



Gas to Power Journal

Peakload Power and Energy Storage

Weekly News

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South Africa: Policy change to spark surge in captive power investment

Industry in South Africa are used to rolling blackouts and load-shedding due to a chronic lack of power generation infrastructure. But Absa Bank expects President Cyril Ramaphosa's latest move to allow business produce up to 100 MW electricity without a generation license will unlock fresh investment in decentralized power plants, reducing reliance on state-run Eskom.

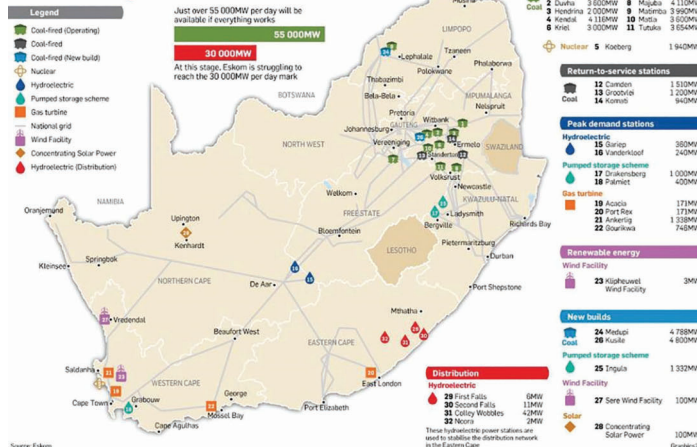
Under South Africa's official IPP program, the government has been backing the offtake & termination payments due by Eskom under the PPA, which is a requirement for investors and financiers to achieve bankability. In contrast, the new captive power projects will be driven by private sector agreements without Government support, reducing the level of contingent liabilities in National Treasury's books.

"Banks will evaluate the credit quality of the private sector off taker in their assessment, but in most cases the banks will be prepared to take a long-term view on the financing as the projects are value-enhancing and typically result in cost savings for customers," explained Theuns Ehlers, head of resource and project finance at Absa Bank.

Miners, industry eager to set up captive power plants

As far as captive power is concerned, a number of South African businesses in the mining, property and industrial sectors have

Eskom power stations



already spent considerable time to plan on project development activities, hence the President's announcement is likely to ignite a flurry of activity.

"There are dozens of projects that are already well advanced and this will fast-track their timelines for implementation," Ehlers noted.

Two models are on the table to fund energy projects: The first is one where a business enters into a long-term Power Purchase Agreement (PPA) with an Independent Power Producer (IPP). "This is emerging as the more common structure and allows the respective businesses to focus on their

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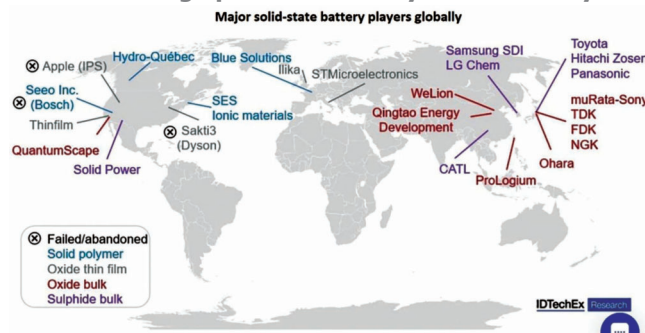
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Solid state battery market could top \$8 billion by 2031

Investment in solid state batteries is surging with technologies close to mass production and IDTechEx forecasts the overall market may well grow to over \$8 billion by 2031. Replacing liquid electrolytes with solid-state counterparts pushes the energy density beyond 1,000 Watt-hours per litre (Wh/L), while enhancing operational safety and durability.

High-end lithium-ion batteries can reach an energy density of over 700 Wh/L at cell level, with a maximum driving range of about 500 km for electric vehicles. That is significantly less than the first generation solid state batteries. Fire risk is another serious hazard, given that lithium-ion batteries use flammable and corrosive liquids IDTechEx said, noting that dozens of electric vehicle fire accidents have been caused by battery combustion.

