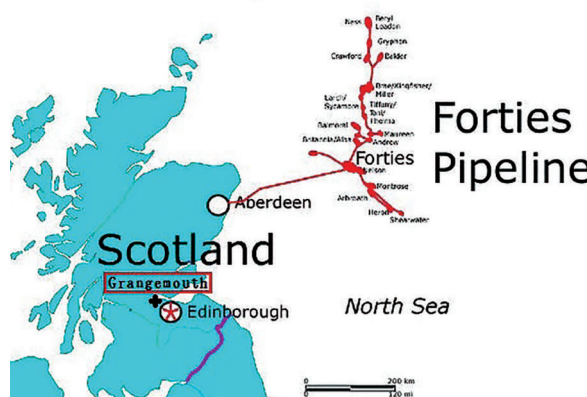




Slump in UK gas output, high coal and CO2 prices fuel price rally

The slump in UK gas production, down 28% year-to-date, combined with high coal and carbon prices and booming LNG demand in Asia, has been fuelling the price rally at the British gas trading hub NBP. Though Wood Mackenzie expects UK gas production will recover to 35 billion cubic metres (bcm) in 2022, additional LNG imports might be needed to cover demand this winter.



Between January and August this year, UK gas production amounted to just 17 bcm, down from 24 bcm over the same period in 2020. The steep drop in output was caused by delays of new upstream projects and the three-week maintenance of Forties Pipeline System in June, which halted supply from all 67 field operators in Britain.

Low summer supply amid longer maintenance

Works on the British offshore gas gathering system throughout the year meant that large fields like Elgin/Franklin, Shearwater and

ETAP have all been offline for much longer than usual. But Wood Mackenzie expects UK gas production to recover through the remainder of the year. Indeed, August output has already climbed 72% over July. Still, the summer slump means overall 2021 production will be slightly over 27 bcm, compared with 34 bcm in 2019 and 35 bcm this year. Analysts forecast an increase in UK gas output to 35 bcm in 2022.

The supply rebound will be largely caused by the start-up of new gas projects such as Saturn Banks, and others that were deferred from 2020 as a result of the coronavirus pandemic. These

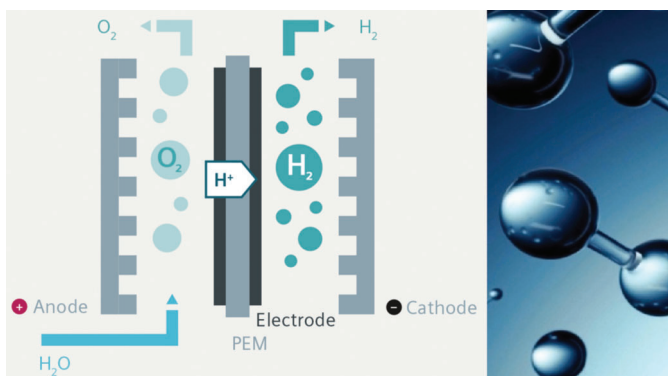
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Toray and Siemens jointly develop PEM electrolyser with new membrane

Toray Industries and Siemens Energy were chosen to partake in Japan's Green Innovation Funding Program to promote multi megawatt class PEM (Polymer Electrolyte Membrane) electrolysis in Japan. Together with Tokyo Electric, the two manufacturers will install a demo plant based on Toray's proprietary hydrocarbon electrolyte membranes.

The Japanese Ministry of Economy, Trade and Industry (METI) is organising and sponsoring a Green Hydrogen Project scheme together with the New Energy and Industrial Technology Development Organization (NEDO). The Siemens/Toray initiative will receive the funding together with six other companies including the Yamanashi Prefectural Enterprises Bureau, and Tokyo Electric, Siemens said without specifying the exact amount of the financial support.

The Japanese government is striving to reach a carbon-neutral society by 2050, which has set in motion an urgent quest for technological innova-



tions to reach this objective. Producing green hydrogen through PEM water electrolysis, using renewable energy sources, is seen as a vital means to decarbonise hard-to-abate industries where

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include Arran, Columbus and Finlaggan.

Tight UK winter balance puts strain on power sector

In the short term, analysts are wary about an already tight UK winter balance which is premised on this supply recovery, so any disruption will put the UK system under significant strain. "With limited UK gas storage, the levers that the UK can pull to balance the market include higher gas imports from Norway or the continent; additional LNG cargoes; increased coal burn; and higher electricity imports," analysts said.

