



Weekly News

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Australian LNG turns green by replacing gas gensets with renewables

Australian LNG producers strive to lower their high carbon footprint as buyers announce Net Zero targets. However, most cargoes from Down Under incur more than the world's average 0.56 ton of CO₂e per ton of LNG produced. Carbon offsets an option, as are retrofitting liquefaction plants with CCS and replacing gas gensets with renewables and batteries.

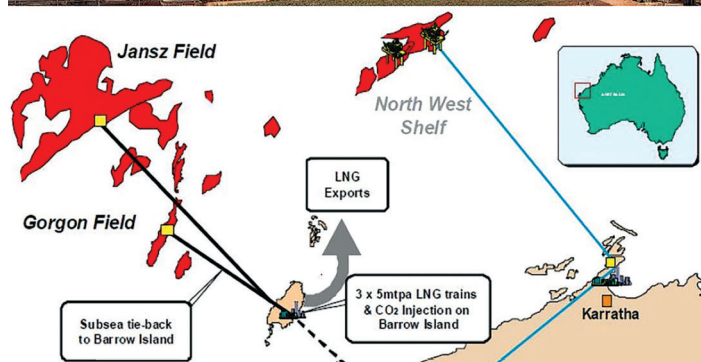
Speaking at the APPEA conference today, Wood Mackenzie analyst Daniel Toleman urged Australia to become a frontrunner in green LNG to not risk losing market share as its largest customers – China, Japan and South Korea – seek to decarbonise their energy imports.

CCS needs a carbon price

Carbon capture and storage (CCS) brings many challenges tough, he cautioned. Regulators must allow carbon credits to be assigned to injected CO₂. Moreover, CCS also requires a carbon price to work commercially.

"We are still far away from both a global carbon price and a carbon creditation system for CCS in Australia. There are also geological and technical hurdles, as evidenced by ongoing issues at the Gorgon LNG CCS project," Toleman noted. Chevron had to shoulder a 46% cost overrun for its US\$54 billion Gorgon project with the CO₂ injection project estimated to cost another US\$2 billion.

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Chevron's Gorgon LNG project includes CCS

Germany frees up €900 million for new hydrogen auction platform

The German economy ministry has dedicated €900 million for a hydrogen auction platform, set up by Siemens Energy, Linde, Nordex and ThyssenKrupp. Green hydrogen or derivatives will be bought abroad through the H2Global Foundation, and resold to industry via annual auctions starting from 2024.

The funding from the economy ministry will help compensate the differential between the purchase price of hydrogen derivatives, e.g. from Australia, and the domestic sales price in Germany. It will "thus provide an incentive for the market ramp-up," the ministry said in a statement.

Economy minister Peter Altmaier hailed the H2Global Foundation as a "missing link" for the success of the country's hydrogen strategy. "The crucial thing is that we achieve the large-scale industrial ramp-up in the next few years," he said.

Tendering for the green hydrogen derivatives will start this year, while deliveries of the actual hydrogen products are expected from 2024.



Counting the costs

Though green hydrogen is seen as a silver bullet to reduce industry emission, the cost for producing hydrogen from wind and solar power is still considerably higher than for hydrogen made from natural gas. With cheap coal and natural gas readily available, the production cost of grey hydrogen can go as low as circa \$1 per kilogram of hydrogen for regions with low gas/coal prices like the Middle

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Faced with low-cost LNG supply coming online from Qatar at break-even prices below US\$4 per MMBtu, Australia cannot compete on cost so it needs to differentiate to not lose out. Offering 'green LNG' would be an option.

Though 'carbon-neutral LNG' has caused much ado in industry headlines, it still only accounts for less than 1% of delivered cargoes up until 2021. No clear template has been agreed as to what a 'green LNG' cargo is in emission accounting terms, but buyers are having a closer look on emissions caused along the LNG value chain from upstream production to end-user consumption.

Much work still lies ahead of Australian producers. Over half of Australian LNG

plants have emissions above the world's average of 0.56 tCO₂e/tLNG, Wood Mackenzie figures show. One reason for this is the high CO₂ intensity of gas fields that supply several Australian LNG projects. Another one is the far distance of upstream supply from liquefaction plants which requires much compression, which is highly emission-intensive, to transport the gas.

