens will supply two SGT5-4000F gas turbines, one SST5-4000 steam turbine, and three SGen5-2000H generators, along with the SPPA-T3000 control systems, transformers and related electrical equipment, and the fuel gas system.

The independent power project is expected to deliver first power by March 2021 and enter full combined cycle mode by early 2022.



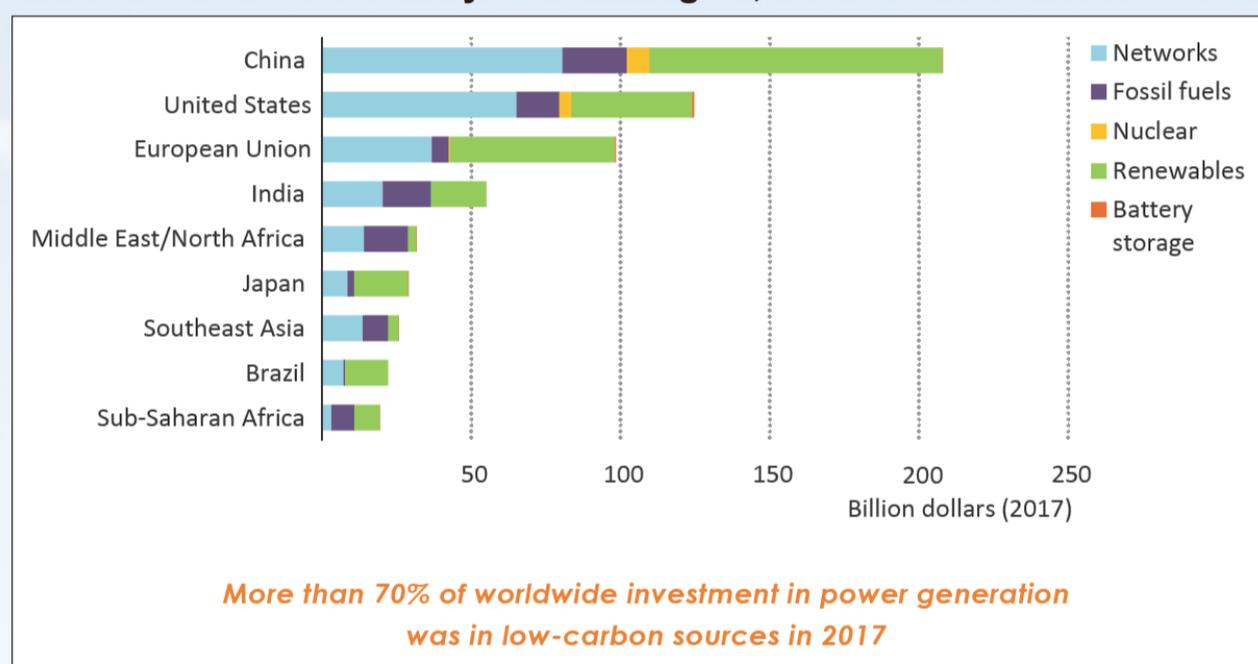
Global investment in the power sector by technology, 2015-2017



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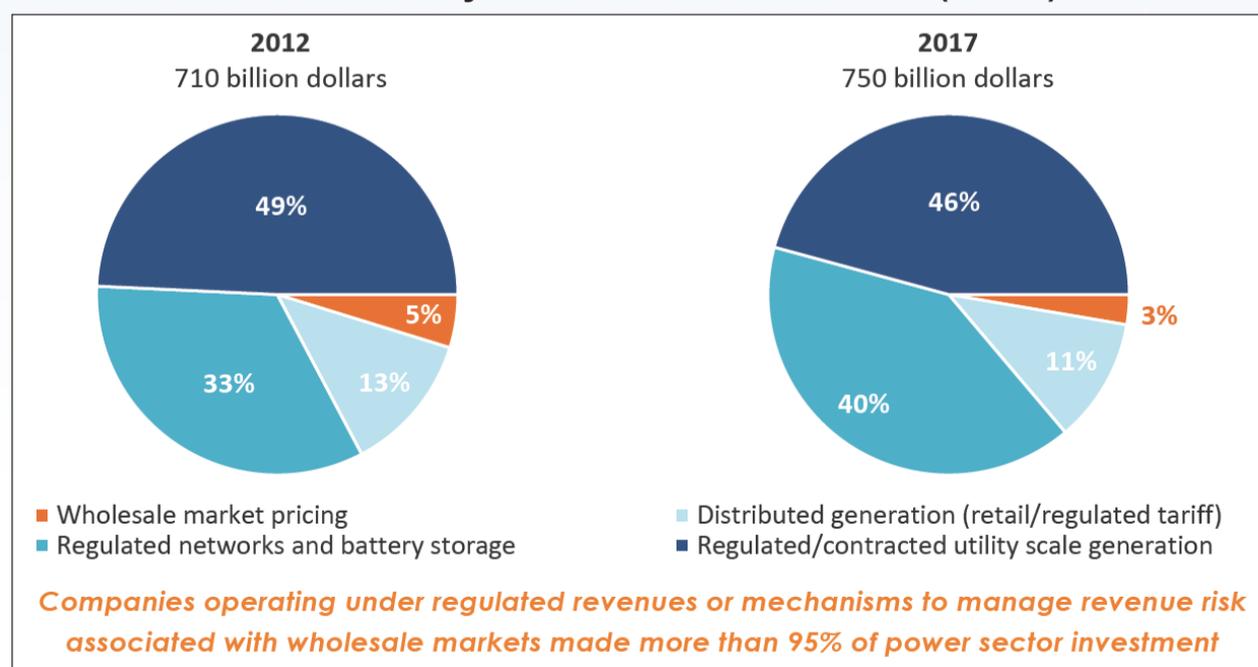
World Energy Outlook 2018, © IEA/OECD, Figure 7.26, page 310