Any material demand response will have

to come from the power generation sector, though some flexible gas power units are "system critical" because they supply vital ancillary services to balance the grid.

Short-term LNG bookings deemed "challenging"

Booking additional LNG cargoes on a short-term basis amid growing Asian LNG demand will prove challenging. The UK's coal capacity has shrunk to just 4 Gigawatts – offering less switching potential in periods of high gas prices than previously. Higher coal-burn would be an option, but this would come at an inopportune time given that the world's

policy makers will meet at the COP26 Climate Summit in Glasgow in November.

"UK and European gas prices will remain elevated at current levels throughout winter," analysts forecasts. Hence British oil and gas producers will be keen to bring production back quickly in order to capitalise on the record price levels.

"A recovery in UK gas production is critical for this winter," analysts stressed, underlining the importance of fresh investment into domestic gas supply to avoid an over-reliance on LNG and pipeline gas imports at a time of growing competition for volumes in Europe and globally. ■

US associated gas production falls in Permian shale after 3-year growth

Production of associated gas from crude oil wells in the Permian shale has fallen after three years of steady growth as the Covid 19 pandemic depressed oil demand and production. Since 2020, the share of associated gas in all five US onshore crude oil-producing regions dropped 1.5% to just 37.7% of overall gas output.

When natural gas dissolves in crude oil under the pressure of a rock formation, associated gas is released when the pressure on the crude oil is relieved by bringing it to the surface.

The Permian region, spanning parts of western Texas and eastern New Mexico, produced 50% of total U.S. associated gas in 2020. Only the Permian managed to raise its production of both crude oil and associated gas last year, but these increases did not offset declines in both crude oil and associated gas production in the other four regions. Analysts from the US Information Administration (EIA) explained "some of this increase in associated gas production can be attributed to greater natural gas take-away capacity in the Permian region."

In the three years prior to the pandemic, the share of associated gas in US onshore oil production in the 5 onshore oil regions

has been increasing steadily, along with oil production. The most rapid pace of growth, at 6.1 billion cubic feet per day (Bcf/d), took place between 2016 and 2019, according to EIA figures. In 2020, however, associated gas production averaged 14.2 Bcf/d a 4.1% decline from 2019 amid a 9.2% drop in onshore oil production.

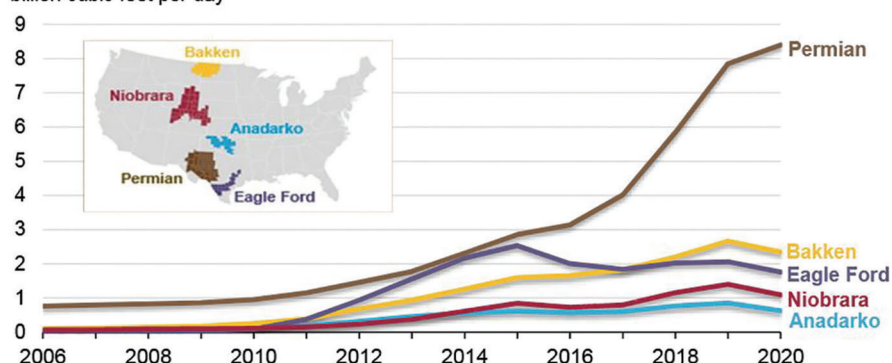
Gas liquids used for ethane production

Associated gas contains natural gas plant liquids (NGPLs) such as ethane, propane,

normal butane, isobutane, and natural gasoline. NGPLs are used as feedstock to produce plastics, fibres, and other products; they are also used for heating and for transportation.

Though the pandemic caused a temporary drop in associated gas output, years of rising associated gas production led to record high volumes of NGPL production in 2020, driven by high ethane demand, EIA analysts pointed out. Ethane consumption has been growing steadily both domestically and through exports since 2014. ■

Associated gas production in major U.S. crude oil production regions (2006–2020)
billion cubic feet per day



Source: Graph by the U.S. Energy Information Administration, based on Enverus Drillinginfo data
Note: EIA designates wells as either oil or natural gas wells based on a gas-oil ratio (GOR) of 6,000 cubic feet (cf) of natural gas to 1 barrel (b) of oil (cf/b) for each year's production. We classify GOR equal to or less than 6,000 cf/b as oil wells and GOR greater than 6,000 cf/b as natural gas wells. Natural gas volumes have been converted to the federal pressure base of 14.73 pound-force per square inch.

Continued from page 1

electrification is not an option.

