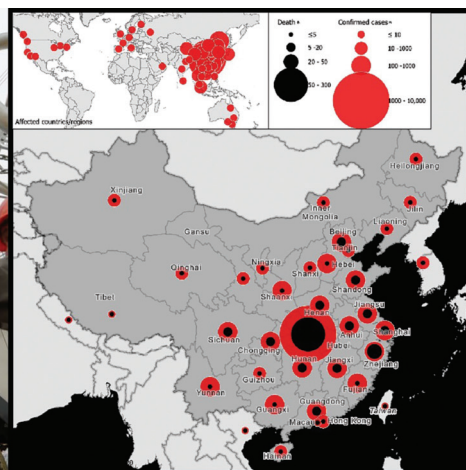




7 February 2020

Peak power load in Hubei plunges as factories stay closed



continued on page 2

Beijing offers 'force majeure' shields to domestic gas companies

continued on page 2

AGENDA

Utility-scale energy storage outcompetes gas peakers in California

Continued from page 1, top story

White House hawks, such as senior trade adviser Peter Navarro, are still pushing President Trump to go further with tariffs on China.

Containment crucial for GDP growth

Estimating how much economic damage the coronavirus outbreak will inflict is difficult and will ultimately depend on the duration

and severity of the outbreak. Over 20,000 cases of infections are confirmed globally, the vast majority within China. And numbers keep rising.

Assuming a relatively quick containment of the virus, Wood Mackenzie expects slower Q1 economic growth in China at 5.8 percent year-on-year, before a notable rebound to 6 percent in Q2 and then a return to our previous slowing trajectory.

"In effect, our forecast for China's GDP growth in 2020 is unchanged at 5.8 percent. This is bullish, and there are of course far more pessimistic forecasts," Mr. Thompson said. In contrast, the China Academy of Social Sciences warned that economic growth could fall below 5 percent in Q1. "This is a worst-case scenario," he said, "and would be more damaging to the global economy."

U.S. renewables power output to double through 2050, growing faster than electricity demand

Electricity generation from renewable energy sources in the United States is forecast to double between now and 2050. Declining capital costs, and higher renewable portfolio standards (RPS) targets in some U.S. states, will prolong the sharp growth in renewables seen during the past ten years while gas-fired generation stays rangebound.

After 2045, renewables will generate more electricity than gas-fired power plants, according to the government's Annual Energy Outlook (AEO2020). Overall the United States is seen to add 117 gigawatts (GW) of new wind and solar capacity between 2020

and 2023, as renewables grow faster than overall electricity demand.

Meanwhile, gas-fired generation retains its market share while coal and nuclear generation continue to decline.

"We see renewables as the fastest-growing source of electricity generation through

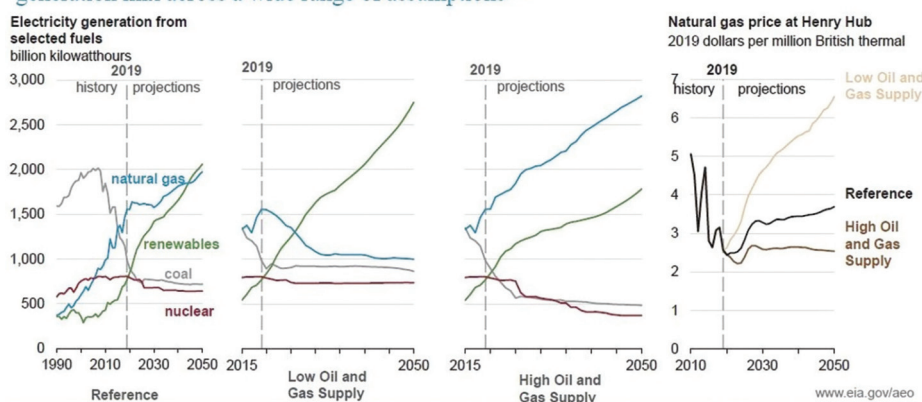
2050 as cost declines make them economically competitive beyond the expiration of existing federal and state policy supports," noted U.S. Energy Information Administration (EIA) head Linda Capuano.