Retrofitting LNG plants

Initial steps are being taken by Australian LNG exporters to decarbonise their operations, whereby approaches vary for new and existing projects. "While it may be uneconomical for existing projects to adopt re-

newable power due to sunk capital in building gas-powered generation, new projects can install electric drives to utilise renewable energy and batteries," Toleman said.

Batteries can lower gas usage at LNG plants as less spinning reserve is required. Microgrids combined with batteries reduce the fuel usage on offshore platforms and solar power could cut the emission intensity from coal seam gas developments.

"As carbon consciousness increases, LNG marketing must evolve," he said, stressing: "The delivered cost of LNG will no longer be the only cost factor for buyers and ultimately carbon cost considerations will lead to new differentiations and scrutiny between projects." ■

Nigeria's gas-related electricity shortages could have been avoided

Power generation in Nigeria dropped to 3,059 MW on May 28 and stayed below 4,000 MW for the following seven days, 6% below average production. Low pressure on the Escravos-Lagos Pipeline System (ELPS) had left several gas turbine power plants with insufficient fuel, leading to widespread blackouts that "could have been avoided," Wärtsilä claims.

Unlike gas turbine power plants, gas engine power plants have the flexibility to function during low gas pressure events. "This flexibility significantly lowers power production risk - a clear advantage at times of gas supply disruptions and systemic power shortages," said Yussuff Wale, managing director of Wärtsilä Marine & Power Services Nigeria.

Blackouts are frequent in Nigeria, where the national grid system failed 84 times and partially collapsed 43 times from 2013 to 2020, according to TCN data. The World Bank estimates the economic cost of power shortages in the country at around \$28 billion annually - equivalent to 2 percent of GDP.

Disruptions in fuel supply

Natural gas is used to fuel more than 80% of power generation capacity in Nigeria,

home to Africa's largest gas reserves. But most of Nigeria's oil and gas bounty is exported, and the little volumes left for the domestic market along with insufficient pipeline capacity causes frequent disruptions in fuel supply for power generating.

Trunk lines like the Escravos-Lagos

Pipeline System (ELPS) require sufficient gas volumes to be fed into the system within a specified pressure range. A drop in volume tends to lower pressure which disrupts gas deliveries to all consumers along the pipeline. "In such a scenario, high pressure off-takers such as gas turbine power plants

can no longer operate and drop out as consumers, thus freeing up the remaining gas volumes for low pressure off-takers such as reciprocating gas engine power plants which can continue to operate at full rated capacity," Mr Wale explained. Small, modular combustion engines should be used to ensure load flexibility and enable larger combined-cycle power plants to provide a stable baseload. ■



Stretch of the Escravos-Lagos Pipeline

Continued from page 1

East, Russia and North America, according to KPMG figures, and still stays well below \$2/kg hydrogen for other regions, like Europe.

The cost of green hydrogen, in contrast, is still in the range of \$2.5 to \$6 per kilo hydrogen. In most cases this means green hydrogen is more expensive than both grey and blue, but at the lower end of the range it is cost-competitive with blue.

"At around €6 per kilo, green hydrogen is not competitive today with fossil energies. Cost parity would be at €1/kg equivalent to €25 per MWh," analysts at Cap Gemini pointed out. Government support is vital to build up the market for green hydrogen in

the hope to gradually bring down the cost of electrolyzers and incentivise a wide-spread adoption of hydrogen by the industry and transport sector.

Economy of scale

By 2050, scale-up of electrolyzers and technical innovations could help incur cost parity for green hydrogen with the one produced from fossil fuels, KPMG forecasts.

The size of electrolyzers has increased tenfold over the past decade from 0.1 MWe to over 1.0 MWe. Hydrogenics, for example, supplied a 1 MW electrolyser to a German consortium that produces 200 cubic meter per hour of hydrogen - for now. ■

Gas to Power Journal

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South Africa needs 6 GW new capacity to ease electricity constraints

To mitigate blackout risks, South Africa needs 4-6 GW installed power gen capacity and the government aims to add 20 GW in the long term. GE reckons renewables and LNG-fuelled power will be the country's "fastest and most cost-effective pathway to decarbonisation."