Lithium-ion energy storage technologies typically employ liquid electrolytes, with lithium salts such as LiPF₆, LiBF₄, or LiClO₄ in an organic sol-



vent. The decomposition of the electrolyte at the negative electrode causes a firm interface which limits conductivity and energy flows. Moreover, the size of lithium-ion batteries is limited because they

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areas of core competence," he commented.

The second model entails a business using its own balance sheet to procure the required equipment to develop and operate a project. "In this model, the business retains the risks associated with the construction and operating of the power plant. Debt financing is typically limited to corporate-style covenants, with shorter funding tenors compared to the IPP model," Ehlers explained.

Trend to self-generation and decentralized power

Self-generation is set to displace expensive power. The added benefit, according to Absa Bank, is that these projects are procured outside of official Government-run programs, potentially achieving execution in a shorter timeframe.

South Africa's electricity grid was designed for centralised electricity generation, and most of Eskom's large coal power

plants are situated in the coal-belts of Limpopo and Mpumalanga. But thanks to the renewable energy rollout, more and more electricity is now being generated at the centres of demand, where most load is needed by industry.

"This calls for a redesign of the transmission grid," said Bhavik Vallabhjee, Absa Bank's head of power and renewables. In particular, he calls for more clarity around the cost of so-called wheeling arrangements.

Eskom is the custodian of the transmission infrastructure in South Africa, hence self-generation and "wheeling outside the fence" currently must entail a wheeling charge. "Although the Electricity Act permits "wheeling", the exact cost of wheeling is not widely clear and clarity needs to be obtained in this regard, to provide certainty to IPP's and potential buyers of the all-in cost of power procured over the long term," Ehlers underlined.

Policy changes set to spark renewables surge

Looking ahead, Absa Bank hopes that change in policy – notably the permit to run 100 MW generating units without regulatory permit – could translate into significant additions of wind and solar power capacity.

"Potentially, this could be equal to the entire renewable energy generation capacity added to the grid over the past decade," said Vallabhjee, suggesting this is likely to drive construction activity, job creation and general economic confidence across the broader economy.

"Green is the new Gold. The current Eskom CEO is supportive of the 'green agenda,'" he noted with a view to Eskom's recent announcement at the COP26 Climate Summit in Glasgow it would be seeking to borrow more than \$30 billion to help close its ageing coal-fired power plants, and make the switch to renewables. ■

Honeywell turns to Advent Solvent tech to capture CO2 at lower cost

Honeywell has entered a licensing arrangement with University of Texas at Austin to utilize the latter's new Advent Solvent technology to capture CO2 more efficiently and at a lower cost. Carbon pricing accelerates retrofits in the power sector and Honeywell says applying advanced solvent CCS to a typical 650 WM plant allows operators to capture about 3.4 million tons of CO2 annually.

This is equivalent to removing nearly 735,000 cars from the road each year, Honeywell engineers said who based their calculations on conversion factors from the US Environmental Protection Agency (EPA).

CO2 pricing accelerates CCS retrofits

Several national governments, use CO2 pricing as a policy lever make industries retrofit their facilities with CCS. In the US, developers of permanent carbon storage can benefit from \$50 per ton tax credit as per IRS Section 45Q while the comparable carbon price in Europe is \$60/ton.

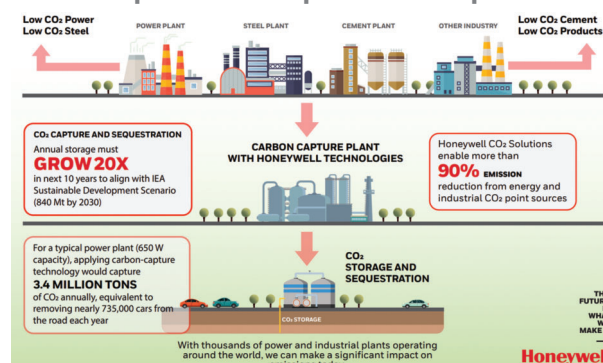
Analysts pointed out in 2022, CCUS projects worldwide were capturing and storing/using 40 million metric tons per year of carbon dioxide. But in order to align with the IEA Sustainable Development Scenario (SDS), which demonstrates a pathway to limit global temperature rise by less than 1.65° C, the CCUS project capacity would have to be over 20 times higher and capture 840 million metric tons per year of CO2 by 2030.

