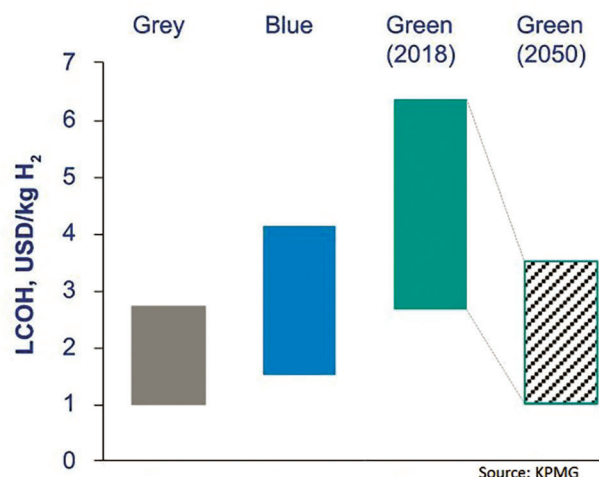




Gazprom lobbies EU to not prefer green over grey hydrogen

Grey hydrogen, produced from natural gas, could become a lifeline for Gazprom's business model if it manages to convince the EU to adopt a "technologically neutral approach." Grey hydrogen currently costs \$1–1.80 per kilogram to produce, which is far cheaper than the \$2.50–6.80/kg for green, or renewable hydrogen.



Gazprom is lobbying the European Union to cover its hydrogen demand in a "technologically neutral" way and focus on total CO₂ emissions instead of prioritising green hydrogen, produced through electrolysis with renewable energy.

Germany, the biggest buyer of Russian gas in the world, is embracing hydrogen to reduce the carbon footprint of energy-intensive industries, transportation and power generation. The government in Berlin expects that around 90 to 110 TWh of hydrogen will be needed

by 2030. To cover part of this demand, policy makers support up to 5 GW new-built green hydrogen production capacity – but the lion's share will need to be imported, partly as grey hydrogen.

The Russian gas major currently produces over 350,000 tons of hydrogen by various technologies, mostly from natural gas steam reforming. Hereby, methane reacts with steam under 3–25 bar

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Guangdong factories forced to ration electricity use

Industries in Guangdong, southern China's manufacturing hub, are forced to ration electricity use as China Southern Power Grid, the regional TSO, is struggling to meet demand. Export-orientated manufacturers in the province staged 30% growth the first five month of 2021 alone, but supply of coal-fired and imported power from Yunnan is limited.

Economic recovery, both at home and overseas, has caused a nearly 30% rise in electricity demand in Guangdong province in the first four month of 2021, compared to a 13.2% increase in China nationwide. Hot weather makes the situation worse: China Southern Power Grid remarked the recent pike in temperatures has seen current peak load demand already exceeding the 2020 high.



Factories in Guangdong face electricity shortages

More than a third of Guangdong's power demand is met by local coal-fired plants, but comparatively high prices for thermal coal due to production restrictions have reduced the willingness of generators to increase output. Another

third of Guangdong's electricity needs is covered by imports from Yunnan and other provinces but lower-than-expected rainfall in May limits available hydro power supply.

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pressure in the presence of a catalyst to produce hydrogen, carbon monoxide, and some small amount of CO₂ which can be captured.

Striving to lower costs

The Russian Academy of Sciences (RAS) strives to solve technical challenges in producing grey hydrogen through steam reforming in the most cost-efficient way. If scientist manage to bring the costs down below \$1/kg, the Russian-made grey hydrogen likely become an attractive fuel for exports – both to Europe and China. To that

end, RAS is not only looking for technology improvement in steam reforming but also at was to transport the fuel to end-users. The findings of the studies will be factored into Gazprom's sustainable development scenarios up to 2050.

But cheap grey hydrogen is not only produced in Russia. With coal and natural gas readily available, production costs for grey hydrogen are around \$1/kg also in the Middle East and parts of North America.

KPMG analysts say the cost advantage of grey over green hydrogen is likely to continue until 2030, at least, unless regulation

will hike the CO₂ price substantially. In the absence of a carbon price in countries like Russia, grey hydrogen will continue to out-competing green hydrogen which cannot be produced for less than \$2.5/kg.