Coal power units – retrofit or retire

Although coal-fired and nuclear generation decline through the mid-2020's as a result of retirements, generation from these sources stabilizes over the longer term as the more economically viable plants remain in service. Going forward, coal-fired plants must either invest in heat rate improvement technologies by 2025 or retire to comply with the Affordable Clean Energy (ACE) rule.

At projected Reference case prices, natural gas-fired generation is the marginal fuel source to fulfill incremental demand and increases in the later projection years, averaging 0.8% growth per year through 2050.

Declining costs for new wind and solar projects support the growing renewables share of the generation mix across a wide range of assumptions—



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Continued from page 1

can be postponed to later in the year," analysts said, suggesting "it might be early for Chinese companies to justify and obtain reliefs from performance."

Energy demand "greatly affected" by coronavirus outbreak

Chinese LNG offtakers are apprehensive amid uncertainty of how quickly the virus can be contained. "Demand for LNG will be greatly affected," one end-user told Platts. "There is a decline in residential gas demand, gas power generation and traffic. If the epidemic lasts until May, I think the LNG growth rate will be a single digit."

If and when Chinese LNG importers will resort to using 'force majeure' certificates,

they would be obliged to provide proof of delivery delays or cancellations, sales contracts or agreements, as well as customs declarations. Traders indicated Chinese gas buyers might try to delay February cargo deliveries due to a downbeat demand outlook as impacted as millions of Chinese citizens are quarantined which heavily impacts the domestic economy.

Economic fears, sparked by the fast-spreading coronavirus, now outweigh the positive news of the phase-1 trade deal between the United States and China, whereby Beijing committed to purchase an additional \$52.4 billion of energy products from the United States, including oil, coal and LNG.

Drax assesses 'options' for final coal power units

The last two coal units at Drax Power Station may soon shut down as the operator weighs up options. On a positive note, Drax said it secured capacity contracts for 2,562 MW at the latest T3 auction for existing gas, pumped storage and hydro assets. These contracts, running from October 2022 to September 2023, are priced at £6.44 per kilowatt and worth some £15 million.

Drax stressed it did not accept agreements for its two coal unit at Drax Power Station or the small Combined Cycle Gas Turbine (CCGT) at Blackburn Mill and will now assess options for these assets, alongside discussions with National Grid, Ofgem and the UK Government.

A new-build CCGT at Damhead Creek and four new-build Open Cycle Gas Turbine

projects participated in the auction but exited above the clearing price and did not accept agreements.

The 3,906 MW Drax Power Station at Selby, North Yorkshire, has largely been converted from coal to natural gas and wood pellets as the government sees to exit coal by 2025 at the latest. Drax' remaining coal-fired power units have capacity contracts through to the end of

September 2022.

Will Gardiner, CEO of Drax Group, conceded earlier the likelihood of the last coal-fired units at Selby running "past 2023 is extremely low".

Coal not to pitch into T4-auction

Looking ahead, Drax now prepares for the T-4 auction, due to be held in March, which covers the delivery period from October 2023. However, Drax noted it does not expect to sign a capacity agreement for its coal-fired power assets in the T-4 auction. So, early retirement of these assets is on the cards.

Bowing to growing regulatory pressure, several other UK utilities have announced the closure of some of their left-over coal power assets, including SSE's Fiddlers Ferry unit in Cheshire which is meant to close by March 31.

Fuel costs are another key obstacle for coal power in Britain. Falling capital costs for offshore wind and solar PV, as well as the 2013 introduction of a carbon price support levy has made it increasingly uneconomic to run coal-fired power units. Natural gas-fired units are also burdened by the carbon price, although to a lesser degree. ■



View of the 3.9GW Drax Power Station

SSE and EDF Energy secure UK capacity contracts at £6.44/kWh

British utilities SSE and EDF Energy are among the winners of the latest T3 auction for capacity in 2022/23. Contracts for 45.06 gigawatts (GW) of back-up power generation capacity were awarded at a price of £6.44 per kilowatthour per year. SSE's Keadby 1&2 gas power units as well as the Hinkley Point B nuclear reactor failed to get contracts.

The UK capacity market is designed to remunerate energy companies for making power generation capacity available at short notice at times of peak demand.

EDF Energy confirmed it secured a one-year agreements, lasting from October 2022 to September 2023, for 12 nuclear power units with a total of 5.9 GW of capacity as well as three gas-fired blocks at its West Burton power plant and two battery storage units.