Green hydrogen can not only be used for large-scale power generation and other electric power applications, but also for sector coupling such as heat, transport, and industrial applications. Under the cooperation

agreement, Toray will provide Siemens Energy with its proprietary hydrocarbon electrolyte membranes which will then be installed, demonstrated and technically validated in Siemens' large industrial scale PEM water electrolyser. ■

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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

Microbes eat away small volumes of hydrogen stored underground

Researchers have measured the effect of microbes eating away some of the hydrogen stored in subsurface porous rocks. Though the majority of sites – 37 out of the 42 examined – are at risk of microbial effects, the actual hydrogen consumption is likely to be “negligible to small.”

Hydrogen, a clean alternative to natural gas, can alleviate a key drawback of renewable energy generation – its intermittency. This requires suitable sites to store green hydrogen, produced from excess wind and solar power, for use in industry or reconversion into electricity at times of high demand.

HyStorPor selects 5 fields

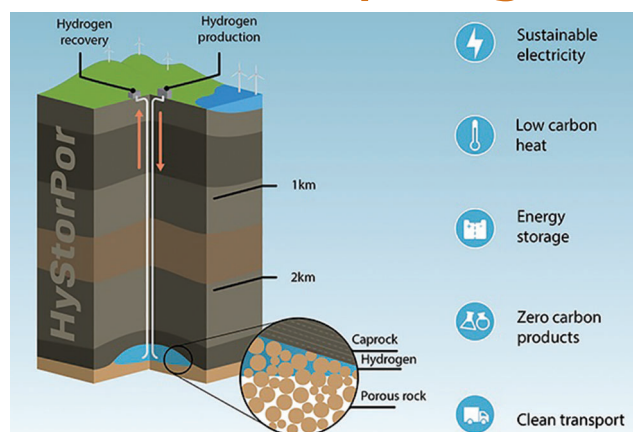
The UK government has been urged to double its target to produce 5 GW of hydrogen by 2030, and the HyStorPor project is examining the feasibility of storing excess hydrogen in reservoir rocks as a means of accelerating its deployment. Investors were concerned microbes could eat away significant volumes of the stored hydrogen, and lower injection rates. But a study of 42 storage sites found that actual microbial hydrogen consumption is unlikely to be an impediment.

“Oil and gas fields with temperatures of

more than 122°C can be considered sterile to microbial growth,” say researchers from the University of Edinburgh and Clausthal University of Technology, Germany. Five of the 42 fields – situated in the British and Norwegian North Sea and the Irish Sea – were found to have “environmental conditions that impede microbial growth” and are hence most suitable for hydrogen storage.

Microbes “no impediment”

The risk for microbial growth is reduced at extreme salinities, hence depleted oil and gas fields with low salinity, low temperature and close to neutral pH are likely to host substantial microbial growth. Researchers concluded that the microbial consumption of hydrogen in most cases constitutes a “negligible to small percentage of the stored hydrogen,” ranging from less than 0.01% to 3.2% at the most.



Lead researcher Eike Marie Thaysen from Edinburgh University cautioned, however, the findings need to be confirmed by laboratory and field experiments on microbial hydrogen consumption at high hydrogen pressures. Gion Joel Strobel, co-author from TU Clausthal called the study an “excellent example of interdisciplinary work” between reservoir engineering and microbial science.

“The storage of hydrogen could be a key factor in the hydrogen-based economy, which could help reduce carbon emissions in carbon-heavy industries,” he stressed with a view to the UK government considering doubling its 5 GW hydrogen production target to 10 GW by 2030. ■

Cost of green hydrogen expected to plunge to \$1.40/kg by 2030

The cost of producing hydrogen gas from renewables is forecast to fall sharply over the next decade, providing an affordable fuel to decarbonise the energy and transport sectors. In Germany and Texas, RES hydrogen costs could fall to \$1.40 a kilogram by 2030 from the current range of \$2.50 to \$6.80, according to research published in Nature Energy.

Technology improvements could allow for a further slide in price to 80 cents by 2050, equivalent to a natural gas price of \$6 per MMBtu. At this price, green hydrogen-fuelled power stations would be cost competitive with natural gas-fired power plants in most market zones around the globe.

Green hydrogen “already cost competitive”

Producing green hydrogen via electrolysis of water, using electricity from wind and solar power sources, is still more costly in most markets than the alternative method where natural gas is ‘reformed’ into hydrogen and CO₂.