Taking a long-term view to 2050, KPMG suggests that scale-up and innovations could help secure cost parity of green hydrogen with the one produced from fossil fuels. The unit size of new electrolyzers has increased tenfold from 0.1 MWe in 2000 to currently well over 1.0 MWe as pilot projects mature and are turned to commercial-scale applications. ■

Shell to expand new 10 MW electrolyser in Germany to 100 MW

Royal Dutch Shell has just launched Europe's largest PEM hydrogen electrolyser – called Refhyne – at its refinery in Rheinland, Germany, and already plans to scale up the 10 MW facility to 100 MW. At the Wesseling site of the refinery, Shell also aims to produce aviation fuel from renewables as well as bio-LNG.

The polymer electrolyte membrane (PEM) electrolyser makes use of renewable energy to produce up to 1,300 tonnes a year of green hydrogen, used initially to produce low-carbon fuels and later also to decarbonise other industries. The PEM electrolyser was built at a cost of around €20 million (\$23.72 million), half of which from EU funds notably the Fuel Cells and Hydrogen Joint Undertaking.

Hydrogen is considered green if it is produced from wind and solar power, as opposed to grey hydrogen derived from natural gas reforming. By 2025, hydrogen with as much as two weeks of stored energy is forecast to be a cost-effective storage method based on projected power and energy capacity capital costs.

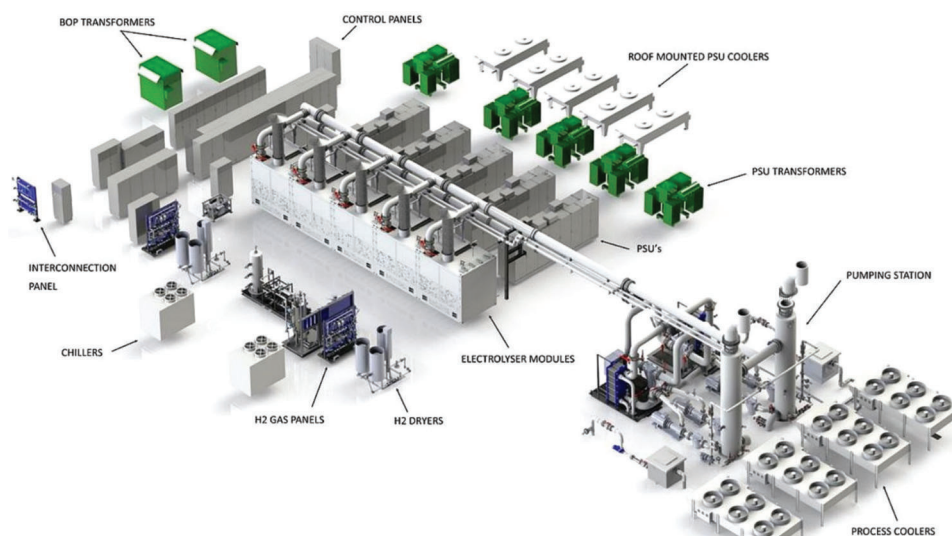
Consortium with ITM Power

The Refhyne project at Wesseling near Cologne was carried out by a consortium

of Shell and ITM Power which manufactured the electrolyser in Sheffield, UK. Other partners are the research organisation SINTEF and consultants Sphera and Element Energy.

North Rhine Westphalia, Germany's most

industrialised state is looking to clean up its heavy industry through hydrogen. Currently, NRW accounts for 30% of Germany's grey hydrogen usage with this figure set to increase as more supply of the clean fuel becomes available. ■



Scheme of Shell's Refhyne electrolyser

Continued from page 1

Electricity rationing or self-generation

As demand outstrips supply, many industries in Guangdong were forced to reduce operations to as little as three days a week in May due to electricity rationing, while others have switched production to non-peak hours or are relying on higher cost self-generated power.

"It's worth pointing out that industrial sectors using natural gas and other energy

sources have not been impacted. Fuel costs have of course risen considerably but supply availability has remained steady," said WoodMackenzie's Vice Chair Energy, Asia Pacific, Gavin Thompson.