Smaller footprint through advanced solvent

Technically speaking, UT Austin's patented solution utilizes an advanced solvent, which enables CO2 to be captured with much smaller equipment which creates viable project economics today under current CO2 policy frameworks in North America and Europe.

"The licensing agreement with Honeywell enables us to commercially scale this in ways that can make major contributions toward zero emissions efforts," said Gary Rochelle, professor at the McKetta Department of Chemical Engineering and leader of TxCMP at UT Austin,

He and his team have established an efficient, second-generation amine scrubbing



system through years of research and analysis. The improved performance from this solution can unlock project economics for "hard to abate" industries such as steel, cement, and chemical plants, and coal, natural gas and bio-energy power plants.

Ben Owens, general manager, Honeywell Sustainable Technology Solutions said by working with UT Austin, our advanced solvent carbon capture system will enable lower cost of CO2 captured post-combustion. Honeywell's cost analysis compares estimated capital and operating costs of its solution against other conventional amine solvents in same applications. Today, 15 million tons per year of CO2 is being captured and used in storage/utilization units through Honeywell's CO2 Solutions process expertise. The company currently has the capacity to capture 40 million tons per year through its installed projects worldwide. ■

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Risk of Omicron-related lockdowns increases oil price volatility; Fitch

Fitch Ratings warns of a "highly uncertain" situation in global oil and gas markets as the fast spread of the Omicron variant could result in renewed lockdowns and higher price volatility. Though OPEC has been trying to stabilize markets, some alliance members – notably Russia and the UEA – are keen to raise production to monetise their large reserves.

Analysts expect US oil production will continue recovering in 2022, though the near-term output is unlikely to materially exceed pre-pandemic levels.

Demand will continue to rise 2022, Fitch says assuming new lockdowns will be shorter and less severe than those in 2020. "The recovery might reverse if Omicron or other potential new variants prove significantly more infectious or dangerous, leading to new prolonged synchronised lockdowns," analysts said in Fitch Ratings latest report, entitled "Global Oil Sector's Recovery Is Supported by Growing Demand and Supply Policies".

"Long-term price assumptions remain unchanged," Fitch analyst said, noting "the impending energy transition may increasingly affect demand in the global oil market, although significant uncertainty remains."

Capex of oil & gas majors rebounds to 9% by 2022

As oil markets are likely to stay bullish going into the New Year, Fitch anticipates the cap-

ital expenditure of oil and gas companies will accelerated to 9% over the course of 2022.

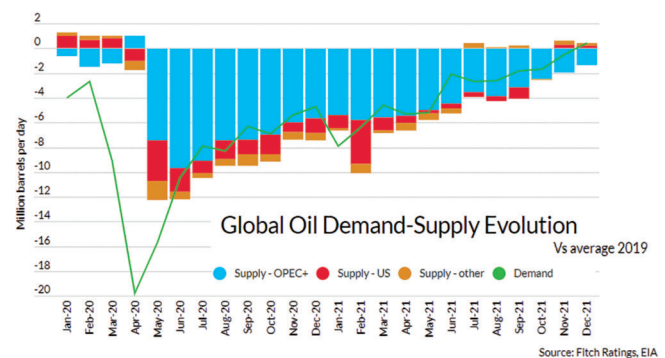
The pandemic had reduced 2020 corporate Capex by €36 billion, or about 7% compared to 2019 amid crippling lockdowns. But analysts explained this decline was "still modest" versus a 14% drop in revenue, as continued growth in spending among telecoms and utilities helped balance cuts among the industrial, natural resources-related sector.