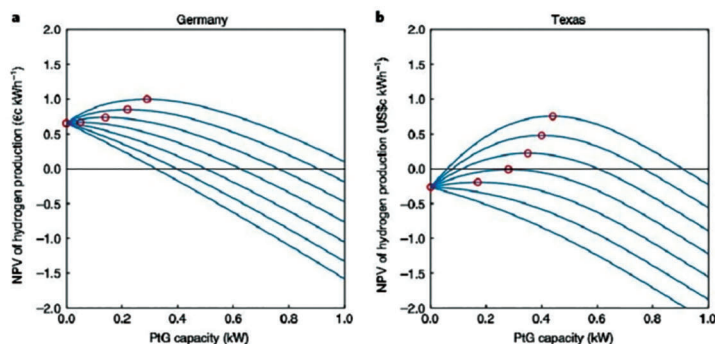
In Germany and Texas, however, hydrogen

produced using wind power is already attractive for small- and medium-scale users, Gunther Glenk and Stefan Reichelstein write in a research paper.

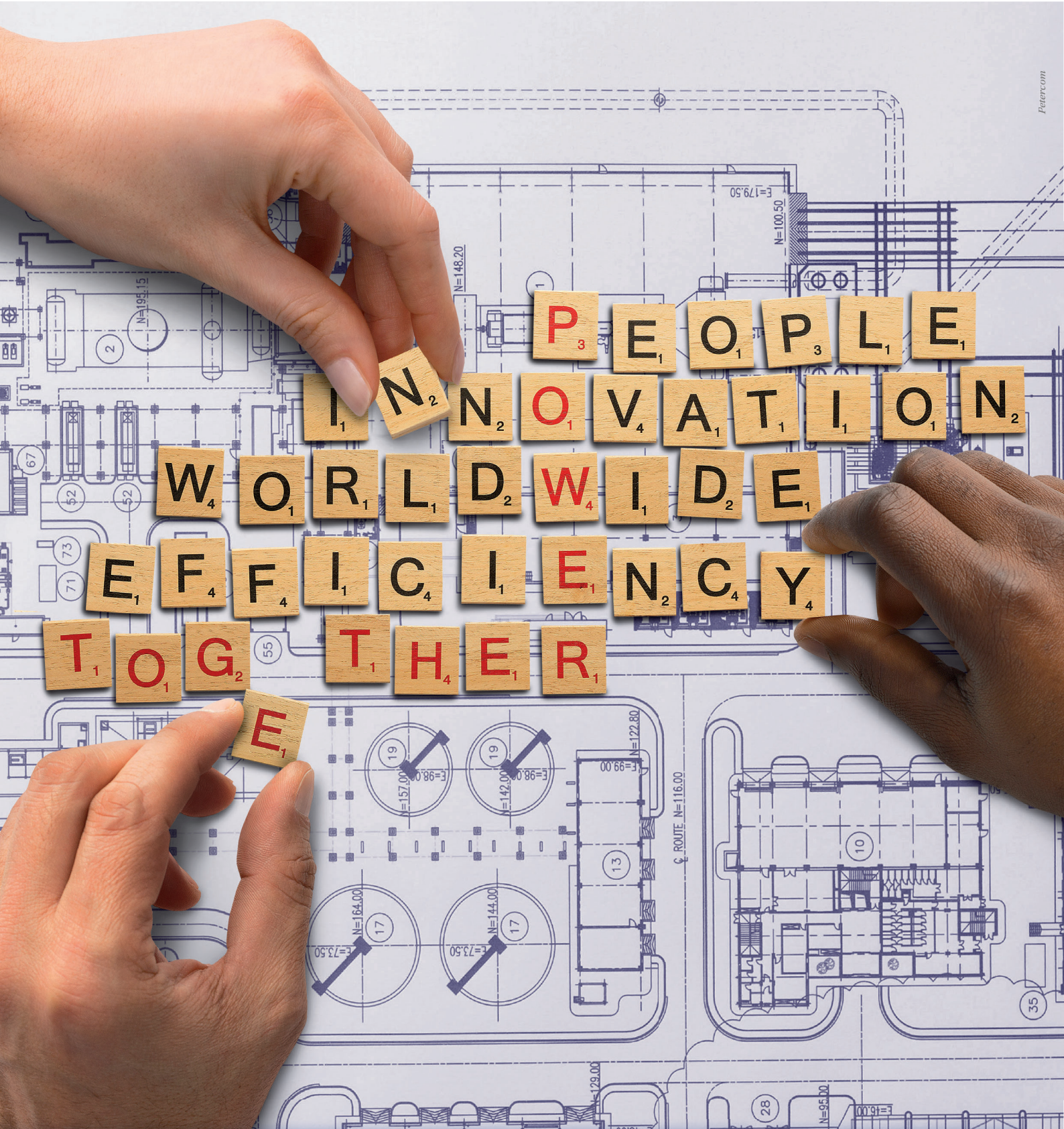
Renewable hydrogen, produced for €3.23 per kilo, is already cost competitive in niche applications, although not yet for industrial-scale supply. This might well change within if the cost for renewable hydrogen continues to fall towards €2.50 per kilo.