Power sector investment by selected region, 2017



World Energy Outlook 2018, © IEA/OECD, Figure 7.27, page 310

Power sector investment by remuneration mechanism (\$2017)



World Energy Outlook 2018, © IEA/OECD, Figure 7.28, page 311

Oil

Oil market well supplied despite Opec+ cuts

- Crude prices unlikely to see significant rise
- Demand is slowing “considerably” says IEA

Mark Goetz

The issue at the time of writing this article was the seizure by Iran of two British-flagged oil tankers in the Strait of Hormuz; and as tensions heighten between Iran and the West, particularly the US, sanctions have taken a tough bite into Iran's economy. Oil is Iran's main source of income, but exports during June have declined to under 300 000 b/d, compared to 2.5 million b/d in April 2018.

Iran said the seizure of the British tanker *Stena Impero* was in reprisal for the detention by British forces in Gibraltar of an Iranian tanker alleged to be breaking EU sanctions over the shipment of oil to Syria. How the situation plays out could determine the movement of the oil market, but it seems that only a serious crisis will impact prices considering the volumes that are available due to growing stocks.

If the situation remains calm in the Persian Gulf, it is unlikely that crude oil prices will see any significant rise in the foreseeable future due to the fact that the oil market remains saturated. In its latest *Oil Market Report*, the Paris-based International Energy Agency (IEA) said commercial stocks in the OECD countries are high and well above the five-year average.

Opec and its allies, led by Russia, have been trying to reduce that volume and put the oil market back into balance – meaning that supply and demand equal out, but that is not the case despite Opec+ efforts. During a meeting of Opec+ in early July, the group agreed to extend their production cuts until March 2020, but according to the IEA that “does not change the fundamental outlook of an oversupplied market”.

The IEA forecasts that the ‘call’ on Opec oil would decline to 28 million b/d during the first quarter of 2020, the

lowest since 2003. That suggests that the situation is serious for those countries that depend on oil revenues to keep their economies rolling. Output by Opec members fell by 90 000 b/d in June to 29.9 million b/d. However, the decline is not expected to continue, the agency said overall demand for Opec crude would likely average 29.1 million b/d for 2020.

Commenting on oil prices during an energy conference in India in mid-July, IEA Executive Director Fatih Birol noted that price is determined by the market. “If we see the market today, we see that the demand is slowing down considerably.” He added that demand for oil is driven primarily by the petrochemical industry, not by demand for fuel for automobiles.

The price of Brent crude in mid-July was in the lower \$60/b range, while WTI was in the mid-\$50/b range.

The global economy is showing

weakness and demand for crude oil in China is slipping. Economists credit the trade war between the US and China as the key element in what some fear could be indications of a new recession. Still demand continues to slip while oil production from non-Opec producers like the US and Brazil boost the global average.

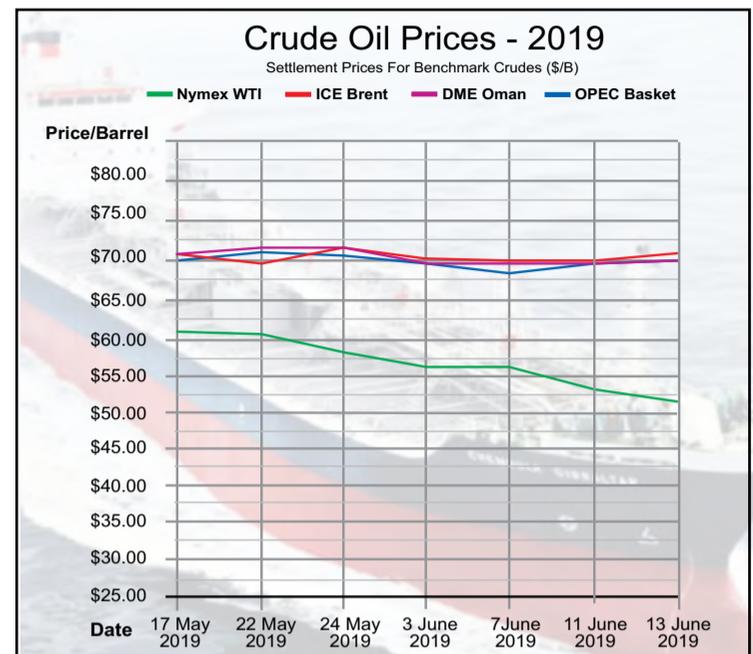
Even though Opec+ has cut production over the last four months by more than 1.2 million b/d, an amount it thought would bring the market back into balance, overall global output has increased by an average of 500 000 b/d during the same period, signaling that Opec is losing its share in the global market.

In its recent monthly report, Opec said it expects to have to fight for its share of the global oil market in the time ahead. It forecast that demand for its oil would fall by 4 per cent during 2019 due to increasing output from the

US, Brazil and Norway. It said demand for Opec crude would decline to 29.27 million b/d in 2020, down by 1.34 million b/d from a projection made earlier this year.

Despite advances made by renewables in the energy markets, the days of crude oil and gas are far from over. Hydrocarbons will be part of the energy scene for decades to come, but already Opec is acknowledging that there is a swelling tide of resistance to the world's continuing reliance on oil.

During the Opec meeting in Vienna in July, Opec Secretary General Mohammed Barkindo drew attention to the “growing mass mobilization of world opinion... against oil”, and a growing opinion in which “civil society is being misled to believe oil is the cause of climate change”. Barkindo described climate change campaigners as “perhaps the greatest threat” to the future of the oil industry.