Due to its competitiveness and bankability either as a bridge or destination fuel, LNG is a fuel of choice to decarbonise countries like South Africa without adequate commercial gas reserves, GE said in a position paper. Firming up new LNG supply is seen as a critical first step in developing the country's Gas Master Plan.

South Africa's energy mix will evolve to include greater amounts of renewables, even as coal remains the dominant fuel be-

yond 2040. But it is reliable gas technology that will make investments "economically sound", Elisee Sezan, CEO for GE's Gas Power business in sub-Saharan Africa said: "We believe that gas will not just be a backup fuel but will be the new baseload capacity for the coal repurposing national program," she stressed.

Fuel switching quicker than new RES

Considering the time-to-market for new wind and solar project, coal-to-gas switching represents a potential quick win for emissions reductions. Renewable energy sources (RES) emit zero emissions but have high upfront capital requirements, which tends to derail many projects across Africa.

GE believes in and promotes additional renewables capacity, augmented where needed with gas generation to provide system flexibil-

ity and dependable capacity.

"Retiring aging coal-fired capacity and replacing it with new, high efficiency combined cycle gas power technology would almost immediately bring down power sector emissions and total energy-related CO2 emissions," said Nosizwe Dlengezele, GE Gas Power's chief commercial officer, sub-Saharan Africa. GE's HA gas turbine portfolio offers more than 64% combined cycle efficiency, fuel flexibility, and hydrogen capability which, according to him, "positions the HA gas turbine as an ideal fit for South Africa."

Today, coal-fired plants still account for 84.5% of South Africa's total CO2 emissions and the move to a more diversified fuel mix will clean up matters. By 2030, South Africa aims to reduce its annual greenhouse gas (GHG) emissions by 28% less than its 2015-set targets in the updated draft of the Nationally Determined Contribution (NDC) and become a net zero economy by 2050. ■



Emissions from Eskom's Kriel coal power plant

Eskom strives to replace 10 GW of thermal power by 2030

South Africa's state utility Eskom needs to reconfigure its fleet given that 10,000 MW of thermal capacity will retire by 2030. Bhavtik Vallabhjee, Head of Power Utilities at Absa Bank pointed out a renewables rollout would still be cheaper than retrofitting ageing coal power plants to clean coal units.

World Bank lending requirements stipulate Eskom needs to shift to green energy but that comes at a substantial cost. Onshore wind, solar PV and imported hydro are some of the options, while some coal- and diesel-fuelled peaking plants will be converted to run on natural gas.

Shift to renewables and gas gensets

The South African government has already made plans how to diversify the country's generating mix away from coal. With global markets being awash with cheap gas and LNG, the cleaner-burning thermal energy source will be used as a transition fuel.

Thermal coal still made up a staggering 71% of South Africa's generation mix last year but this number is meant to fall to under 60%, according to South Africa's 2019 Integrated Resources Plan (IRP) that sets out the government's roadmap until 2030. The contribution of wind, meanwhile, is meant to rise to 17.8%, solar PV to 6.3%, solar CSP to 0.6% and hydro is intended to