However, the utility failed to secure capacity contracts for its nuclear units at Hinkley Point B nuclear power unit. "Although Hinkley Point B entered into the auction and we are confident it will operate to its scheduled closure date of 2023, it exited above

the clearing price and therefore did not get an agreement," EDF Energy said in a statement.

Scotland's SSE won capacity contracts for nearly 2.8 GW of gas-fired, hydroelectric and pumped storage capacity. But it failed to get contracts for three of its gas-fired power stations. "While our Medway, Keadby 1 and Keadby 2 stations have not been awarded capacity contracts in this auction, this will not im-

pact our existing operations and we will have further opportunities to secure contracts in future auctions," commented SSE's energy director, Martin Pibworth. ■



Hinkley Point B failed to win a capacity contract

Siemens had "slow start" into FY2020, considers further job cuts

German industrial giant Siemens has "got off to a somewhat slow start into the new fiscal year," CEO Joe Kaeser noted when presenting first quarter results. Revenues fell 1 percent to 20.32 billion Euros due to a 4 percent drop in orders, hence Kaeser did not rule out redundancies at the energy division.

Market weakness for short-cycle businesses, however, made EBITA from industrial business plunge 30 percent to 1.43 billion Euros (\$1.58 billion). Net income declined 3 percent to 1.1 billion Euros though they include "substantially better results" from outside industrial businesses.

On a positive note, Siemens said the book-to-bill ratio was a strong 1.22 and the order backlog reached a new high at 149 billion Euros.

Carving out Siemens Energy

"The weak performance across our energy businesses reinforces our priorities. We confirm our full-year guidance and will list Siemens Energy on the stock exchange in September as planned," the CEO underlined.

A decision on Siemens Energy's future

headquarters will be taken shortly, as the carveout – the legal separation of the energy segment from other Siemens activities – is meant to be completed by the end of March.

Preparing for the spin-off and listing of Siemens Energy in September 2020, Kaeser wants the new company to focus on the transition from conventional to renewable power sources as well as on the shift from fossil to synthetic fuels, notably 'green hydrogen'.

"A robust, profitable and innovative business in the renewable energy field is a key prerequisite for success. For us, this business is Siemens Gamesa Renewable Energy or SGRE for short," he said, announcing "we'll contribute all our shares in SGRE to



the new Siemens Energy company."

The Munich-headquartered company late Tuesday announced it will purchase Iberdrola's 8 percent stake in Siemens Gamesa for 1.1 billion Euros. Siemens said it will pay the total amount of €1.1 billion from its own resources and settle all legal disputes. ■

Cost optimization to save €1,000 million at Siemens Gas and Power

Anticipating "moderate revenue growth" for Gas and Power, Siemens hopes to reach an adjusted EBITA margin of 2-5% in fiscal 2020. Hence, the company is pushing through a wider cost optimization program with 1,000 million Euros in savings at the Gas and Power segment "on track and confirmed."

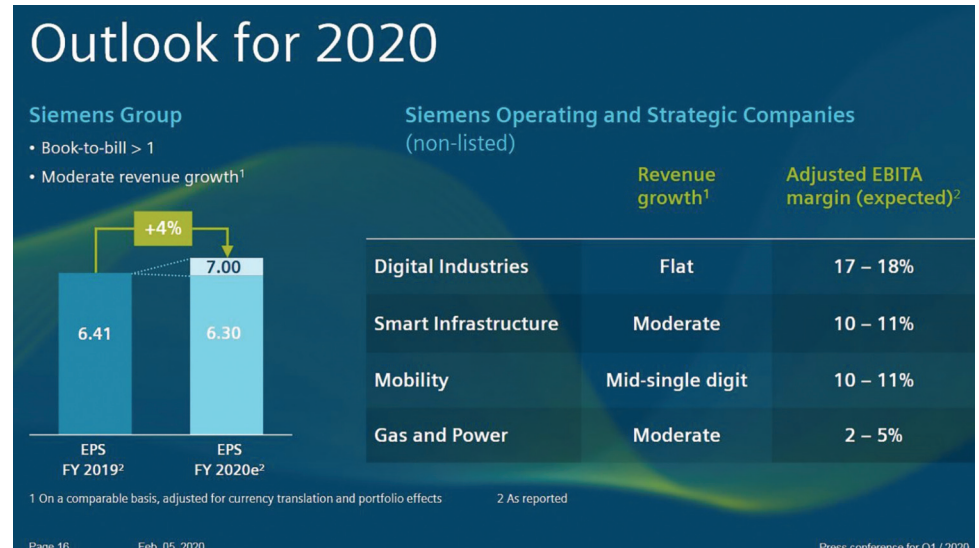
In the first quarter, profits from Siemens PG came in at 1.4 percent – a sharp drop from a 3.8 percent profit rate in Q1-2019. Hence, some 70 percent of the cost saving target is meant to be achieved already by 2021.