Gas

Turkey encroaches on Cyprus offshore resources

Turkey says it will continue with its illegal exploration activities in the Cyprus Exclusive Economic Zone, in spite of international pressure.

David Gregory

By insisting that its continental shelf extends halfway across the Mediterranean and that its actions safeguard the interests of Turkish-Cypriots, Turkey has unsettled the region beyond its usual manner by sending two drillships into the Cyprus Exclusive Economic Zone (EEZ). Against the advice of the European Union, the US, Israel and Egypt, Turkey has moved into a portion of the East Mediterranean Sea where according to international law under the UN Convention on the Law of the Sea (UNCLOS) it has no legitimate claim.

Ankara, and particularly Turkish President Recep Tayyip Erdogan, has repeatedly rejected appeals by foreign bodies to refrain from acting in a way that would heighten tension in the area and has stated that Turkey will continue with its exploration activities.

In early May Turkey moved its Fatih drillship to a location 80 km west of

Cyprus and spudded a well that was expected to be complete in late July. The Republic of Cyprus, responded by appealing to other EU members and friends for diplomatic support to get Turkey to withdraw its vessel. It also took legal steps to secure some 20 arrest warrants for members of the Fatih crew and executives of the foreign companies involved in the operations. Unfazed, Turkey in early July moved a second drillship, the *Yavuz*, to a location east of the island where it plans to drill.

The arrival of the *Yavuz* prompted the EU Foreign Affairs Council to take action against Turkey with moderate sanctions. A statement issued by the Council in early July said: “In light of Turkey's continued and new illegal drilling activities, the Council decides to suspend negotiations on the Comprehensive Air Transport Agreement and agrees not to hold the Association Council and further meetings of the EU-Turkey high-level dialogues for

the time being. The Council endorses the Commission's proposal to reduce the pre-accession assistance to Turkey for 2020 and invites the European Investment Bank to review its lending activities in Turkey, notably with regard to sovereign-backed lending.”

Turkish Foreign Minister Mevlut Cavusoglu responded by saying: “There is no need to take it [the Council's sanctions] seriously. These are simple things. These aren't things that will impact us. We have three ships there. [Including the seismic vessel *Barbaros*.] God willing, we will send a fourth ship to the Eastern Mediterranean as soon as possible. Let them understand that they cannot deal with Turkey with such methods,” he said.

As a country with very few hydrocarbon reserves, but one that uses at least 45 billion m³ (bcm) of natural gas annually and which will need much more in the future, the natural gas reserves that exist in the East Mediterranean south of Cyprus are too attractive to

ignore. Trillions of cubic feet of natural gas have been discovered and are being developed offshore Egypt, Israel and Cyprus. More exploration in the region is expected to lead to more significant discoveries.

Turkey, which is not a signatory to UNCLOS, claims a huge block of the East Mediterranean off its southern coast that encroaches not only on the Cyprus EEZ, but also on that of Greece. To the east of Cyprus, most of the EEZ north, east and south of the island has been claimed by the Turkish-Cypriot administration in the Turkish-occupied north and awarded to Turkish Petroleum (TPAO).

The Fatih is drilling in an area that Turkey claims as its own, and which Ankara will refuse to consider Cypriot territory even if negotiations between the two sides to reunite the island do resume and include the hydrocarbon issue. In the east, the *Yavuz* is there to assert the Turkish-Cypriot claim to its share of the island's

resources. Should either drillship make a discovery, it is difficult to imagine how Turkey might develop the resource without the assistance of major international companies who would risk being sued by the legitimate government.

For its part, the Republic of Cyprus soldiers on with its hydrocarbons exploration programme. Several important discoveries have been made in the island's offshore, including those by ExxonMobil, Eni/Total and Noble Energy, but none are large enough to launch Cyprus into the status of a natural gas country, as it hopes.

Later this year, the operators in Cyprus will begin a two-year, 10-well exploration and appraisal period that is expected to establish whether the island has a future as a gas producer and exporter. Were it not for Turkey breathing down its neck, this would be an aspiring time for Cyprus and not the apprehensive time that Ankara has created.

Smoothing out Europe's electricity landscape

Based on current trends in the European marketplace, flexible generation is likely to become more important in the coming years, with large and small plants combining in different ways to smooth the transition to a renewable future.

Paul Verrill

One of the important things about electricity is that when it is created it has to either be used or stored. If there is an imbalance between generation and supply then the first impact is for the grid frequency to either rise or fall. If this goes outside of operational limits, the integrity of the power grid becomes at risk and electrical protection systems start to disconnect consumers and generators from the grid. If there is no correction, then a blackout may result.

So the question that power markets have always had to solve is: what happens when a conventional power plant suddenly fails or goes offline? In the past, this sort of imbalance in the market would require another power station to turn up, but as levels of renewables in the market grow, fewer conventional generating plants in the market are already online and ready to increase generation.

So in the absence of large power stations, how do markets use flexibility from a small fast-starting gas plant or electricity from a greenhouse for a short period to cater for demand until the conventional plant is up and running again? The same thing can happen when there's an unexpected surge in demand for electricity – due to an unforeseen

change in weather patterns, for example.

As renewables make up an increasingly large proportion of the power mix in Europe, flexible generation will inevitably become more important in the future. By its very nature, renewable energy production is intermittent as it is often dependent on the weather; solar generation, for example, is only possible when the sun shines. This, and the fact that large gas and coal plants are often slow to fire up, means those reserves of electricity are often needed quickly during periods of peak demand; however, flexible generation needs income streams in order to justify the cost of capital.

One of these income streams is derived from operating in formal balancing markets, and a related source of income is to generate for system (or imbalance) prices in the market.