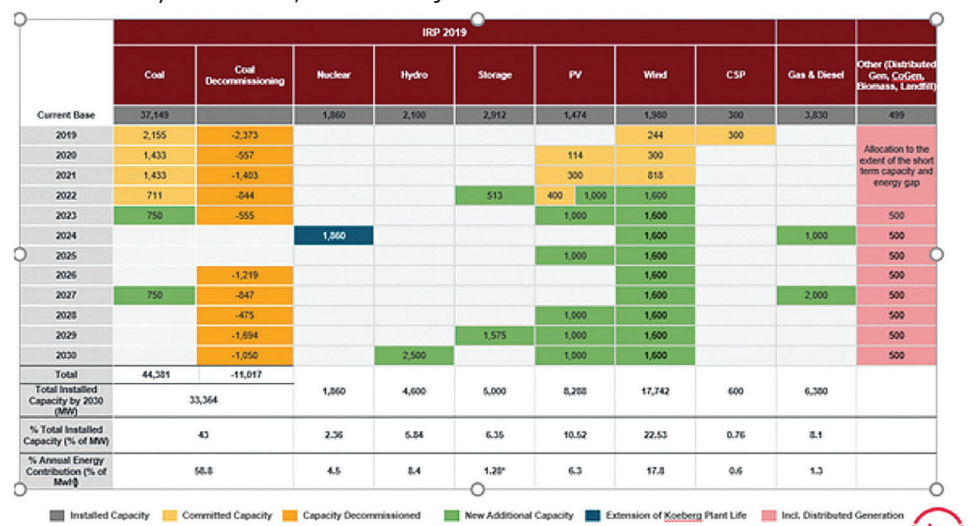
account for 8.4% of the power mix. Although new build coal is still in the IRP plan, analysts doubt this will materialise.

IPPs attracted by Africa's high rate of return

Independent Power Producers will play a larger role in the future generation of South Africa's power, rather than extensive reliance solely on Eskom, Mr Vallabhjee

forecast, singling out Africa as "a compelling investment case"

"On a risk-adjusted return basis, projects on the continent boast better returns than many other jurisdictions, he stressed, explaining this is highlighted by the "quality of the energy projects that are being delivered in places like Mozambique, Ghana, Senegal, Egypt, and Morocco, amongst others." ■



DNV verifies Brill Power's new battery management system

Brill Power, a spin-out of Oxford University, has had its new lithium-ion battery management and control technology verified by the classification society DNV. Simulations and testing in DNV's battery lab in Arnhem, the Netherlands, confirmed a higher utilized pack capacity that could potentially lower lifetime cost.

Control hardware-in-the-loop (CHIL) testing was used to validate the safety functionalities of the battery management system by simulating battery data within and outside of safe operational limits. The response of the battery management system to these simulated data were monitored and compared with their intended behaviour.

DNV then conducted power hardware-in-the-loop (PHIL) testing on real battery cells to validate the functional safety and compare Brill Powers' battery management system with rival energy storage systems.

Storage vital as RES build-out surges

Energy storage plays an increasingly important role to balance the grid in the face of a higher penetration of variable renewable energy sources (RES) and related intermittent generation. Solar PV and wind power are forecast to dominate the energy mix by 2050, when they each have a 31% share,

according to DNV's Energy Transition Outlook 2020. Energy storage will hence become vital for balancing supply and demand, potentially delaying or avoiding the need of costly grid upgrades.

"At DNV, we are keen to support the energy transition in a safe and robust way. Independent testing is a crucial element to verify any technology to ensure that it meets safety and performance requirements"

said Hari Vamadevan, DNV's regional director for UK & Ireland.

Brill Power had approached DNV to test, appraise and ultimately verify the company's latest battery management system. "Their exemplary work is an essential part of our wider mission to not only demonstrate our ability to increase the lifetime and sustainability of lithium-ion battery packs but

to also reinforce our commitment to safety for this new technology within the power, renewables and electric vehicle industries," said Brill's CEO Christoph Birkel.

Formed in 2016, Brill Power provides battery intelligence solutions for energy storage systems and electric vehicles. The company, founded by Oxford graduates, develops battery management and control technology for lithium-ion packs. ■



Battery testing at DNV's lab

Highview develops 10-hour CRYObattery in Chile to backup solarPV

Highview Power in a joint venture with Enlase, the largest backup power provider in Chile, is developing the country's first liquid air energy storage project in the Atacama region. The 50 MW/ 50 MWh can supply emergency power for over 10 hours and will be paired with solar photovoltaic.

With one of the highest solar irradiations in the world, the Atacama region could potentially generate all of Chile's electricity. A massive 110 MW solar thermal and 100 MW photovoltaic electricity project, based on 392,000 solar panels, is under development in the Atacama Desert. By pair-

ing inherently intermittent solar PV with energy storage, the hybrid system can ensure supply security 24/7.