With industrial production remaining robust throughout China, WoodMac expects steady growth in power demand. The provinces of Hunan, Shandong and Zhejiang are all facing potential power shortages at times of high temperatures this summer. ■

Gas to Power Journal

Publisher
Stuart Fryer

Editor
Anja Karl
Tel: +44 (0)7733 684 682
anja@gastopowerjournal.com

New Business & Databases
Stephan Venter
Tel: +44 (0) 207 017 3407
venter@gastopowerjournal.com

Subscriptions
Margarita Tokere
Tel: +33 (0)7 67 62 58 77
margarita@gastopowerjournal.com

Layout & Production
Vivian Chee
Tel: +44 (0) 208 995 5540
chee@btconnect.com

Coal-to-gas switching policies push up China's LNG imports

Only Asia has seen LNG imports increase despite the pandemic, largely due the Chinese government's coal-to-gas switching policies which pushed up imports by 1.0 billion cubic feet per day (Bcf/d) in 2020. India's LNG imports increased 0.4 Bcf/d year-on-year as low prices for spot cargoes in spring and summer last year prompted fuel switching.

China remains the second largest LNG importer globally, with 68.9 million tons or a 19.3% market share – up by almost 2% from its 2019 market share, and bound to expand further, according to figures in the newly release Annual Report 2021 by the International Group of Liquefied Natural Gas Importers (GIIGNL).

In India, import grew 2.7 million tons or 11% underpinned by the operational start of the Mudra LNG regas terminal and higher utilization rate of the Kochi LNG terminal. Comparatively cheap spot LNG prices in the

shoulder seasons prompted many Indian utility buyers to dispatch gas-fired rather than coal-fired plants for power generation.

In contrast, LNG import to Japan eased of 0.3 Bcf/d over the course of last year to average 9.8 Bcf/d, largely due to the greater utilisation of nuclear reactors for baseload power generation.

Carbon price "too low" to make a difference

Coal-to-gas switching is, so far, still largely policy-driven given that the price on carbon emissions in Asia is far too low to make a

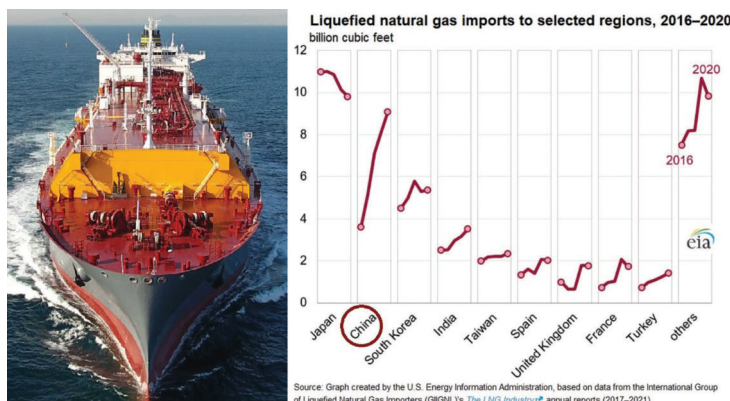
fuel switch economically viable. Boston Consulting Group finds that levying a price of \$40 per ton on carbon emissions in China would render gas-burn 30% cheaper than coal.

More generally in Asia, a carbon price of \$20 to \$50 per ton would bring gas to achieve cost equivalence with coal. However, these are all still "well below what is required to get the world onto a trajectory compatible with the Paris Agreement 2° Celsius pathway – about \$125 per ton," analysts pointed.

Assuming such carbon pricing was in place, for new combined-cycle gas turbine generator (CCGT) built now, there would be a positive cash-flow through 2040.

Today, the median price of carbon across 46 national jurisdictions is roughly \$13 per ton but just about a third of national prices are above the \$20 mark. Analysts see carbon pricing as an essential policy instrument to promote investment in small-scale LNG regas and integrated gas-fired power projects, often situated in remote areas.

Policy makers are urged to steer new investment by increasing the price of carbon, controlling pollution and rewarding efficiency. "The adoption of natural gas technologies has already proved to be a highly cost-effective solution for improving air quality and reducing emissions, through fuel switching away from coal and oil," analysts concluded.



fuel switch economically viable. Boston Consulting Group finds that levying a price of \$40 per ton on carbon emissions in China would render gas-burn 30% cheaper than coal.

More generally in Asia, a carbon price of \$20 to \$50

Gas demand rebound risks to undermine climate targets – IEA says

A rebound in gas demand through 2024, following the pandemic-related plunge last year risks to undermine the world's goal of reaching net zero emissions by 2050, the International Energy Agency (IEA) warned. Gas demand in 2021 is forecast to rise by 3.6% as global economies recover from the coronavirus crisis.