Markets across Europe have prices called system (or imbalance) prices, which effectively set the price which you receive for any excess generation you 'spill' into the market (i.e. generate without a sale to an end user) or the price you pay for any power you consume but have not contracted for, 'shortfall', at a price that reflects the cost of the system operator balancing the system to correct for the imbalance position caused by your spill or shortfall.

Given that electricity must be used as it is created or else the frequency of the system changes, the system must therefore be balanced by the system operator. The cost of doing this is recovered via system prices, the mechanisms of which are often set up to penalise generators for oversupplying a short system (i.e. when demand is low) and undersupplying a long system (i.e. when there's a surplus of demand). In other words, they get penalised for making things worse.

Under an approach called 'dual system pricing', a party that generates too much power will either sell it at a price that matches the cost of balancing the system if the market as a whole is also generating too much power, or the market price if the market is short of power. In both of these cases, a generator producing excess power can at best only get the market price.

Smaller-scale, flexible technologies such as batteries and 'peakers' (reciprocating engines or open cycle gas turbines) are very useful as they are capable of ramping up electricity production (or decreasing it) at very short notice – in some cases and particularly for batteries, in a matter of seconds. This helps to balance the system when there are significant, sudden supply-demand fluctuations.

Under an approach where these generators get at best the wholesale

market price for power, such plants are not fully incentivised to generate to help balance the system.

When Britain swapped from 'dual' to 'single' system pricing, this meant that a party providing an excess of generation in a market that was short of power would no longer be paid just the market price, but could instead receive a higher price and therefore be rewarded for correcting the imbalance in the system. With this change and with parties being permitted to knowingly generate without having sold power in Britain, a market was created for speculatively generating power to solve problems within the power market.

While some countries – such as Britain – are only just discovering the benefits of flexible generation in balancing the system, the Netherlands has been doing this for many years, often by utilising power from greenhouses. This works by setting up a central dispatch platform and connecting it to combined heat and power (CHP) plants located in commercial greenhouses used to grow various crops and flowers, thereby creating a 'virtual power plant' (VPP). When the grid operator needs additional supplies of electricity, the virtual plant centrally switches on the CHP units, aggregates all of the electricity produced by these units and sends it to the grid.

Although many of these greenhouses are small-scale operations, combined they can make a big difference when it comes to balancing the system. Taking into account their CO₂ and heat storage capacities, the greenhouse sector can provide up to an extra 300 MW of flexible power in the Netherlands market if needed. They can also react quickly to reduce demand by, for example, turning off their 'grow' lights when there's a shortage of supply; this demand response adds another 200 MW of flexibility.

However, there are risks associated with this form of generation. As the crops are the central money generator in a greenhouse, many greenhouses automatically switch on their 'grow' lights when light intensity levels drop – during a thunderstorm, for example – thereby causing volatility in the system rather than smoothing out imbalances.

That said, many VPPs used in the Netherlands are developed with technology capable of giving operators the ability to forecast and optimise energy from greenhouses spread across the country. This powerful tool means that spare electricity in individual customer-owned CHP units can be aggregated to provide a mostly reliable source of electricity for TenneT, the Dutch grid operator.

The switch to single system prices effectively brought this trend to the

British market. This has changed the dynamic so that there is now a reward for going against the bias of the system. To undersupply a system with an excess of generation or supply into a system with a shortage of generation can now be profitable.

To give an example, if prices in a short market are expected to go to £150/MWh, a party that is generating excess power would be paid at this price. This keeps the grid operator happy as it creates more opportunities for investment in balancing. Overall, this reduces costs as long as system prices are reflective of the real costs of balancing the system, with suppressed system prices preventing the self-balancing that parties would be doing were they paying a reflective price for any imbalances.

This trend helps to improve overall imbalance in the market as high system/imbalance prices encourage wind farms and supply companies to produce better forecasts and to sell out their forecasting errors ahead of delivery.

This switch to single system prices hasn't happened in all countries around Europe. This is partly because they are governed by different regulations. Investors in some electricity markets are prohibited from deliberately trying to cause an imbalance in the system, which restricts the types of balancing that are possible in these markets. Other markets do not offer the same level of financial reward so there's less incentive to invest in flexible generation.

There are also risks associated with this form of generation. One is the price volatility associated with flexible assets, which tend to generate a disproportionate amount of their revenues and profits during high price periods and the unpredictability, which requires careful analysis of the associated risks/opportunities.

That said, based on current trends in the European marketplace, flexible generation is likely to become more important in the coming years, providing a fleet of units ready and able to respond to imbalances in the market.

As this approach to balancing supply and demand grows, the routes to market evolve beyond just generating for system or imbalance prices and in Britain small flexible plants are entering the Balancing Mechanism that was formerly the domain of large power stations. At the same time, the existing plants are expected to find increasingly innovative ways to deliver flexibility and this effect of large and small plants combining in different ways looks set to smooth the transition to a renewable future.

Paul Verrill is Director of energy market data analysis, EnAppSys.



Verrill: As renewables make up an increasingly large proportion of the power mix, flexible generation will inevitably become more important

It's high time for hydrogen

The use of hydrogen as an energy carrier is gaining momentum. The International Energy Agency recently produced a landmark report to analyse the current state of play and to offer guidance on future development. **TEI Times** outlines some of the highlights.

Some see 2019 as a critical year for hydrogen. It is gaining global traction and could finally be set on a path to fulfil its longstanding potential as a clean energy solution. In order to help governments and companies seize the opportunity, the government of Japan under its presidency of the G20 called on the International Energy Agency (IEA) to prepare a report on the sector that lays out where things stand now; the ways in which hydrogen can help to achieve a clean, secure and affordable energy future; and how its potential can be realised.

'The Future of Hydrogen: seizing today's opportunities' report, released at the G20 summit in Osaka at the end of June, hopes to "help to get things moving", by identifying the "most promising immediate opportunities to provide a springboard for the future".