Engineering, procurement, and construction (EPC) on the CRYObattery project will be carried out by SK Ingeniería y Construcción, part of the Sigdo Koppers group. The \$150 billion project is currently in the pre-feasibility engineering phase and is scheduled to enter environmental processing in August this year. Construction is slated to start in the second half of 2023.



Render of the 100 MW solar PV project in the Atacama Desert

Turning RES into baseload power

The objective to Highview Enlase is make Latin America tap its potential for using wind and solar power as

baseload. When paired with solar and wind, Highview's cryogenic energy storage can achieve an equivalent performance to thermal and nuclear power plant.

The technology utilizes air liquefaction, in which ambient air is cooled and turned to liquid at -196 °C (-320 °F). The liquid air is stored at low pressure and later heated and expanded to drive a turbine and generate power.

The CRYPBattery is scalable with no size limitations and geographic constraints, Highview said, claiming: "It is the only long duration energy storage solution available today that is locatable and can offer multiple gigawatt-hours (weeks) of storage." The energy storage plants also offer voltage control, grid balancing and synchronous inertia that give grid operators the flexibility to manage power and energy services independently. ■

IEA says \$1 billion Capex for clean energy needed to reach Net Zero

Energy investment rebounded 10% worldwide so far in 2021, making up most of what it lost last year due to the pandemic, the International Energy Agency (IEA) finds. By the end of the 2020s, however, capital spending on clean energy projects needs to surge sevenfold to above \$1 trillion to reach Net-Zero emissions by 2050.

Challenges in mobilising finance for clean energy projects pushed down annual energy investments by around 20% since 2016. The pandemic dealt a serious blow to corporate balance sheets and consumers' ability to pay, and put additional strains on public finances.

Clean energy investment in emerging and developing economies declined by 8% to less than \$150 billion in 2020, with IEA analysts expecting "only a slight rebound" expected in 2021. This is deemed insufficient to reign in emissions, particularly in emerging markets in Asia and Africa.

The bulk of emission growth for years to come will stem from emerging and developing economies. In an IEA scenario reflecting today's announced and existing policies, emissions from these economies are projected to grow by 5 gigatonnes (Gt) over the next twenty years. In contrast, they are forecast to fall by 2 Gt in advanced economies in Western Europe and North

America and to plateau in China.

High bar to access debt finance

Whether Asia and Africa gets serious about transitioning to clean energy largely depends on the cost and availability of capital. Technologies like wind, solar PV and electric vehicles require relatively high upfront investments that are offset over time by lower operating and fuel expenditures.

"The shift towards a more capital-intensive energy system means that keeping financing costs low will be critical to accelerating energy transitions while keeping them affordable," analyst commented. However, for the moment, capital is significantly more expensive to come by in Africa and developing Asia than in advanced economies.

Nominal financing costs in developing economies range some 700 to 1 500 basis points – up to seven times – above values for the United States and Europe, with higher levels in riskier segments. The