If a power-to-gas facility can also source electricity from the grid, it would achieve higher capacity utilization which may substantially lower break-even prices for hydrogen.

Hybrid power plants, combining renewables with a power-to-gas station, can produce hydrogen cheaply by taking advantage of fluctuations in electricity prices and intermittent renewable energy supply. Once produced at scale, hydrogen is very valuable as it can be used for power generation or for storing excess renewable energy in the natural gas grid. ■



Optimal PtG capacity size and corresponding NPV. a,b. Given a normalized wind energy capacity of 1.0 kW, the figure shows the NPV of an optimized hybrid energy system in Germany (a) and Texas (b) for alternative hydrogen prices ranging from €/US\$2.0 to 5.0 kg⁻¹ (blue lines). The red circles mark the optimal PtG capacity size for each alternative hydrogen price. The circles at 0.0 kW reflect that no PtG capacity should be installed.

A close-up photograph of three hands placing wooden letter tiles onto a technical architectural drawing. The tiles are arranged to spell out 'PEOPLE INNOVATION WORLDWIDE EFFICIENCY TOGETHER'. The tiles are light-colored wood with black or red letters. Some tiles have small numbers in the corners, likely indicating their point value in a game like Scrabble. The background is a detailed technical drawing with various lines, circles, and text, including 'ROUTE N=116.00' and 'N=122.80'.

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CCS could substantially curtail carbon emissions of LNG projects

Carbon capture and storage (CCS), alongside with electrification and the use of renewables and energy storage could substantially reduce carbon emissions of LNG projects. More than 25% of overall carbon emissions could be removed depending on the technology adopted, according to Wood Mackenzie calculations, with capturing reservoir CO₂ found to be much cheaper than post-combustion capture.

Around 40% of the total scope 1 and 2 LNG emissions are from the process of gas liquefaction, but senior analysts Daniel Toleman underlined that “each plant has a unique emissions profile,” hence the best way to reduce the carbon footprint of an Arctic liquefaction plant may vary significantly from one in Qatar or Australia.

“The good news is that LNG players are well placed to lead the CCS charge, with strong balance sheets, operational capability and reservoir expertise. There are also economic incentives for pursuing CCS as reducing emissions mitigates against a carbon tax, helps future-proof the asset and can offer pricing upside,” he said.

Comparing two technologies

The cost of retrofitting an LNG terminal with CCS depend on how far the CO₂ source is to the injection site, the project's economies of scale, and whether existing infrastructure can be repurposed. Capturing reservoir CO₂ – irrespective of whether the CO₂ is sequestered or vented – is significantly cheaper than post-combustion capture.

All liquefaction projects need to remove carbon emissions from the feedgas stream before cooling down the natural gas to minus 165 degrees to prevent the CO₂ from freezing and blocking processes. As such,

the acid gas removal unit (AGRU) used to capture CO₂ does not incur additional costs. Reservoir CCS can reduce the overall intensity of LNG projects by 25%, and in some cases up to 50%, according to Wood Mackenzie findings.

In contrast, the second approach of post-combustion CCS involves capturing CO₂ from the LNG flue gas stream. This technology needs to be retrofitted from scratch but when integrated in a new-build LNG facility, there can be some design and location synergies. Tax credits can also help improve the economics of post-combustion CCS, analysts noted. “For example, in the US, new-build post-combustion projects can become very competitive as well with the application of the 45Q tax credit for carbon sequestration,” Toleman explained.

First movers in Qatar, Australia and Malaysia

Looking ahead, Toleman expects CCS will play a significant role in reducing emissions from LNG projects as long as country-specific legislation progresses, as well as construction costs can be brought down. “Low-cost reservoir CCS projects are likely to be the first to move ahead,” he said, urging market observer to: “look out for projects in Qatar, Australia, Malaysia and Timor Leste.