Essentially, it details a set of pragmatic and actionable recommendations that it says will make it possible for governments and industry take full advantage of the increasing momentum in the sector.

The potential benefits of increasing the use of hydrogen to help tackle critical energy challenges are wide ranging. It offers ways of decarbonising a range of sectors – including long-haul transport, chemicals, and iron and steel – where it is proving difficult to meaningfully reduce emissions. It can also help improve air quality and strengthen energy security.

Despite very ambitious international climate goals, global energy-related CO₂ emissions reached an all-time high in 2018. The Hydrogen Council recently said it expects hydrogen to account for about 20 per cent of world energy demand by 2050. This will cut global carbon emissions by 6 Gt, accounting for a big portion of worldwide efforts to limit global warming.

One of the main advantages of hydrogen is its versatility. It can be produced from a wide variety of fuels, including renewables, nuclear, natural gas, coal and oil and can be transported as a gas by pipelines or

in liquid form by ships, much like liquefied natural gas (LNG). It can be transformed into electricity and methane to power homes and feed industry, and into fuels for cars, trucks, ships and planes.

Importantly, it can enable renewables to provide an even greater contribution. Hydrogen has the potential to help with variable output from renewables, like solar photovoltaics (PV) and wind, whose availability is not always well matched with demand. According to the IEA, hydrogen is one of the leading options for storing energy from renewables and looks promising to be a lowest-cost option for storing electricity over days, weeks or even months.

"Hydrogen and hydrogen-based fuels can transport energy from renewables over long distances – from regions with abundant solar and wind resources, such as Australia or Latin America, to energy-hungry cities thousands of kilometres away," said the report.

Despite its huge potential, however, there have been false starts for hydrogen in the past. The IEA believes this time could be different. Falling costs has seen the rapid growth of solar PV, wind, batteries and electric vehicles and there is a growing coalition of voices in favour of hydrogen. These include renewable electricity suppliers, industrial gas producers, electricity and gas utilities, automakers, oil and gas companies, major engineering firms and the governments of most of the world's largest economies.

Further, while interest in hydrogen continues to be strongly linked with climate change ambition, there has been a noticeable broadening of the policy objectives to which hydrogen can contribute. According to the IEA, "energy security, local air pollution, economic development and energy access are now routinely cited".

Today, hydrogen is used mostly in oil refining and for the production of fertilisers but for it to make a significant contribution to the clean energy transition, however, it also needs to be adopted in sectors where it is almost completely absent, such as transport, buildings and power generation.

However, clean, widespread use of hydrogen in global energy transitions faces several challenges: producing it from renewables is expensive due to the high cost of electrolyzers (currently hydrogen is almost entirely produced from natural gas and coal, which results in high CO₂ emissions); development of the hydrogen infrastructure is slow; and current regulations limit the industry's development.

In order to boost the use of hydrogen, the IEA makes several key recommendations to scale up its use and also identifies four near term opportunities.

Firstly the report recommends governments, companies and others should first establish a role for hydrogen in long-term energy strategies. National, regional and city governments can guide future expectations. Companies should also have clear long-term goals. Key sectors include refining, chemicals, iron and steel, freight and long-distance transport, buildings, and power generation and storage.

The next recommendation is to stimulate commercial demand for clean hydrogen. Clean hydrogen technologies are available but costs remain challenging. Policies that create sustainable markets for clean hydrogen, especially to reduce emissions from fossil fuel-based hydrogen, are needed to underpin investments by suppliers, distributors and users. By scaling up supply chains, these investments can drive cost reductions, whether from low-carbon electricity or fossil fuels with carbon capture, utilisation and storage.

Thirdly, the IEA suggests that investment risks for first-movers be addressed. New applications for hydrogen, as well as clean hydrogen supply and infrastructure projects, stand at the riskiest point of the deployment curve. Targeted and time-limited loans, guarantees and other tools can help the private sector to invest, learn and share risks and rewards.

Next, it recommends R&D support to bring down costs. Alongside cost reductions from economies of scale, R&D is crucial to lower costs and improve performance, including for fuel cells, hydrogen-based fuels and electrolyzers (technology that produces hydrogen from water). Government actions, including use of public funds, are critical in setting the research agenda, taking risks and attracting private capital for innovation, it says.

Eliminating unnecessary regulatory barriers and harmonising standards is the next recommendation. Project developers face hurdles where regulations and permit requirements are unclear, unfit for new purposes, or inconsistent across sectors and countries. Sharing knowledge and harmonising standards is key, including for equipment, safety and certifying emissions from different sources. Hydrogen's complex supply chains mean governments, companies, communities and civil society need to consult regularly.

The IEA also says there should be international engagement and tracking of progress. The report states that enhanced international co-operation is needed across the board but especially on standards, sharing of good practices and cross-border infrastructure. Hydrogen production and use need to be monitored and reported on a regular basis to keep track of progress towards long-term goals.

Finally, the report recommends governments and private sector focus on four key opportunities to further increase momentum over the next decade. These opportunities are:

- Make industrial ports the nerve centres for scaling up the use of clean hydrogen. Today, much of the refining and chemicals production that uses hydrogen based on fossil fuels is already concentrated in coastal industrial zones around the world, such as the North Sea in Europe, the Gulf Coast in North America and southeast China. Encouraging these plants to shift to cleaner hydrogen production would drive down overall costs. These large sources of hydrogen supply can also fuel ships and trucks serving the ports and power other nearby industrial facilities like steel plants.

- Build on existing infrastructure, such as millions of kilometres of natural gas pipelines. Introducing clean hydrogen to replace just 5 per cent of the volume of countries' natural gas supplies would significantly boost demand for hydrogen and drive down costs.