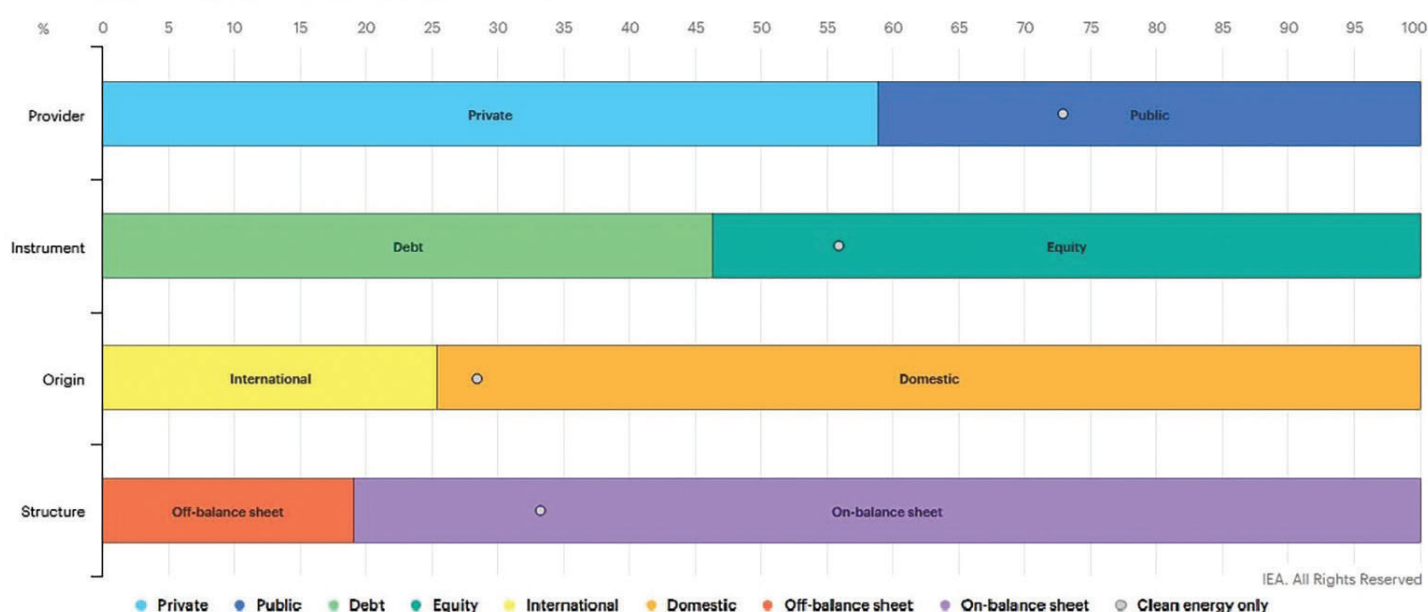
IEA warned this incurs a "high bar for projects to raise debt finance" and hampers some from offering "sufficient returns on equity."

Attracting more private investors

Today, energy investment across emerging Asia and most of Africa are still heavily reliant on public sources of finance, so far. But in IEA's climate-driven scenarios, over 70% of clean energy investments are privately financed, especially in renewables and efficiency.

Provision of blended capital from development bank is deemed "critical to attract private investors," especially to markets and sectors at early stages of readiness like energy access project or electrification of remote areas. To boost finance to the required scale, IEA analysts propose the use of long-term local-currency debt for renewable power as well as risk capital to support new technologies, companies and project development.

Sources of primary finance for energy investment in emerging markets and developing economies in IEA's climate driven scenarios, 2026-2030



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Rolls-Royce sets up 250 kW hydrogen fuel cell at Friedrichshafen

Hydrogen fuel cell technology is making in-roads at the Friedrichshafen plant of Rolls-Royce's Power Systems where a 250 kW demonstrator is being set up for testing. At the PowerLab, four low-temperature polymer electrolyte membrane (PEM) fuel cells are ready, containerised with separate compartments for fuel cells and batteries.

Safety dictates that the container separates fuel cells and batteries as well as supporting power electronics, Rolls-Royce Power Systems said, having designed the modules at the company's plants in Ruhstorf, Bavaria, and Friedrichshafen. The control system has now been fully refined, cooling and air conditioning are on the roof, and a rack system enables simple maintenance, so individual modules can be replaced as required.

Commissioning in the autumn

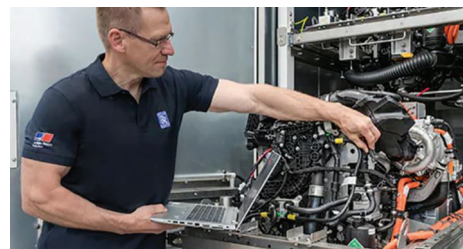
The energy systems – using fuel cells from Rolls-Royce automotive arm – have been put through their paces on a test stand. "Power flexing characteristics and performance are excellent, and as expected there are no

vibrations or no loud noises," said Dr. Peter Riegger. The next step is to connect all four demo modules together in the container and hook up the batteries and power circuit.

The overall system consists of fuel cell modules, batteries, fire protection, air conditioning and safety systems, cooling, gas supply and automation. Commissioning is slated for the second half of 2021.

The demonstrator will be used test purposes and to show prospective clients which applications the system is suitable for. These include standby power, prime power, uninterruptible power supplies (UPS) and 'black start' capability, allowing the system to be started from scratch without a mains connection.