LNG players in the US, who benefit from the 45Q tax credit, will likely be the first LNG players to take post-combustion CCS forward. Apart from applying CCS technology, operators of LNG export terminals can also lower their emission footprint by paying for carbon offsets or investing in systems to reduce methane leakage. ■

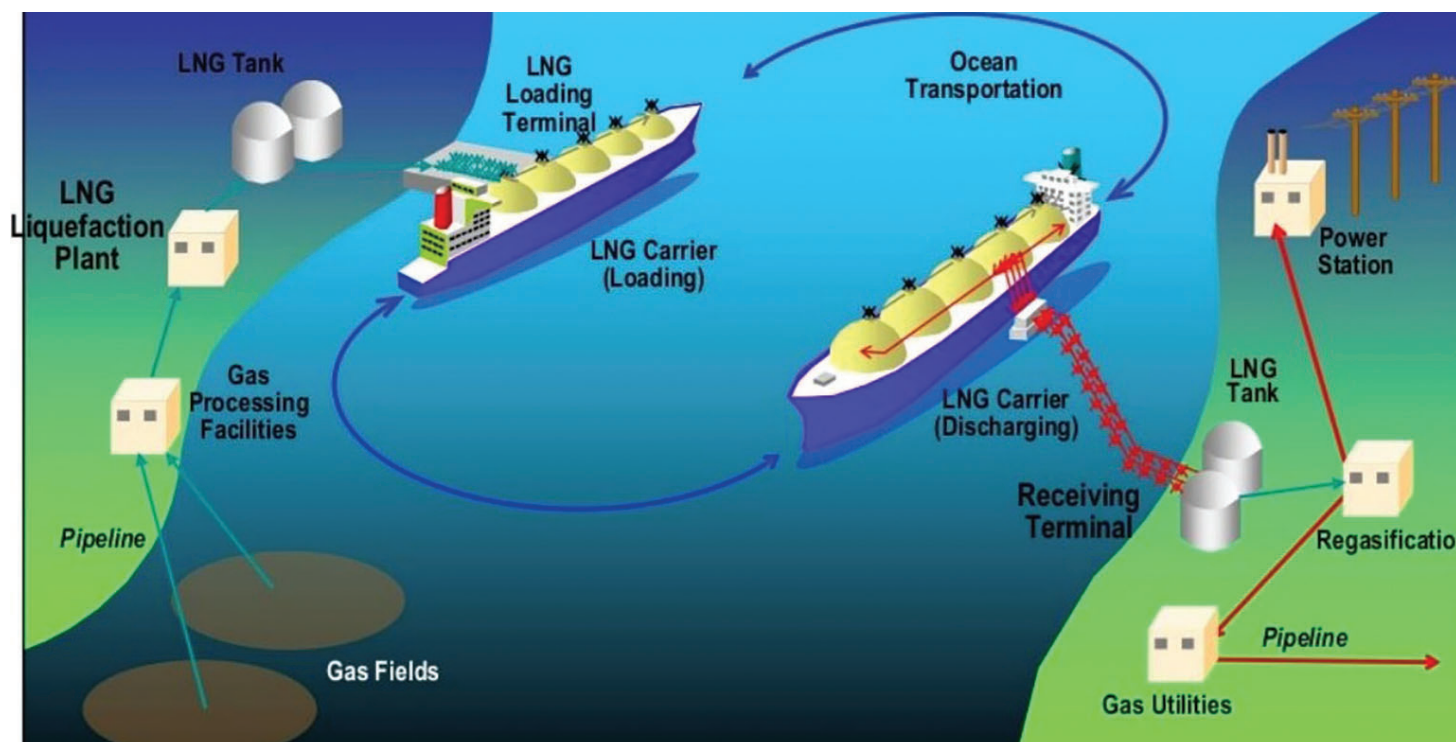
NEWS NUDGES

Emission monitoring market surges

Global market for Continuous Emission Monitoring Systems (CEMS) is forecast to grow at a rate of 7.8% from \$2.2 billion in 2020 to reach \$3.8 billion by 2027, according to MarketandMarkets. The power gen segment is likely to surge 8.3% and reach \$1.3 billion over the forecast period.

INNIO joins UN Global Compact

INNIO has joined United Global Compact, the world's largest corporate sustainability initiative. The Austrian manufacturer reinforced its commitment to environmental, social and governance (ESG) goals for its Jenbacher and Waukesha gas engine businesses.