- Expand hydrogen in transport through fleets, freight and corridors. Powering high mileage cars, trucks and buses to carry passengers and goods along popular routes can make fuel cell vehicles more competitive.

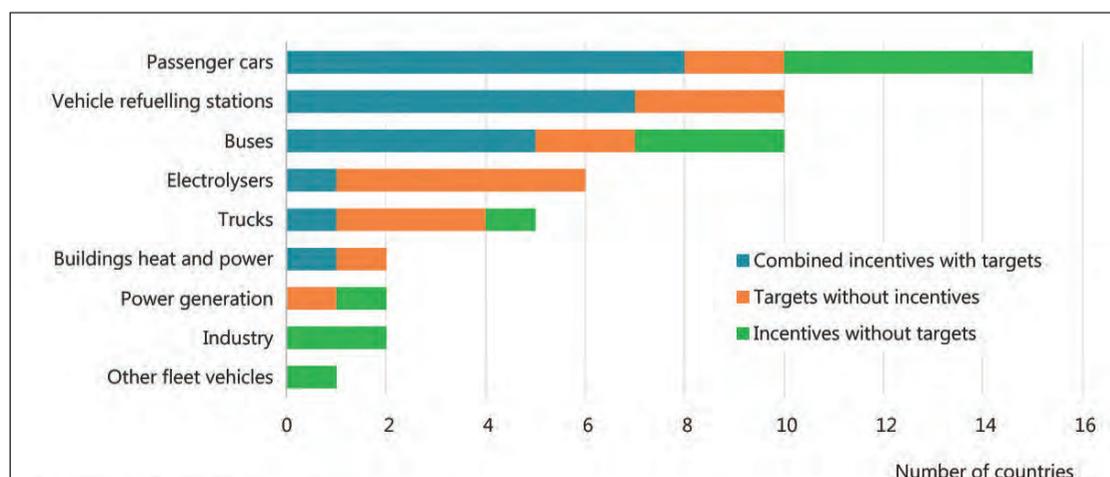
- Launch the hydrogen trade's first international shipping routes. Lessons from the successful growth of the global LNG market can be leveraged. International hydrogen trade needs to start soon if it is to make an impact on the global energy system.

The report says that by building on current policies, infrastructure and skills, these mutually supportive opportunities can help to scale up infrastructure development, enhance investor confidence and lower costs.

Fatih Birol, Executive Director at the IEA said: "I very much hope our report on hydrogen will inform discussions and decisions among G20 countries, as well as those among other governments and companies across the world. I hope it will help to translate hydrogen's current momentum into real-world action that sets hydrogen firmly on the path to becoming a significant enabler of a clean, secure and affordable energy future."

Beyond this report, the IEA says it will remain focused on hydrogen, further expanding its expertise in order to monitor progress and provide guidance on technologies, policies and market design. "We will continue to work closely with governments and all other stakeholders to support your efforts to make the most out of hydrogen's huge potential."

Policies directly supporting hydrogen deployment by target application



Note: Based on available data up to May 2019.

Source: IEA analysis and government surveys in collaboration with IEA Hydrogen Technology Collaboration Programme; IPHE (2019), Country Updates.

CCS gets some new chemistry

A new process for capturing carbon dioxide is being demonstrated at a pilot project at the Drax power station in the UK. Junior Isles reports.

According to many industry observers, the world will not be able to achieve its climate ambitions without carbon capture and storage (CCS). Although the electricity sector is making a rapid transition away from fossil fuels, globally, coal and gas will continue to play a significant role for decades to come. Finding a way of decarbonising existing and future fossil fired fleet is therefore crucial. Cutting carbon emissions in industry is also important and currently there are very limited options when it comes to cutting carbon dioxide emissions.

The International Energy Agency (IEA) states that CCS could reduce global CO₂ emissions by 19 per cent, and that fighting climate change could cost 70 per cent more without CCS.

But in spite of the pressing need for the technology, its commercial uptake has been very slow. A report published in May by the International Association of Oil and Gas Producers (IOGP) noted there are only 18 commercial projects in operation globally today with a total capture capacity of some 40 Mtpa CO₂.

CCS deployment has been predominantly limited by economics – several projects have seen budgeted capital costs spiral, and the technology also imposes an energy penalty on power plants, which makes the business case in power generation challenging.

But this could be set to change as a team of chemists and engineers look to implement a new carbon capture technology at the massive Drax power station in North Yorkshire, UK.

In June, C-Capture, the designer of

innovative chemical processes for carbon dioxide removal, working alongside the Drax Group, secured a £5 million grant from the UK government for a two year programme of work to progress their £11 million bioenergy and carbon capture and storage (BECCS) pilot project at Drax.

The funding will be used by Leeds-based C-Capture, a company established in 2009 out of Leeds University's School of Chemistry following investment from IP Group, and Drax's Innovation team to further develop its understanding of how C-Capture's technology could be scaled up.

Explaining the origins of C-Capture and the technology, Professor Chris Rayner, an organic chemist and Founder of the group, said: "About 10 years ago, maybe longer, we started looking at ways where we could selectively get CO₂ to react in the presence of other gases – particularly things like nitrogen and oxygen, which is typically what is in flue gases – and try to develop new chemistry to do that. People have been doing CO₂ separation for many years. The original technology patented in the 1930s used amines. They capture CO₂ very well but they've been around for so long, when we set up C-Capture we thought there must be a better way to do it."

After four or five years of research and development, the company has come up with a process that allows CO₂ to be captured under much milder conditions than has been previously possible.

"The chemistry is much better in terms of performance and environmental profile but still uses very simple chemicals... and for the scale that CCS is done on, it has to be simple and really scalable," said Professor Rayner.