Andreas Schell, CEO of Rolls-Royce



View into MTU fuel cell

Power Systems underlined "fuel cells will form an elementary part of our product portfolio for sustainable solutions." In his view, the technology fuel cell technology is set to make a "huge contribution" to a successful energy turnaround. "That's why Rolls-Royce sees it as its mission to assume a pioneering role in fuel cell applications," he concluded. ■

Vantaa Energy and Wärtsilä eye FID on P2G plant in Finland

Finnish utility, Vantaa Energy, has engaged Wärtsilä to pre-engineer and develop a Power-to-Gas (P2G) plant. Due commissioned in early 2025, it would be the first P2G plant in Finland to produce carbon-neutral, synthetic methane on a commercial scale with a fuel capacity of 10 MW.

Synthetic methane is made from CO₂ and hydrogen produced with renewable energy. Vantaa Energy and Wärtsilä in May 2020 agreed to jointly examine the profitability of adding a P2G unit to Vantaa's waste-to-energy plant. Financial close on the project hinges on the outcome of these profitability forecasts.

The pre-engineering phase of the project is lead by Wärtsilä and due completed by the end of 2022, with a view to getting plant ready for commissioning in less than three years' time.

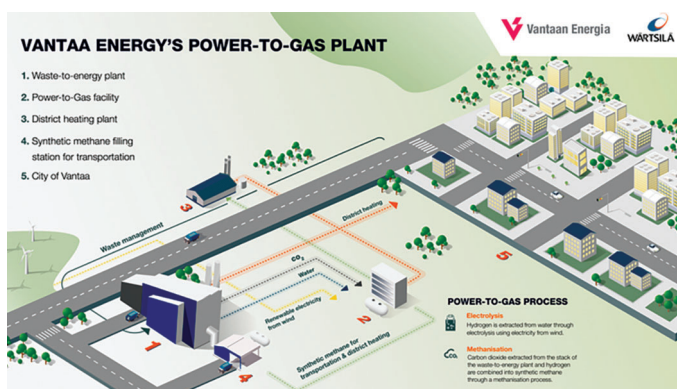
Coupling heat, power & transport

Once completed, the P2G plant will produce synthetic methane by extracting hydrogen from water, as well as CO₂ out of emissions from an existing waste to energy plant. The resultant methane will be enough to fuel up to 200 trucks per day, and replace natural gas in district heating during peaks in winter.

Vantaa Energy took

the decision to be fossil-free by 2026 hence versatile technologies such as energy storage will be an important enabler to reach this goal. CEO Jukka Toivonen pointed out the advantageous location of P2G plant. "We have access to clean water and renewable electricity using wind energy, and the waste heat produced in the process can be utilised for district heating," he said, adding coupling of heat, electricity and transportation will provides "completely new business opportunities."

Finland aims for carbon neutrality by 2035 – fifteen years earlier than the EU which recently raised its emissions reduction target to 55% by 2030 and aspires to Net Zero by 2050. ■



Render of Vantaa Energy's P2G plant

Wärtsilä, Soletair and Q-Power to showcase P2X tech at Dubai Expo

Finish engine maker Wärtsilä, together with Soletair Power and Q Power, will showcase Power-to-X (P2X) technology at the upcoming World Expo in Dubai. A demo unit will capture CO₂ from the air inside the Finnish pavilion and combine it with hydrogen split from water by electrolysis.

Capturing CO₂ from in-house air improves the quality of the air. A biosynthesis process then converts it into carbon-neutral synthetic methane fuel, which can be used to provide clean power for domestic applications like making coffee.

At a larger-scale, Soletair's technology can absorb CO₂ in air supplied to building ventilation. The captured CO₂ is then integrated to an electrolyser and synthesis units where it gets converted to fuels which can be used for decentralised power generation.