The stringent and rigorous savings program is part of Siemens' Vision 2020+ that is meant to transform the company by mid-2021, or early 2022, before leading to an "ultimate value creation" in all businesses. In this context, 320 million in savings at Digital Industries being "accelerated" and a further 300 million Euros will be cut at the Smart Infrastructure division.

Responding to "disruptive" market transformation

Energy, as well as oil and gas markets, are undergoing a "disruptive transformation at high speed," Roland Busch, Siemens Chief Technical Officer (CTO) noted.

"The 10 to 20-year market and technology cycles we were used to have been contracting radically," he said, stressing "the driving forces behind this change are decarbonization, decentralization and digitalization."



Rapid adaption to these changes is vital for any energy company or manufacturer. The planned spinoff of Siemens Energy will help give the overall company "a leaner and thus more agile setup" and reduce costs in all areas.

"In implementing lean and effective governance, we're aiming to achieve savings of around €500 million. Here, we're on track,"

Busch noted. At Global Business Services, Siemens is "confident" to achieve savings of about €90 million.

As for Siemens Energy, more specific details about target achievement will be disclosed when the new company has been fully carved out. The legal separation is meant to be completed by the end of March. ■

Cheap shale gas production keeps Henry Hub prices low through 2050

2050 amid an abundance of low-cost resources, primarily in the Permian Basin. "With continued technologically-enabled growth in production, we see the United States remaining a net exporter of energy for some time," said the head of the U.S. Energy Information Administration (EIA), Linda Capuano.

Production of natural gas grows at a faster rate than consumption in most cases after 2020, leading to an increase in exports. Continued development of tight oil and shale gas resources in the East and Southwest regions, U.S. crude oil production is seen to set annual records through the mid-2020s while natural gas production will keep growth through 2050.

However, dry gas production is seen grow just 1.9 percent from through 2025, which is considerably slower than the 5.1 percent growth rate in the five years running up to 2020.

Shut-in of US LNG production on the cards

Rampant US gas supply has been outpacing demand growth for the past year, slashing prices in Europe and Asia. Some US exporters are considering shutting in production as record low gas prices at the Dutch TTF hub challenge the profitability of lique-

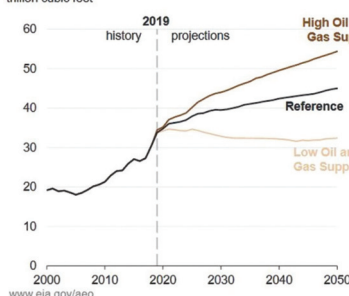
fying and shipping gas to Europe.

Prices at the Dutch TTF gas trading have averaged \$4.5/MMBtu in 2019 but would have to drop below an average of \$3.8/MMBtu through 2020 to balance the market. "Our forecast touches back down to the low US\$3/million Btu range during the summer. The risks to price remain heavily weighted to the downside," said Wood Mackenzie's director, European Gas, Murray Douglas.

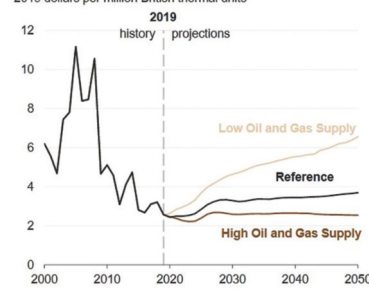
Yet, shut-ins of US gas production is still unlikely at this point - given the political clout surrounding American gas exports as well as the importance and competitiveness of Henry Hub-indexed supply for global markets. American LNG supply is gearing up

AEO2020 natural gas prices depend on resource and technology assumptions

AEO2020 dry natural gas production
trillion cubic feet



AEO2020 natural gas spot price at Henry Hub
2019 dollars per million British thermal units



to make up 46% of Atlantic Basin trade by 2022.