The technology is what Professor Rayner calls a post-combustion, solvent-based capture process.

He explained: "When you generate power, you're usually burning something... The flue gas produced will usually have anything between 5-15 per cent of CO₂, as well as quite a lot of nitrogen and some oxygen. The key thing is to selectively react the CO₂ and leave anything else unreacted."

This is achieved in a two-step process. The first stage has an absorber column, where a shower of the new amine-free solvent comes down the column while the flue gas is blown upwards. When the solvent comes into contact with the flue gas, it selectively reacts with the CO₂, leaving the remaining gases to continue upwards to exit the top of the column free of CO₂.

Solvent with CO₂ attached to it remains at the bottom of the column. This is then pumped into a stripper column that operates at a much higher temperature, around 100-120°C, compared to 20-30°C in the first. At this temperature, the bond between the solvent and the CO₂ breaks and the CO₂ comes out of the stripper column as a pure stream that can be used or sequestered. This stripper column also serves to regenerate the

solvent, so that "lean" solvent is ready to capture more CO₂.

"It's a continuous process, where the solvent is pumped around the absorber and stripper, so flue gas goes into one end and a stream of CO₂ comes out of the other," said Professor Rayner.

The key thing in the process is the new class of solvent, which has quite a different reactivity compared to amines. An important aspect of the solvents is their energy requirement – a big drawback with current solvent-based post combustion capture is they require a significant amount of energy to heat up the solvent in order to release the CO₂. This parasitic load reduces the efficiency of the power station.

According to Professor Rayner, the new solvents are less reactive with air than existing amine solvents and therefore oxidise less, resulting in less degradation over time. "We think we have major benefits in terms of solvent lifetime compared with the current best technologies," he noted.

He added that the new solvents are much less corrosive than many of the amines that are currently used. This means cheaper construction materials can be used, which could in turn significantly lower the cost of building plants.

With the economics of CCS being a major stumbling block, the development of the technology comes at a crucial time.

Professor Rayner said: "Pretty much everyone says we need to decarbonise as rapidly as we can. In three of the four scenarios presented by the IPCC, we need CCS to limit warming to 2°C... if the [UK] government is to reach its net zero target by 2050, then CCS is essential. So we need to start doing things now and we need to start doing them on scale."

"Costs are an issue but there have been numerous high-level studies that show that the cost of doing nothing far outweighs the cost of deploying CCS... The costs of these things are always coming down."

"To calculate the cost of capturing a tonne of CO₂ from a very large power station is a very difficult calculation but what I can say, is that the energy penalty of our process is significantly lower when comparing our technology with others that are out there. World-leading amine processes use about 2.5 GJ per tonne of CO₂ captured. Ours is in the region of 1.5-2 GJ/t. The Drax project is trying to understand that number and firm up whether it's nearer to 1.5 or 2. Even if it's 2 GJ, that's still a major improvement compared to all the current technologies."

Since it began capturing carbon dioxide in February, proving the technology works, the team at the Drax pilot has done different upgrades on the solvent and this work will continue.

The recent government grant will help take the pilot project up from about 1 t/day of CO₂ capture to 100 t/day over the next two years. This size will provide much of the chemistry and engineering information needed to design a much larger

process.

"We hope that we will have everything we need to design a very large process within a couple of years," said Professor Rayner. To give an idea of the final scale needed, he says Drax would need roughly a 10 000 t/day capture installation on its site.

The Drax pilot will be running for at least another six months before trials are shifted to Norway. Here a chemistry validation and testing programme will be conducted with research partners SINTEF and the CO₂ Technology Centre Mongstad. The pilot scale rigs at Mongstad will enable more accurate measurement of parameters such as energy consumption and emissions. In addition to being larger in scale, the Norway facility will also provide a degree of independent validation.

"As the programme begins to get finalised at Drax we will move things over to Norway, which will probably be some time towards the end of next year," said Professor Rayner. "It will happen when we think we have enough good data to operate the plant in Norway."

The goal is to have a large scale process on the Drax site in the mid 2020s. This would coincide with the government's timeframe of having CO₂ capture clusters and CO₂ transport infrastructure in place.

"There's no point building a big capture plant if you have no way of disposing of the CO₂," noted Professor Rayner. "Over the next 5-10 years, there will be lots of developments where clusters of CO₂ producers will have to come together in different locations to provide hubs, which can then take the CO₂ via pipelines to the North Sea for storage in geological features, mainly depleted oil wells."

With Drax being the UK's largest power plant, and one that has switched from coal to biomass, the world will be watching this next step closely. Notably, as it runs on biomass it will become the world's first negative emissions power station – effectively removing carbon dioxide from the atmosphere while electricity is being produced. This is important in offsetting emissions from other sectors that are very difficult to decarbonise such as aviation.

Professor Rayner summed up: "The Drax project has given us a high profile, which has helped with enquiries from outside. Now, a number of projects are under discussion around world. We also will be deploying the technology in other areas which require large scale CO₂ separation such as industrial emitters like cement, iron and steel, and hydrogen manufacture, and gas upgrading applications, such as purification of natural gas and biogas."

"Working with Caspar Schoolderman, our COO and Director of Engineering and Doug Barnes, Head of Chemistry, we've developed something that is incredibly new and important for the future... seeing something go from a very small scale in a lab up to, say, 10 000 t of CO₂ capture a day, would be awesome. And that really is just getting things started."

Professor Rayner: "we've developed something that is incredibly new and important for the future"





Junior Isles

High speed change

The energy transition is real. And the speed at which it is happening is exhilarating; everyday, the rhetoric around electrification and the hydrogen economy increasingly becomes a reality.