Earlier this year, Fitch Ratings had raised its 'vulnerability scores' for 100 utilities in Europe, the Middle East and Asia (EMEA) for the period 2025-2050. Integrated utilities like Enel, Iberdrola and EDP score a moderate 15 points, while Engie and Naturgie score 30-35 points due to higher transition risk of gas-fired generation, compared to transmission and distribution (T&D) assets.

Electric utilities exposed to coal generation

were assigned given a higher risk score given that they are mandated in most countries to transition to a low-carbon economy. Utilities often face the choice to either convert their coal power units to natural gas or shut them completely.

In contrast, companies focussed on gas T&D networks enjoy a relatively low and stable 'vulnerability score'. This is due to greater energy efficiency and the substitution of natural gas by other energy sources, such as renewables or district heating or heat pumps, which can reduce utilisation of gas infrastructure in the longer term. ■



German chancellor opposes linking Nord Stream 2 to Ukraine crisis

Germany's new chancellor Olaf Scholz has spoken out against linking the operational permit for the Russian-German gas interconnector Nord Stream 2 to efforts to de-escalate the Ukraine crisis. "Nord Stream 2 is a private sector project," he said, stressing it is up to regulators to decide how far Nord Stream 2 must meet EU unbundling criteria.

The German network authority BNetzA is currently investigating whether Nord Stream 2 meets third-party access rules, as stipulated for the EU's common energy market. Nord Stream 2 will connect Germany directly with Russia and the regulator has suspended the certification process for the pipeline until the Swiss-based operator Nord Stream AG has founded a subsidiary under German law solely to govern the German stretch of the pipeline.

Much controversy has been caused by Nord Stream 2 over the past years. Like Scholz, his predecessor Angela Merkel had

also held the opinion that the pipeline is "a private sector endeavour" – a position widely criticised by Poland, Hungary and France.

No suitable instrument to punish Russia

Delays in the approval process for Nord Stream 2 have pushed back the pipeline's operational start date which makes the project "not a suitable instrument to penalise Russia in case it attempts to invade neighbouring Ukraine," German government sources said.

As the national and EU permit procedure for the pipeline is ongoing and would take a while, there is "neither the option of nor the need for a political decision at the moment", said the sources. In view of the long procedure, it "makes no sense to single out this issue now."

Quarrel over sustainability of gas vs nuclear energy

Speaking at a press conference with the French president Emmanuel Macron on Friday, Scholz also commented on the ongoing debate about whether to label nuclear energy and natural gas as sustainable investments under the EU taxonomy.

The European Commission wants to publish a so-called delegated act next week – finalising a proposal before Christmas, which could then only be blocked by a large majority of member states. The proposal to be tabled by the Commission on Monday is largely seen as "very relevant" in deciding the future mainstays of the EU power generation mix.

Germany has led the call to keep nuclear out of the European Union's green finance taxonomy "for some time," but parts of the new coalition government have called for natural gas to be recognised in it as a transition fuel on the way to climate neutrality. ■



Doubling renewables by 2030 – ‘a gigantic task’ for Germany

Plans of Germany's new coalition government to double electricity production from renewable sources by 2030 “present a gigantic task,” Chancellor Olaf Scholz admitted. His aim is to “gradually get out of fossil fuels” by supporting investment in green energy projects.