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KOGAS about to win \$4.75bn tender for LNG-to-Power project in Vietnam

Korea Gas Corp. (KOGAS) and Hanwha Energy are close to winning a contract to build the 1,500 MW Hai Lang LNG-fuelled power plant in Vietnam. The two companies, in consortium with Southern Power and Vietnam's T&T Group, were the only bidders in the 5.5 trillion Won (\$4.75bn) project tender and currently in exclusive negotiations with the local government.

To be built in Quang Tri Province, situated at the North Central Coast region of Vietnam, the power plant will be developed in stages. The first stage will see the construction of a 1,500 MW power unit, scheduled to start operations in 2028. The project cost for the first pages is estimated at 2.5 trillion Won (\$2.15bn).

Through the second and third project phase, the capacity of power plant will be expanded to 4,500 MW – with total project cost estimated to amount to 5.5 trillion won, if all goes to plan.

The KOGAS/Hanwha Energy consortium has been working to expand its market share in Vietnam through cooperation with local companies and targeted acquisitions. Hanwha recently bought a 10% stake in Vietnamese energy company Bamboo Capital Group, while KOGAS is cooperating with

Energy Capital Vietnam to 3,600 MW LNG-fuelled power plant in the Mui Ke Ga area in the south-eastern Binh Thuan province.

The central Vietnamese government is actively prompting a shift from coal to LNG as a fuel for power generation in a bid to counter the country's power shortages, which already caused a series of blackouts during 2020 and this summer. The target, set by the government, is to expand the capacity of installed LNG power generation to 4.1 GW by 2025 and up to 59 GW by 2045.

In addition, the government is incentivising the construction of 42.3 GW of solar energy, 45.9 GW of wind power capacity to meet its green energy objectives and decarbonisation goals. ■



Render of of Vietnam's Hai Lang LNG power plant

Taiwan's CTCI and Siemens win EPC contract to build Sun Ba CCCT Phase-2

CTCI, Taiwan's leading engineering, procurement and construction (EPC) contractor, has been selected to build Phase-2 of the Sun Ba combined cycle power plant in southern Taiwan in consortium with Siemens Energy. The 1,100 MW plant, powered by a HL-class turbine, is due fully operational in 2024.

Sun Ba Phase-2 is "another big win," CTCI said, noting the contract comes on the heels of a multi-billion dollar EPC contract for five generating units at Hsinta and Taichung power plants, both in Taiwan, last September.

As one of the world's foremost manufacturers of semiconductors and a technology leader, Taiwan depends on secure and affordable power supply. Since Taiwan must import its entire natural gas requirements as LNG at comparatively high costs, the efficiency of gas-fired power plants has a particularly strong impact on their economic viability.



View of Sun Ba CCGT in Taiwan's Shan Shang district

Situated in Taiwan's rural Shan Shang district, Tainan province, the Sun Ba gas-fired power plant is owned by the privately-run utility company Sun Ba Power Corp. Phase-2 is designed as a multi-shaft combined cycle power plant, in which two gas turbines and one steam turbine each drive its own electrical generator.

Siemens Energy's scope of supply includes the plant's power island, consisting of two SGT6-9000HL gas turbines, one SST-5000 steam turbine, three SGen6-2000P generators, two heat recovery steam generators, and the SPPA-T3000 control system. CTCI is responsible for the construction and installation, and whole EPC work of the balance of plant.

All electricity generated by the 1.1 GW plant will be sold to state utility company Taipower, adding flexibility to power dispatch. Expanding flexible CCGT capacity is in line with policies set out by the Government to raise the gas-fired power ratio to 50% by 2025. ■

NEWS NUDGES

EnerMech signs new deals in Americas

Integrated solutions specialist EnerMech has secured several multi-sector contracts in the Americas. The multiple sector awards span the oil and gas, petrochemicals, maritime, and power generation industries. The largest contract is for nitrogen and leak testing of installations for an E&P operator in off-shore Gulf of Mexico. As a result of these new awards EnerMech doubled its electrical team, and increased the number of mechanical pipefitters.

GE deploys first PTA unit for polyester producer in Turkey

SASA Polyester Sanayi, a Turkish polyester and polymer producer, has turned to GE Power Conversion to build a Purified Terephthalic Acid (PTA) production in the city of Adana. PTA is used in the pharmaceutical and textile industries, and GE's new electrical system includes a 6-poles motor-generator (46.5 MW) and a soft starter.

The motor-generators, built on the principle of salient pole rotors, are suitable for applications requiring long duty cycles. GE has a long history and solid expertise in 4 and 6 pole synchronous motors with more than 800 machines and 5,700 MW installed worldwide.