Breath turned into carbon-neutral fuel

Striving to make the world more sustainable, Atte Palomäki, Wärtsilä's head of marketing, called on Expo participants to "imagine a world where your breath turns into carbon neutral fuel." The company's P2X demo at Dubai seeks to prove that "even the most ambitious ideas can be turned into real innovations." ■



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Remote-controlled 300 MW gas power plant to backup Bavarian grid

Siemens Energy will build a remote-controlled, gas power plant in Leipheim, in Germany's southern state of Bavaria. Owned by LEAG, the 300 MW plant will only be dispatched on request of the TSO Amprion to ensure grid stability in an emergency.

Used exclusively for grid stabilisation purposes, the Leipheim plant will not be available to the free energy market. Built at former military airbase, the 300 MW plant consists of a SGT5-4000F gas turbine, an SGen-2000P generator, and the SPPA-T3000 control system. Siemens Energy will also provide a system for cooling the intake air and a system for injecting fully desalinated water into the gas turbine.

Fast-start in 30 mins

Amprion will call on the plant in emergency situation which can occur when there's a failure of equipment in the grid, like cables. Special grid-related equipment will be able to supply an electrical capacity of up to

300 MW in a maximum period of 30 minutes.

"By making this investment, we're taking responsibility for a secure power supply in southern Germany," said LEAG board member Hubertus Altmann. "Like the other two gas turbine power plants operated by LEAG in Thyrow and Ahrensfelde near Berlin, the Leipheim plant will help stabilize the grid once it's completed. These types of plants are urgently needed to ensure the success of the (green) energy transition."

Remote operations

The 300 MW plant will be operated and dispatched remotely from Siemens Energy's



Render of the grid-stabilisation plant in Leipheim

ISO-certified Remote O&M Support Center (ROMSC). Two persons will operate the plant locally during the day shift, while control and monitoring are handled from Erlangen.

The project was developed together with Stadtwerke Ulm/Neu-Ulm and STEAG, and all regulatory permits have been obtained. In February 2021, the special-purpose company GKL for building the plant was transferred to the eastern German energy provider LEAG energy provider. ■

Siemens GIS switchgear to help stabilise Norwegian power grid

Norwegian transmission system operator Lyse Elnett has contracted Siemens Energy to build new substations and modernise existing ones in the Sør-Rogaland region. Under an 8-year framework agreement, worth up to €200 million, the TSO will eliminate fluorinated gases in their substations by adopting Siemens' clean air insulated switchgear.

Norway is a front-runner in phasing out F-gases in its electricity network. Over the past two years, Siemens Energy has received orders for more than 60 bays of F-gas-free gas insulated switchgear (GIS) up to 145 kilovolts from Norwegian grid operators.

The latest agreement with Lyse Elnett covers design and construction of new substations as well as modifications and upgrades of existing substations, including the supply of transmission products and services. The largest assignments will be the delivery of 145 kV GIS with associated protection and control systems.

"Limiting the environmental impact of our operations without compromising on safety and reliability of power transmission, is a top priority

for us. When it comes to reducing the usage of F-gases, we know that the alternatives from Siemens Energy have zero global warming potential. The agreement is an essential step on our pathway to a more environmentally friendly operation of our substations," says Evy Thorbjørnsen, project director at Lyse Elnett.

Clean air switchgear without SF6

Combining clean air and vacuum interrupter units, which are sealed for life, have shown the outstanding performance. Since 2010,

this technology is available for high-voltage switching applications and reached almost 6-million hours of commercial operation.

Looking ahead, Siemens Energy and Mitsubishi Electric have joined forces to develop high-voltage switchgear that substitutes sulphur hexafluoride (SF6) with clean air for insulation. Research starts with a 245-kV dead-tank circuit breaker. But once developed, the two OEMs will manufacture and sell the switchgear independently.

The potent greenhouse gas SF6 is still used in most substations. The chemical has a potential for global-warming roughly 23,500 times greater than CO2, so it can do much harm even with a very low number of leakages. Regulations hence want to reduce or prohibit the use of fluorinated gases in the electrical industry.

Circuit breakers that use clean air and vacuum switching technology have been available for at least 15 years for voltage levels up to 72.5 kV. They are now being deployed also for other substation products, including gas-insulated switchgear up to 145 kV. ■



SF6-free switchgear at the Koengen substation in Bergen, Norway

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