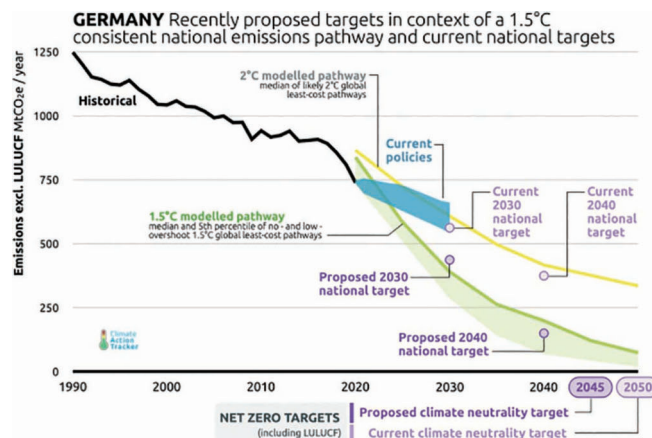
“Behind us lie 250 years in which our prosperity was based on the burning of coal, oil and gas. Now we have about 23 years ahead of us in which we must and will get out of fossil fuels,” Scholz told Parliament. To succeed in its climate ambition, he promised the government would ring in a “decade of investments in the future.”

“It is about laying the foundations for a new technological era, from hydrogen pipelines to decentralised power supply and electric charging stations,” he explained. The new German government coalition took office in early December and laid out its plans to get the country on a path to climate neutrality in line with the 1.5°C global warming limit of the Paris Agreement. How to finance climate action is a key issue for the coalition.

Targets overly ambitious?

Renewable capacity targets set by coalition government (SPD/FDP and the Green Party) for 2030 are widely regarded “very ambitious” – as well as the objective to secure 80% of power demand from renewable sources at the end of the decade. Analysts at the German Federal Environment Agency (UBA) say changes to taxation and CO2 pricing should be used to make the transport sector more sustainable.

Uncertainty abounds over the future role of natural gas, which kept Germany from signing a pledge at the COP26 Climate Summit to end foreign fossil fuel funding by 2022. Permitted projects must be consistent



with a 1.5°C warming limit which basically means carbon capture and storage or utilisation (CCS/CCU) and hydrogen, though Germany needs gas for emergency power.

“This is basically carbon capture and storage or utilisation,” said Jochen Flasbarth, German state environment secretary, “but it can also mean H₂-ready gas infrastructure, though this is on clearly stated in the text.

Germany's state-owned development bank KfW, has freed up funding for several large-scale projects aimed at improving the efficiency of existing natural gas infrastructure, including gas-fired power stations. Berlin wants these projects to be “made possible” even if the government needs to wait and withhold its signatory on the COP26 pledge to end fossil fired funding.

Carbon pricing – a way out?

Analyst at the German environment agency (UBA) argue that higher CO₂ prices com-

bined with an abolition of the renewables levy, taxation reforms for company cars and a bonus-malus system for car purchases could all help the sector cut its emissions by 2030.

By the end of this decade, the CO₂ price should reflect “the true societal costs of climate protection,” UBA analysts said in a recent report, adding these higher energy costs need to be made “affordable to consumers by scrapping the renewables levy.”

Analysts also suggested the private use of company cars should be taxed far more heavily. Though the German car industry is starting to embrace the shift to electric vehicles, many challenges still lie ahead. The Green Party hence wants to dedicate substantial amounts of public finance to reform and upgrade Germany's ageing railway infrastructure, reduce the use of petrol and diesel cars in cities and encourage new models of sharing and renting vehicles. ■

Continued from page 1

need a membrane to separate the cathode and anode, as well as an impermeable casing to avoid leakage.

Solid electrolytes safer and long-lasting

By replacing organic liquid electrolytes with solid counterparts, the novel solid-state batteries are safer and long-lasting. Initially, early generations of solid-state batteries may have “similar or even less energy density than conventional lithium-ion batteries,” analysts cautioned. But they were quick to add that “the energy available in the battery pack can be comparable or even higher than the latter.”

With the larger electrochemical window

that the solid electrolytes can provide, high voltage cathode materials can be used. In addition, high-energy-density lithium metal anode can further push the energy density for beyond that of rival battery types.