Starting from 2022, gas demand is forecast to ease to a more moderate 1.7% growth and by 2024 the world's hunger for gas will likely have increased 7% from 2019's pre-Covid levels. Demand this year largely reflects the economic recovery but it will be driven from gas replacing coal and oil in the power gen sector, industry and transport.

Need for stronger policies

To get on track for net-zero emissions by 2050, new measures are needed to promote further fuel substitution and efficiency gains. Keisuke Sadamori, the IEA's Director of Energy Markets and Security said stronger environmental policies need to be implemented to put global gas demand on a path in line with reaching net-zero emissions by 2050.

"These include measures to ensure gas is used more efficiently. At the same time,

the gas industry needs to significantly step up efforts to shift to cleaner and low-carbon gases – and to act quickly and effectively to address needless methane emissions," he specified.

Industry urged to curb emissions

The IEA's latest quarterly Gas Market Report examines how the gas industry can reduce its emission intensity, support the development of low-carbon gasses and develop solutions to minimise emissions from combustion. Reducing methane emission is seen as particularly efficient – in terms of both time and cost.

"The gas industry needs to significantly step up efforts to shift to cleaner and low-carbon gases – and to act quickly and effectively to address needless methane emissions," Sadamori underlined.

The rising gas demand can be met by conventional assets, mainly in Russia and

the Middle East, as well as by LNG. "Robust growth of the LNG carrier fleet will make supplies more adjustable," IEA analysts noted, with current order books representing a 25% increase in the vessel count in the next two to three years. Underground storage capacity, another pivotal source of flexibility, is set to increase by 7% over the forecast period.

But strong policies to curb gas demand in the long-term may incur heightened market volatility and concerns over security of energy supply towards 2050.



California faces high risk of electricity shortages this summer

Higher than normal temperatures are forecast for much of North America this summer, putting California at a high risk of electricity shortfalls and blackouts. Part of the Western Electricity Coordinating Council (WECC), California relies heavily on electricity imports to cover demand peaks and when solar power is unavailable.

Heat waves propel up the load on the grid, e.g. through air conditioning, and can reduce supply if power plant operations need to be ramped down or halted due to a lack of cooling water. The North American Electric Reliability Corporation's (NERC) hence warns of a heightened risk of electricity shortfalls this summer in the western United States, Texas, New England, and parts of the Midwest.

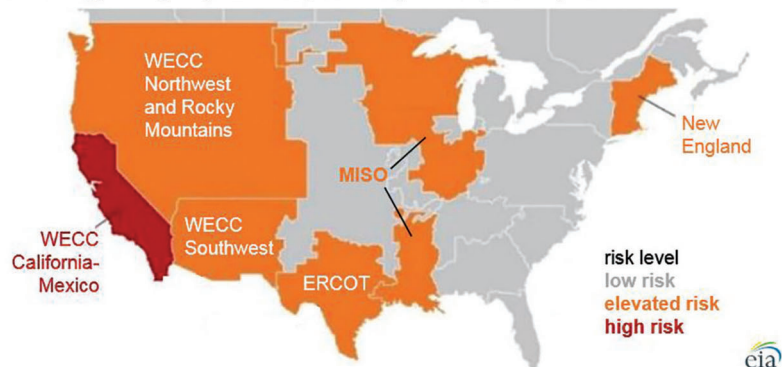
Resource and energy adequacy is "a significant concern" in Western Electricity Coordinating Council (WECC), which includes California. Generating capacity and projected electricity demand are at similar levels as they were in 2020, when an August wide-area heat wave caused rolling blackouts. The energy emergency may repeat this summer.

Solar overreliance and import limits

The highest risk of electricity emergency is in California, a WECC subregion, which relies heavily on energy imports during normal peak summer demand and when solar generation declines in the late afternoon.

Though California's electric utilities have recently added some flexible gas-fired power units, the high reliance on solar PV exacerbates the risk of an electricity emergency. If low solar power supply coincides with peak demand for air conditioning, the stability of

U.S. energy emergency risk areas, summer (June–September) 2021



Source: Map by U.S. Energy Information Administration, based on North American Electric Reliability Corporation (NERC) 2021 Summer Reliability Assessment. Note: ERCOT is the Electric Reliability Council of Texas; MISO is the Midcontinent Independent System Operator; WECC is the Western Electricity Coordinating Council.