Recently, I had the pleasure of attending the Goodwood Festival of Speed and the opportunity to not only see the latest fast cars – as well as the old classics – in action, but also get a first hand look at how quickly times are changing.

Siemens was the technology partner for what is dubbed as ‘the world’s greatest festival of motor sport’, showcasing a host of clean, green and

digital technologies, ranging from electric motorcycles and fast charging systems for electric vehicles, to fuel cells and 3-D printing.

But perhaps the most interesting, from the viewpoint of how fast our energy system is actually changing, was its tie-up with GeoPura to use a 100 kW fuel cell powered by green hydrogen to charge all of the EVs at the festival. Not so long ago, electricity for these festival-type applications would have come from a diesel fuelled generator.

Here was a real life demonstration of what the future will look like. The interest in fuel cells and hydrogen as

one way of electrifying transport cleanly is growing and coming from a variety of areas, not just the ones anticipated.

According to GeoPura, it is not just those responsible for areas where people want to park – car park owners, local authorities supermarkets and even large corporations with car parks. Andrew Cunningham, Managing Director of GeoPura, noted that these organisations are beginning to realise they have “a bit of a problem” even at this early stage of EVs.

“They are beginning to hit up against local distribution network issues and are wondering what the future holds for them. So we expected a lot of interest from that sector but other things have also come out the woodwork. Caravan club members, for example, is a group I never thought would be interested but they have significant issues with people turning up and needing to charge. And it’s not such a small market either.”

For things to really take off, however, these positive conversations first need to be turned into contracts. “Get these in place, and the rest of the infrastructure will follow, because there will be contracts in place to invest against,” said Cunningham.

According to Cunningham, the economics of using hydrogen to charge electric vehicles already makes sense. He estimated that the charge needed to run an EV the same distance as a petrol engine would equate to roughly about £1.10-1.15 per litre, which is a about 10 pence less than current UK petrol prices. And it is expected that these prices will only fall with reducing capex and opex costs.

Ian Wilkinson, Programme Manager at Siemens Corporate Technology said: “The trajectory for the big capital cost, the electrolyser, is downwards. Electrolyser prices are at the beginning of the cost curve. The world volume is still in the 10s of MWs. Tens of GWs are required to do this at scale and that’s when, inevitably, you’ll get the economies of scale... the trajectory for the big operational cost, i.e. the cost of electricity is also downwards. We’ve seen renewable electricity prices come down substantially over the past few years.

“So this is why we are starting with EVs. The commercials work at today’s prices with today’s available equipment, and it will only get better.”

Facilitating the hydrogen economy shows that EVs have a major role to play in the new decarbonised energy landscape – one that goes beyond just replacing combustion engines with a non-CO₂ emitting mode of transport.

Although they will add significant demand to local electricity networks, EVs could also be a key tool in providing utilities and network operators with storage and grid support through smart charging.

Just a few weeks ago UK Power Networks launched a trial called ‘Shift’, where 1000 vehicles will take part in the UK’s first ever trial of a market-led approach to smart charging. The trial aims to develop a large-scale, smart charging solution that can be rolled out nationwide by flexibility service providers like charge-point operators, aggregators and energy suppliers.

Ian Cameron, head of innovation at UK Power Networks said: “There has been a lot of talk about how smart charging could save customers money and help manage the network, but this

is the first time we’ve actually set out to discover how.”

It is hoped the trial will show how smart charging could limit the need to build new infrastructure, which could be a major stumbling block in the UK’s effort to only sell EVs by 2040, and its new legal obligation to reach net zero CO₂ emissions by 2050.

While car parks in shopping malls and workplaces, etc. are fine if a driver plans to be at a location for a long period of time, much investment is still needed for charging vehicles en route. Obviously car manufacturers and companies developing charging systems are a big part of en route charging. Here, rapid charging is key.

Wilkinson noted: “The trend is definitely upwards for faster charging rates. Having a charging post that can supply the power you need is relatively easy – charging posts that can do 350 kW can be designed now and made available. The particular challenge is with managing the heat the battery generates when it’s being charged rapidly. So the limitation will be the battery management system on the car; the charge rates that will be widely adopted is largely a question for the car manufacturers.”

Siemens and GeoPura’s vision is that charging points are available wherever they are needed and that making the dedicated trip to a refuelling point is no longer necessary.

That, however, will require a big shift in the existing mindset. It is therefore no surprise that key players in the chain are making their move.

David Hall, Vice President of Power Systems at Schneider Electric said: “We’re now seeing some of the big fuel companies talk about how they change their fuel stations. A fuel station is not about a trickle charge... so we’re now starting to break this market down into destination venues – where somebody might stay overnight at a hotel or somewhere for several hours – and the high rapid chargers, where you can pull in somewhere and get an 80 per cent charge in 15 minutes. This rapid charging is the area where investment in infrastructure is needed.”

The big question, he asked, is who will roll-out this rapid charge infrastructure? “Will it be the utilities or the contracting businesses that can do connections to the grid? Or might the end-user customer want to own the asset? It’s very early but things are starting to move. Customers are coming to us saying they have large fleets, offices, petrol stations etc., and asking: ‘what can you do for us?’”

On this basis, if things continue to accelerate along with car battery development, Hall believes the UK can meet its EV and net zero targets. He notes, however, that the biggest challenge is the general infrastructure to connect the substations for the high-power chargers.

It was a point echoed by Wilkinson, who said “there is the challenge upstream of providing enough electricity to charge a significant number of cars” from the 350 kW chargers, adding that the Siemens, GeoPura approach addresses that issue.

Whether the future is “filling up” in car parks, etc., where power is provided by fuel cells or whether it is at back-to-the-future petrol stations converted to provide fast charging, remains to be seen. Whatever the final outcome, neither us nor the kids will be saying “are we there yet?” for too much longer.