Evaluating range of polymer electrolytes

Various technology approaches are under development: IDTechEx has identified solid-state battery technologies including solid polymer electrolyte, as well as other 8 inorganic electrolyte types such as LISICON-like, argyrodites, garnet, NASICON-like, Perovskite, LiPON, Li-Hydride, and Li-Halide. In general, oxide, sulfide, and polymer systems have become popular options. ■

Sulfide electrolytes have advantages of high ionic conductivity, even better than liquid electrolytes, low processing temperature and a wide electrochemical stability window. However, analysts cautioned “the difficulty of manufacturing and the toxic by-product hydrogen sulfide generated in the process make the commercialization relatively slow.”

Polymer systems are easy to fabricate, and they are closest to commercialization, while the relatively high operating temperature, low anti-oxide potential, and worse stability indicate challenges. Oxide systems are stable and safe, while the higher interface resistance and high processing temperature show some difficulties in general. ■



Advent Tech joins forces with BASF to manufacture fuel cell membranes

Boston-based Advent Technologies and BASF New Business have joint forces to increase the manufacturing scale of advanced fuel cell membranes, designed for long-term operators. The German chemical giant aims to improve the stability of its Celtec membrane and push up the production capacity with the help of Advent's fuel cell systems and membrane electrode assembly.

Celtec membranes are proton-conductive and can be used at temperatures of up to 180°C for robust fuel cell systems, helping to more efficiently separate hydrogen from gas mixtures.

Under the agreement with Advent, BASF now seeks to manufacture Celtec membranes in large volumes by making use of Advent's fuel cell stack and system testing facilities which will qualify the membrane for the SereneU (telecom power), M-ZERO, (methane emissions reduction), and Honey Badger (portable power, defense) Advent product families.

Replacing coal power with hydrogen

In Greece, BASE supports a large-scale hydrogen and fuel cell project – submitted by Advent and the White Dragon consortium – that is aimed at replacing Greece's largest coal-fired power plants with solar PV and green hydrogen production of up to 4.65GW, and fuel cell heat and power

production of 400 MW capacity.

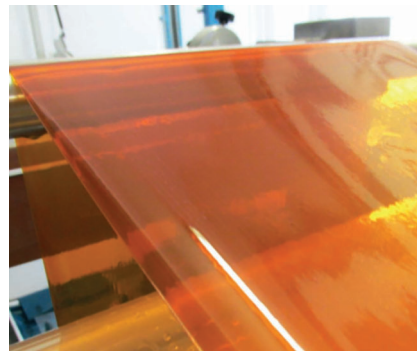
Membrane allows for more efficient H₂ production

Today, hydrogen is mostly extracted from natural gas in steam reformers. Hereby hydrogen is separated from the gas mixture by pressure swing adsorption and the remaining gas is used thermally. Between 70 and 80% of the hydrogen in mixtures can be recovered by traditional methods. BASF's Celtec membrane technology can now isolate the remaining 20%.

"Our Celtec technology can efficiently separate concentrations even of less than 20%, thus helping to increase the reaction yield, said Dr Carsten Henschel, responsible for fuel cell and hydrogen sales at BASF.

Cyclical operation, various impurities in

the gas flow, and changing application conditions can all stress the materials used in high-temperature polymer electrolyte membrane (PEM) fuel cells and electrochemical hydrogen separation systems. "This is where Celtec membrane electrode assemblies show their strength," Henschel said, explaining: "The core of the membrane allows operation at temperatures between 120 und 180°C which facilitates high tolerance of impurities and simplifies water management."



Celtec membrane for high-temperature PEM fuel cells

Duisburg Port turns CO₂-neutral with mtu hydrogen-based energy

Rolls-Royce will ensure a climate-neutral energy supply at the container terminal currently under construction at the port of Duisburg, Germany. The company's power system unit MTU will supply fuel cells to cover peakload demand and a hydrogen-based combined heat and power (CHP) station.

Duisburg Port, one of Europe's largest inland ports, is currently being built as a container terminal on the site of a former coal island. The port will serve as a transshipment point for bulk cargo.

Gov' funding for 4 years' time

Germany's ministry for Economic Affairs and Energy will fund the project for the first four years as part of government's the "Hydrogen Technology Offensive".