California's power grid is in jeopardy.

Worse even, neighbouring states have limited power generation resources during the peak summer period to transfer and export electricity to California, NERC warned. The non-profit regulator NERC oversees regional electric reliability entities in the Lower 48 states, Canada, and parts of Mexico. In its 2021 Summer Reliability Assessment, NERC tabulates anticipated electricity demand and supply changes and highlights any regional challenges that may affect the bulk US power system.

Low reserve margins in Texas

Texas typically has some the smallest reserve margins in the US, meaning it has little unused generating capacity during

times of peak electric load.

The Electric Reliability Council of Texas (ERCOT) anticipated reserve margin increased from 12.9% last summer to 15.3% for this summer as a result of adding new wind, solar, and battery resources. But despite the higher margin, extreme summer heat could still cause supply shortages that may cause local brownouts.

In contrast, ISO-New England and the Midcontinent Independent System Operator (MISO) have sufficient power generating resources to meet projected peak demand. During a heat wave, demand may exceed capacity resources but in that case, electricity can be imported and transferred from surrounding areas to keep the system in balance. ■

Rolls-Royce invests in Berlin-based provider of decentralised power

Rolls-Royce Power Systems is investing in the Berlin-based start-up Kowry Energy. Focusing on Sub-Saharan Africa, the German engineers combine solar photovoltaic and battery storage into hybrid power units. As a young company, Kowry can "adapt to the realities" in Africa and the partnership with Rolls-Royce enhances its market positioning.

Sub-Saharan Africa has some of the lowest electrification rates in the world;



Render of hybrid solar and battery system

hence manufacturers see "great potential" for decentralised power generation projects. Blessed with abundant sunshine, developers can build climate-friendly, local power units for industrial and community customers that operate with minimum use of fossil fuels.

Scalable solar plus storage

"We believe that solving the climate challenge facing our planet will only succeed with the inclusion of the 600 million people of Sub-Saharan Africa who are living without energy today," said Kowry Energy founder Ndiarka Mbodji. That is why the start-up strives to set up "sustainable energy access with scale and speed," notably through solar PV and battery storage for demand of up to 1 MW.

In 2021, Kowry Energy will be launch-

ing projects in Mali and Nigeria and CEO Mbodji is confident to see the company's business model "validated" by a current project pipeline of \$17 million. Looking ahead, he aspires to welcome more investors.

Investor and partner

Rolls-Royce Power Systems as industry partner and investor provides Kowry Energy with strong positioning in the market. "The start-up can rely on our support and know-how in implementing their projects," said Power Systems CFO Louise Öfverström.

Headquartered in Friedrichshafen, RR Power Systems or the former Tognum AG employs around 9,000 people and achieved revenue of £11.76 billion in 2020, with £1.25 billion invested in research and development. ■

Ansaldo performs first MXL3 upgrade to GT26 turbine run by ENGIE

Ansaldo Energia will carry out the first installation of an MXL3 upgrade for GT26 gas turbines at Maxima-Flevo combined-cycle power plant in the Netherlands in spring 2023. The upgraded CCGT, owned by the French utility ENGIE, will deliver 25 MW more output and achieve a 1.5% higher efficiency.

Additionally, the maintenance interval will be extended to 40,000 equivalent operating hours – the same intervals as for the MXL2 upgrade. The MXL3 upgrade allows the power plant operator to switch between 'performance' optimized mode and 'maintenance cost' optimized mode.

Over 60% efficiency

All in all, the MXL3 is expected to boost the current maximum output of the Maxima-Flevo 5 CCGT unit by up to 35 MW. According to Ansaldo, it will be "the first plant with an F-class gas turbine in Western Europe to reach more than 60%

efficiency." The higher efficiency could help save up to 40,000 tons of CO₂ per year, depending on the running profile.

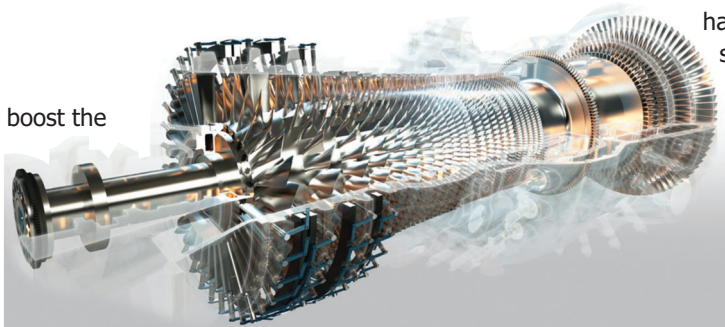
"By acting as a launching customer for the introduction of the cutting edge MXL3 upgrade at Maxima-Flevo power plant, ENGIE continues to be a first mover in the

market," said Cedric Osterrieth, CEO of ENGIE GENERATION Europe.