Over the summer, the British and European LNG marketplace is expected to become "increasingly congested. Hence, some infrastructure constraints will likely surface and place further downward pressure on hub prices. This will become particularly acute in the UK during summer where regas utilisation will be capped at 75%, assuming Norwegian pipeline deliveries follow historical trends.

Gas has "plenty of scope" in Asia to reduce "massive" coal use

LNG and pipeline gas have still a long way to go to reduce, let alone replace, the current "massive coal consumption" by Asian nations. In contrast to Europe, where gas is regarded as one of the fossil fuels amid strives for net-zero emissions, "coal-to-gas switching is important in Asia," the Institute of Energy Economics in Japan (IEEJ) noted.

"The expansion of natural gas and LNG can be expected to contribute to cleaning and diversifying energy supply and reducing Asia's dependence on energy imports from the Middle East," said Ken Koyama, IEEJ chief economist and managing director.

Japan is set to remain the world's No.2 LNG importer, after China. So, the Japanese

market still provides ample opportunities for LNG sellers, particularly as existing contracts expire. Japan's LNG imports are expected to remain above 70 mmtpa through much of the 2020s, and may even exceed 60 mmtpa until at least 2040.

Price is, however, still a big issue. Koyama stated that pipeline gas and LNG were not necessarily the perfect energy source and the biggest challenge remained

how to make them more price competitive, more affordable, more attractive and easier to be selected as preferred energy.

Energy security that has become a major matter of concern because of Asia's growing dependence on energy imports. "Substantial energy demand growth makes it important for Asia to tackle environmental problems. A particularly important problem involves Asia's structurally high dependence on fossil fuels including coal," he stated.

Dirty king coal

Across Asia, thermal coal accounts for around 48 percent of the primary energy consumption, far higher than the global average at 27 percent. "Coal has become a main energy source in Asia, including China and India, as large energy consumers because coal has been locally abundant and price competitive in Asia," the IEEJ report concludes.



Analyzing plant operations on Java to probe clean fuels

Mitsubishi Hitachi Power Systems (MHPS) will conduct joint research with Indonesia's Bandung Institute of Technology (ITB) analyzing big data from local power plant operations on the island of Java to advance clean energy technologies. The aim is to probe new fuels like ammonia and hydrogen.

Diagnosing operations of Indonesia's power plants through artificial intelligence (AI) and big data analysis is meant to enhance efficiency. To that end, MHPS and the ITB seek to establish a joint research and development base in Indonesia.

"Through this joint research, not only will we develop new technologies for clean energy, but also we will improve the performance of existing power plants in Indonesia through big data analysis and Artificial Intelligence (AI)," said MHPS President and CEO Ken Kawai.

On Java, MHPS some sixteen months ago commissioned the 300 MW unit-2 of the Tanjung Priok combined-cycle power plant ahead of schedule. Unit 1 of the Jawa-2 project initially went into operation as a simple gas turbine system this June with output nearing 300 MW, and Unit 2 doubled that capacity to 600 MW. In Indonesia, MHPS claims to hold the top market share for large gas turbines, with a total power gen equipment supplied reaching 12 GW.

Aiming for 100% hydrogen-fuelled power gen

MHPS has already successfully tested a large-scale turbine that runs on a 30% hydrogen fuel mix, combined with natural gas. That turbine reduces CO₂ emissions by 10%, compared to a standard natural gas-fired plant. As a pilot project, MHPS is now working to convert a combined-cycle gas turbine at Vattenfall's 440 MW Magnum power plant in the Netherlands to run solely on hydrogen by 2025.

Optimizing solid oxide fuel cells (SOFC) for distributed power systems is another technology focus, whereby MEGAMIE, one of MHPS's hybrid generating systems, combines SOFC and micro gas turbines. The technology has been in commercial operation at the Marunouchi building of Mitsubishi Estate since March 2019, supplying electric power and heat. ■

MHPS teams up with NTK to manufacture and sell fuel cell stacks

Mitsubishi Hitachi Power Systems (MHPS) and NTK Spark Plug have joint forces to manufacture and sell cylindrical cell stacks – a key element used in solid oxide fuel cells (SOFC). The new joint venture CECYLLS will use NTK's ceramic knowledge to produce the cell stacks that can efficiently utilize heat.