Once ready, it will not only set new standards in cargo handling, but also in climate-friendly energy supply. To that end, the port operator is working with several partners to build a hydrogen-based energy supply network by 2023 that includes options for energy conversion and storage.

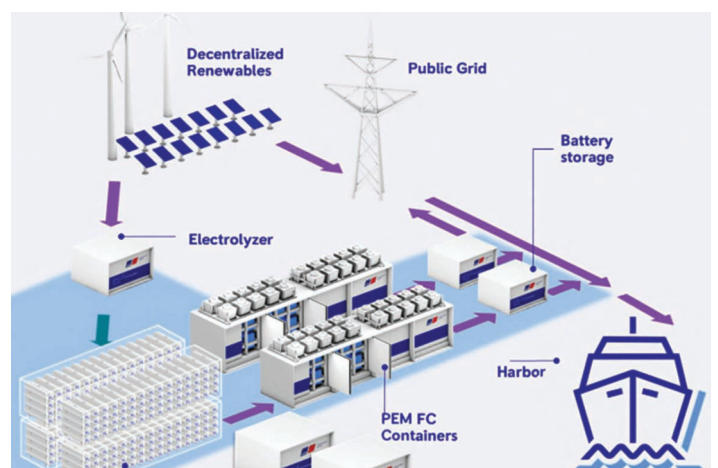
enerport II to be ready by 2023

The key element, called "enerport II", is played by fuel cells and mtu hydrogen

engines – each with different tasks: The H₂-powered mtu fuel cells will supply electricity as soon as the public power grid reaches its limits, e.g. for on-board power supply of ships berthed in the port or in the event of other load peaks.

Two CHPs, powered by mtu hydrogen series 4000 engines, will convert H₂ into electricity if and when needed which can be fed into the container terminal's dedicated electricity network or into the public power grid. The waste heat from the CHP is used for process heat or for heating buildings in and around the port.

Furthermore, solar PV systems and bat-



Rolls-Royce makes Duisburg container terminal climate-neutral with MTU hydrogen technology

tery storage will be integrated into the local supply network, which is being realized by the port operator Duisport, Westenergie Netzservice, Netze Duisburg, Stadtwerke Duisburg and Stadtwerke Duisburg Energiehandel together with the Fraunhofer Institute Umsicht.



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Japan takes “more measured approach” to IGCC deployment

Suspension of the ambitious Kemper integrated gasification combined cycle (IGCC) power plant project has amplified concerns over the prospects of this technology, though IEA chief economist Lazlo Varro said “more promising projects can be found in Japan.” In fact, Osaki CoolGen project took a “more measured approach” to scaling-up IGCCs – their new-built 166 MW oxygen-blown IGCC has been running since March.

Similar to a combined-cycle gas power unit, the IGCC uses gas and steam turbines to generate electricity. However, in this case the gas is synthesis gas – a mixture of primarily hydrogen (H₂) and carbon monoxide (CO) – produced by the gasifier. Theoretically, any carbon-based feedstock could be gasified, including such varied materials as oil refinery bottoms or petroleum coke, municipal waste, and biomass, but in practice coal is most common.

The Osaki CoolGen Corporation was established in 2009 under joint funding by Electric Power Development (J-POWER) and The Chugoku Electric Power. Leveraging expertise gained from the EAGLE project, the Osaki venture is a 166 MW oxygen-blown IGCC demonstration plant (coal feed rate of 1,180 tonnes per day), situated at the Chugoku Electric Power Osaki Power Station in Osakikamijima, Hiroshima prefecture.

To date, the Osaki plant has completed over 500 hours of testing and the project owners plan to add CO₂ capture at a later stage.

“The potential attractiveness of IGCC is its very high efficiency and low emissions relative to other coal technologies, and the ready CO₂

stream generated pre-combustion,” Mr Varro commented. “Nevertheless, the prospects for the technology are uncertain, and the developments at Kemper only amplify concerns.”