Hydrogen-ready turbine

The MXL3 technology allows the co-firing of hydrogen up to 45% of volume flow, with no additional changes to the gas turbine hardware. Raising the hydrogen share of the overall fuel helps to further reduce emissions during the combustion process.

ENGIE is committed to reach Net Zero carbon emissions by 2024 and is hence considering to applying Ansaldo MXL3 technology to all GT26 turbines of its European fleet. ■



Mitsubishi delivers world's largest negative emissions project at Drax

Britain's Drax Group has agreed to license and use Mitsubishi Heavy Industries' (MHI) carbon capture solvent, KS-21 technology, to capture CO₂ at its power station near Selby, North Yorkshire. With the Advanced KM CDR process, MHI will turn Drax Power Station into the largest "negative emissions" plant anywhere in the world.

MHI's advanced Kansai Mitsubishi Carbon Dioxide Recovery (KM CDR) Process utilises the hindered amine solvent KS-1 together with proprietary equipment. The technology recovers CO₂ from various sources of flue gas.

Prior to the KM CDR rollout at Drax, the utility trialled MHI's carbon capture technology in a pilot that started in 2020 and tested two of MHI's proprietary solvents, KS-1 and KS-21. As part of the agreement, MHI will pair its carbon capture technology with off-shore geological storage under the North Sea, helping the UK achieve its target to cut carbon emissions by 78% by 2035.

Solvent may soon be UK-made

Mitsubishi Heavy Industries Engineering, part of MHI, will use the deal with Drax to locate its core CCS team at the company's European headquarters in London. With this move, the Japanese manufacturer seeks to strengthen its supply chain and potentially produce its solvent in the UK.

Kenji Terasawa, President & CEO, Mitsubishi Heavy Industries Engineering, said the company is looking to develop a centre of excellence for the deployment of carbon capture technology across Europe, the Middle East and Africa.

BECCS deployed at Drax by 2027

Drax is already the largest decarbonisation project in Europe, having converted its power station to use biomass instead of coal which reduced emissions by more than 85%. The first BECCS unit at Drax could be

operational before the end of the decade. "With an effective negative emissions policy and investment framework from the government, BECCS could be deployed at Drax as soon as 2027," the MHIE head said.

The planning process is already underway – if successful, work could get underway to build BECCS at Drax as soon as 2024. According to the plant operator, the conversion project could support thousands of jobs across the North of England as soon as 2024, and capturing and storing at least 8 million tonnes of CO₂ a year. ■



Biomass domes at Drax Power Station & Mitsubishi's KM CDR process



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Vietnam's Bac Lieu LNG-to-Power project hires Bechtel for engineering

Bechtel has been awarded a contract to provide front-end engineering and design (FEED) for a new 3,200 MW combined-cycle power plant in Bac Lieu Province in Vietnam's Mekong Delta. The CCGT will be fuelled by LNG and is being developed by Singapore-based Delta Offshore Energy and is due operational in 2023.

Situated some 250 kilometres south of Ho Chi Minh City, formerly Saigon, the CCGT is being developed with an adjacent LNG regas terminal. It is one of about half a dozen being developed in Vietnam.

According to Bechtel, the CCGT design entails four Siemens single shaft H-class turbines and is meant to form the "the energy backbone of the Mekong Delta" as the region industrialises. "This power plant is a game changer for the Bac Lieu province. We want to make a difference in supporting Mekong

Delta and Vietnam by creating jobs and training, working with local businesses, and providing new opportunities for those in the region," said Scott Osborne, Bechtel's general manager for infrastructure in Asia-Pacific.

Turbine installation underway

Installation of the first of four 750 MW gas turbine is understood to have started in early 2021, as Delta Offshore Energy seeks to get the CCGT commissioned less than two year's time.