Solid oxide fuel cells (SOFC) generate electricity using oxygen (O₂) from the air, along with hydrogen (H₂) and carbon monoxide (CO) extracted from reformed town gas or other sources. Cell stacks – the core component for power generation – are composed entirely of ceramic.

Cylindrical fuel stacks are structures of elements (laminates of fuel electrodes, electrolytes, and air electrodes) on the outer surface of a high-strength ceramic substrate tube, which produce a power-generating reaction.

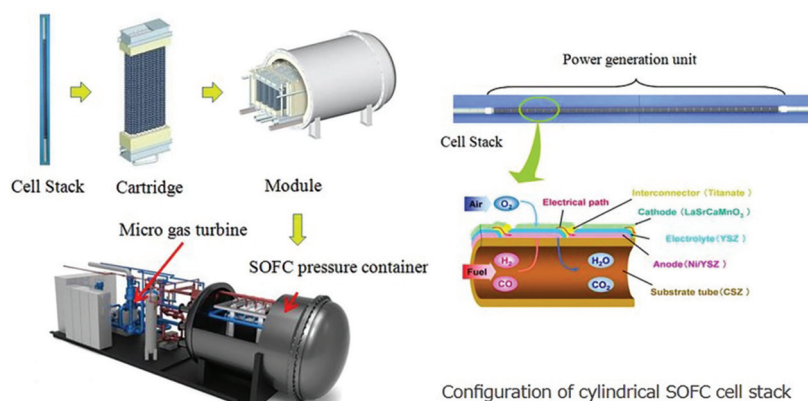
The elements are serially connected by a conductive ceramic interconnector, notably a cylindrical horizontal-stripe cell stack. According to MHPS, this allows for efficient

generation of low current, high voltage electricity.

Komaki pilot project

NTK has a track-record of ceramic forming, printing, and sintering and since 2016 is focused on developing both planar and cylindrical SOFCs. This know-how will be leveraged by CECYLLS to produce and sell MHPS' cylindrical cell stacks that feature long-life and efficient heat utilization capabilities.

Headquartered in Nagoya, Japan, NGK has installed various pressurized hybrid power generation systems, e.g. a demonstration plant in Komaki Factory that consists of a cylindrical solid-oxide fuel cell (SOFC) and a micro gas turbine. ■



Fuel cell tech – ready for commercialization

In 2020, the sector is expected to enter a new stage characterized by rapid commercialization and infrastructure build out after the sector last year had shipped 1.1 GW to Asian markets. "If the 2010s can be seen as the breakout decade for the battery, the 2020s will see the ascendancy of the fuel cell," forecast E4tech.

"There is a real sense that the industry is on the cusp of something great. Fuel cells are proven from a technical perspective, and blowing past the 1 GW mark is a vindication of that," said David Hart, director, Fuel Cells & Hydrogen at E4tech.

At the same time, the broader hydrogen sector is starting to expand as recognition grows that some applications, like heat, will be difficult to fully electrify. This supports and complements fuel cell growth.

Strongest demand growth in China and Korea

Asia remains the largest market for fuel

cells, accounting for 680 MW, driven strongly by Hyundai NEXO sales into Korea and by Korean stationary power. The NEXO also accounts for some growth in European capacity, which rose from 41 MW to 69 MW in 2019. However, the biggest market outside of Asia is North America, which saw shipped capacity of 384 MW – down slightly from 425 MW in 2018, but expected to rebound in 2020.

"To succeed, the fuel cell industry will need to see the supply chain mature quickly enough to deliver on expectations, and to allay any remaining safety concerns," Hart noted. Once that happens, fuel cells will rank as an established technology. ■

Utility-scale energy storage outcompetes gas peakers in California

In California, energy storage is becoming a viable alternative to peakload gas power units. Pacific Gas & Electric (PG&E) is developing utility-scale storage with a combined capacity of 567.5 MW and 4-hour duration, aiming to replace three gas-fired power plants.