EU-funds project for energy efficiency

The European Union (EU) has funded HEATLEAP project has been launched to demonstrate the benefits of waste heat recovery systems such as large heat pumps for industries and gas expanders for electric utilities. Turboden will coordinate the project whereby heat pumps and gas expanders are tested at real scale.

GE completes 9F turbine upgrade on Thessaloniki Power Plant

General Electric today announced the modernization of ELPEDISON's Thessaloniki Power Plant in Greece was completed safely. The upgrade consists of a GE 9F.03 gas turbine, along with a Franco Tosi-supplied steam turbine, which together increase the plant's output by over 20 MW and reduce its start-up costs by 10%.

The Greece government has made plans to transition towards lower carbon power generation which requires operational improvements of many of the country's ageing fleet of thermal power plants. Greece's recovery plan proposes investments and reforms that support climate objectives which triggers operators to upgrade and adapt their power generation infrastructure and shift to a greater use of natural gas and renewables in the energy mix.

"A number of factors drive the growth of the energy sector of Greece," said Silvio Jean, director of ELPEDISON Power Generation: "Primarily, the required improvement of the energy mix, the liberalization of the electricity and natural gas markets as well as the efforts to improve energy efficiency and reduce the costs and infrastructure development."

"As the first independent energy producer in Greece, it is important for us to increase our competitiveness in the power

and to our clients," Jean outlined.

At the Thessaloniki plant's 9F gas turbine, GE installed its DLN 2.6+ combustor system, its OpFlex software solution and its Advanced Gas Path (AGP) technology. The agility of the power plant was further increase by replacing the HP/IP rotor of the steam turbine and reconfiguring the unit in line with new market needs and an increasingly volatile demand structure.

The upgrade also included GE Digital's Operations Performance Management (OPM) software solution. Enabled by secure edge-to-cloud technology, OPM will analyze Thessaloniki's plant historical performance and operations to monitor and diagnose possible issues, improve capacity planning, and drive improved efficiency, flexibility, capacity and emissions.

Commenting on the project, Steven Miller, Services Leader for GE Gas Power Europe said: "With this project, the Thessaloniki Power Plant will see an increase in power output and flexibility, improved efficiency, extended asset lifetime as well as significant savings on fuel costs in line with the energy sector reform that Greece is currently implementing."



Aerial view of ELPEDISON's gas-fired power plant

segment by extending the life of our plants and providing the best service to our users. By using the latest GE technology, we will significantly lower emissions, by improving our heat rate by almost 2% and lower our minimum load, reducing our cost's structure and providing value to the environment

Works for Nord Stream-2 complete, operator targets start up by December

Welding works for the Nord Stream-2 pipeline have been completed, the operator announced, adding the necessary pre-commissioning activities will follow swiftly with the aim of putting the pipeline into operation before the end of this year. Nord Stream-2 help meet Europe's long-term needs for gas imports, the operator stressed, and provide gas "under sensible economic conditions."

With this statement, the pipeline operator is alluding to the lower cost of importing Russian pipeline gas to Germany than LNG. In fact, Germany is the only major economy in Western Europe without its own LNG import terminal, though three projects had been under discussion in Stade, Brunsbüttel and Wilhelmshaven.

German LNG Terminal, a joint venture of Gasunie, Vopak and Oiltanking, has recently applied for planning permission for the 3 million tons per annum (mtpa) Brunsbüttel LNG import project after having been granted exemption from network

access by the European Commission. The project is moving ahead, operators said, suggesting the planned terminal - with two LNG tanks of 165,000 cubic metres each - could be adapted to also import hydrogen at a later stage.

Uniper, the project sponsor of the rival Wilhelmshaven LNG project has abandoned plans to import super-chilled gas after a tender in 2020 showed too little interest in binding bookings of long-term LNG regasification capacities in Germany. The Finnish state-owned energy company Fortum became the majority owner of Uniper in March last year and is now pursuing a strategy of turning the Wilhelmshaven project into an import terminal for hydrogen, green ammonia and a 410 MW onsite electrolyser for the production of green hydrogen.

Stade LNG, the third project owned by Hanseatic Energy Hub is aimed to start operations in 2025, though project sponsors have not yet taken a final investment decision. An open season for the proposed 8.8 mtpa venture, launched in February 2021, confirmed market interest which prompted the Belgian gas transmission system operator Fluxys to join as an industrial partner in March.



Map of the European gas pipeline network

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