Delta, the investor and lead developer for

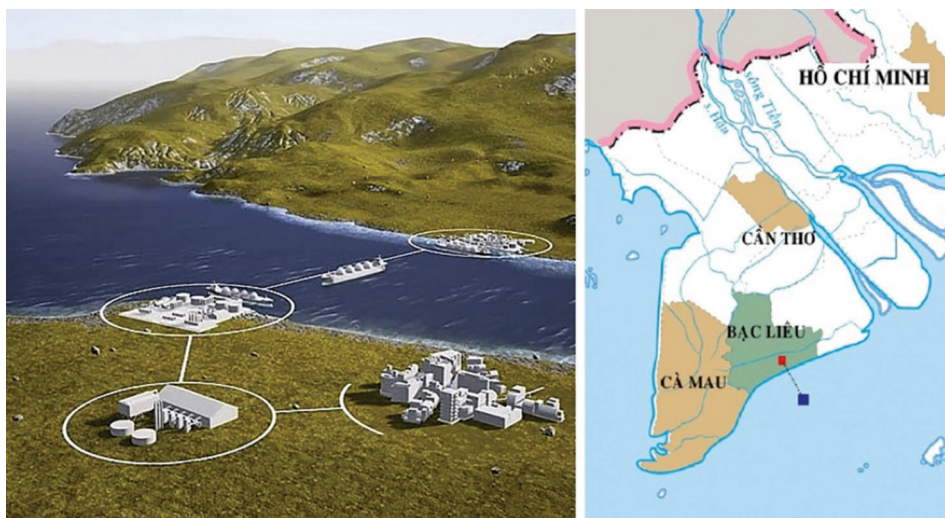
the 3.2 GW power station at Bac Lieu has already agreed to sell all electricity from the LNG-to-Power project to Vietnam Electricity starting from 2023.

In parallel with the FEED services for the gas-fired power plant, Delta Offshore said it was conducting engineering for the offshore LNG import terminal together with Norway's 7 Seas, and was implementing site preparation works.

Private-funded project

The \$4 billion integrated LNG regas and power generation project will mostly private-funded. "The existing Public-Private Partnership model is obsolete given Vietnam's fiscal reality as debt levels approach the National Assembly's imposed ceiling and is re-enforced by Vietnam's sovereign credit rating threshold," said Ian Nguyen, Director of Origination and Government Relations for Delta Offshore.

Vietnam seeks to shift its power sector towards gas generation and has made plans to increase LNG imports from currently around 6 million tons per annum to 10 mtpa by 2030 and 15 mtpa by 2035. To that end, the government supports a second LNG regas terminal near a projected power plant in Ninh Thuan province, backed by Russia's Novatek.



Render of Bac Lieu's LNG regas facility and power project

Argentina's YPF runs peaking power plant on associated gas

YPF Luz, part of the Argentinean oil and gas company YPF, is running the Central Térmica Manantiales Behr on associated gas from its oil production operations. The 58 MW peaking unit is powered by five Wärtsilä 31SG engines and was built by the Finnish manufacturer under a full EPC contract.

The Manantiales Behr basin is one of YPF's mature oil fields; hence intensive infill and stepout drilling are essential to moderating production decline rates. Wind speeds at the basin can reach 180 km/hour, and temperatures range between minus 10 and plus 40 degrees Celsius which makes oil upstream challenging.

Reliable operation is essential since the 58 MW plant provides the electricity needed for oil production. The design of the robust power plant is centered around five highly efficient Wärtsilä 31SG gas-fuelled engines that run on associated gas, which lowers overall operating costs.

Handling low pressure

On the technical side, Wärtsilä faced many challenges especially the fact that the fuel

for the engines is gas supplied at very low pressure from the oil fields. "Fortunately, our technology is able to burn this special gas very efficiently utilising a gas compression plant to increase the pressure, making it suitable for fuel injection," said Jorge Alcaide, Energy Business Director, Region South, Americas, Wärtsilä Energy.

The customer YPF Luz also operates a wind farm adjacent to the power plant site, so the fast-ramp gas engines need to balance the intermittent wind power supply. Combined, the wind farm and gas-fired power unit are operated as an integrated hybrid plant.

Wärtsilä has installed 600 MW of generating capacity in Argentina and 3,630 MW throughout South America. Counting in the Manantiales Behr, the Finnish manufacturer has completed eight projects on time and on budget during the past four years in Argentina.



YPF's Manantiales Behr power plant helps balance wind energy

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