Kemper adds to line of IGCC failures

The track-record of IGCCs is not all that promising, and Kemper is not the first high-profile failure of an IGCC with an integrated carbon-capture storage (CCS) plant: The original US FutureGen project had set its sights on a large-scale IGCC before it was cancelled in 2008.

ZeroGen, another abandoned project in Australia, ZeroGen, also aimed to build an IGCC with CCS plant, before detailed engineering (including of the CO₂ storage) revealed an almost A\$7 billion price tag.

“Arguably, Kemper has now tested the veracity of those estimates from the other side of the world,” Varro commented.

Petra Nova delivered on time and on budget

But there are also success stories of CCS deployment in the United States, notably the



Bird's eye view of Osaki CoolGen IGCC

commissioning of the Petra Nova project in Texas earlier this year. Petra Nova is the second, and much larger, project to retrofit post-combustion capture technology to an existing coal-fired power station, with costs reportedly around 20% lower than the world-first effort at Boundary Dam in Canada. ■

NFE to develop ‘Fast LNG’ and clean gas-to-power project in Mauretania

New Fortress Energy (NFE) has agreed with the Republic of Mauretania to deploy its ‘Fast LNG’ liquefaction technology to make better use of the country’s offshore gas reserves. NFE will supply gas to the existing 180 MW Somolec power plant and a new 120 MW combined-cycle unit, under development, but it will also produce LNG and green ammonia for export.

“The production of liquefied natural gas from these fields with our innovative Fast LNG liquefiers will help accelerate the global transition to cleaner fuels,” said Wes Edens, NFE’s chairman and CEO.

Technically speaking, NFE’s ‘Fast LNG’ liquefaction design combines modular midsize

liquefaction units with jack-up rigs or similar floating infrastructure. According to Edens, this enables a much lower cost and faster deployment schedule than today’s floating liquefaction vessels.

Supply of LNG-based power generation infrastructure will bring affordable and cleaner power to local industry in Mauritania, he explained, and at the same time unlock the country’s potential to earn revenue from exporting of LNG and blue ammonia. Currently, most of the country’s electricity supply is generated from oil-based fuels. ■

Wärtsilä enters Dutch energy storage market

Wärtsilä has been contracted to supply a 25 MW / 48 MWh energy storage system to GIGA Storage to help stabilise the electric grid. Dubbed ‘GIGA Buffalo battery’ – the unit will be the first large-scale energy storage project based on lithium iron phosphate (LFP) chemistry in Europe and is due operational in October 2022.

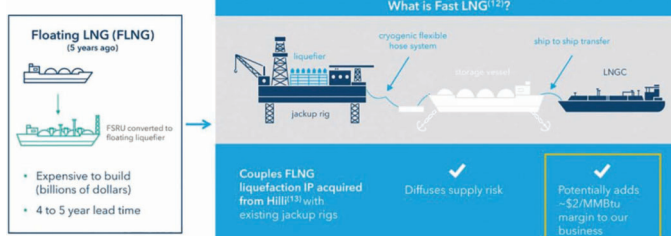
The Dutch government supports the installation of flexible energy storage to backstop rapid growth of renewable energy as the country has pledged to cut greenhouse gas emissions by 49% by 2030, aspiring for a 95% reduction by 2050.

“The Buffalo battery will help stabilise the Netherlands’ electricity grid and save a maximum of 23,000 tons of carbon dioxide emissions per year,” said Maarten Quist, chief operational officer at GIGA Storage. Once operational, the landmark project, will help reach the company’s goal of deploying 1.5 GW of energy storage in Europe by 2025.

Co-located with wind and solar assets at Widnet smart grid near the Wageningen research centre in Lelystad, the Buffalo battery will help the local utility Eneco regulate grid frequency and guarantee a stable and reliability supply of electricity. As the largest energy storage project in the Netherlands to date, it will store the equivalent of the annual energy consumption of more than 9,000 households each year. ■

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