The state regulator, California Public Utilities Commission, recently approved four of PG&E's project totaling 567.5 MW/2,270 MWh to be built in the transmission-constrained Moss Landing area south of San Francisco Bay. The projects include a 300 MW/1,200 MWh system that Vistra Energy would build in near an existing fossil power plant owned by Dynegy, a 182.5 MW/730 MWh Tesla-built lithium-ion battery energy storage system (BESS) located within PG&E's Moss Landing substation, and a stand-alone, transmission-connected 75MW BESS located near the city of Morgan Hill.

The flexible, utility-scale energy storage is meant to replace three peakload gas power plants that would otherwise require reliability must-run (RMR) contracts. In-service date is planned for mid-2022.

Market observers say PG&E's experience at the Moss Landing will "provide vital data



80MW PowerPack substation in Mira Loma, California.

about how the gas-to-storage transition works in practice."

Supportive legislation

Green energy is rapidly expanding in California, spurred by supportive state policies. With the passage of California's Senate Bill 100 in September 2018, the state law now requires that 100% of electricity procured for end-customers and state agencies needs

to be zero-emission by 2045. This landmark legislation could open up a pathway for storage and renewables to become California's primary source of energy supply.

Low capital costs and short construction periods also render the deployment of energy storage attractive compared to building a new

coal- or gas-fired power plant. An average peakload gas power plant takes three years to build, while Tesla's 100 MW Hornsdale energy storage facility was completed in just 100 days.

In sun-soaked locations like Southern California, Texas and New Mexico, energy storage provides a fast, clean and low-cost solution to fill gaps in electricity generation capacity and transmission. ■

Finnish researchers test Terrawatt-scale gas power storage

Modelling from the Technical Research Centre of Finland (VTT) suggests large scale power storage utilising gas may soon be a reality. "First prototypes will be available in 12 months from now with industrial implementation in 24 to 26 months," Gas to Power Journal was told.

Research by the team at VTT has studied gas powerstorage at three distinct scales - KW, MW and Terrawatt (TW). The first stage covers smaller house-hold devices and storage units at this scale are already commercially available. The MW scale projects are expected to start appearing within the next year paving the way to TW storage systems designed to meet the needs of national utilities.

"We aim at showing how storage technologies can balance the electricity grid, and how they mobilise the transport sector. We have a concept ready for the Terrawatt-scale unit," said Pasi Vainikka, principal scientists at VTT. "In modelling we would have a platform that can be used in designing an energy system with mobility and electricity grids merged and with large storage infrastructure in place."

Looking further into the future the team are modelling systems that are entirely renewable, where gas used to store energy is

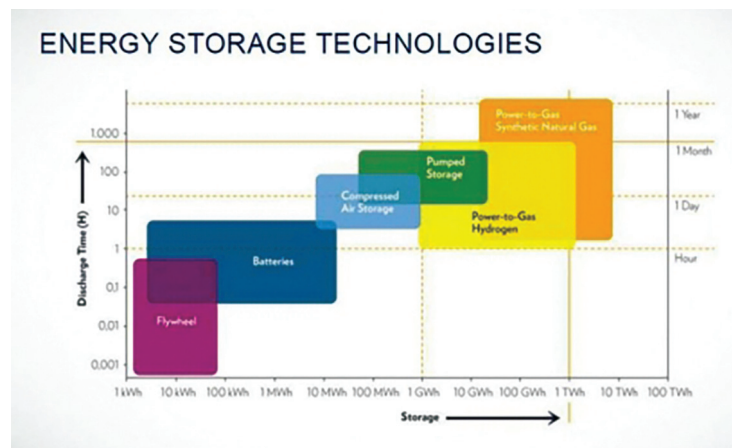
created artificially from excess solar power. This would greatly reduce the environmental impact of gas power generation as there are no extraction or transportation costs.

Natural gas favoured over hydrogen in short term

The driver behind all of this research has been to understand the economics of widespread renewable penetration. As a result the benefits of hydrocarbon based energy storage are more apparent. While there is a range of promising technology focused on hydrogen power generation the costs quickly spiral when TW-scale stor-

age systems are considered.

"By 2030 one would need TerraWatt-hours [in energy storage capacity] and while hydrogen is nice there are currently no capabilities to store 1 TWh hydrogen if it falls in your lap tomorrow," Vainikka said, adding that in our existing hydrocarbon infrastructure "it is possible." ■



Source: ITM Power

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