



Li-ion battery market could reach nearly US\$10 billion globally by 2030

Growth rates of 5.9% through 2030 could help push the global market for lithium-ion phosphate batteries beyond US\$9.9 billion by 2030, up from US\$5.6 billion in 2020. Tesla's Models 3 and Y, for instance, use such batteries but the high cost of lithium-iron phosphate remains "a restraining factor," – as is the "high presence of alternatives [technologies]," ResearchandMarkets cautioned.



Tesla Model Y features li-ion batteries

Lithium-iron phosphate battery is a type of battery that uses lithium-iron phosphate (LiFePO₄) as the cathode material, and a graphitic carbon electrode with a metallic backing at anode.

Tesla's Gigafactory in Berlin has been subject to much controversy. But once up and running, the US carmaker will use it to streamline and expand e-vehicle production in Europe, which inevitably drive up demand for batteries.

Li-ion vs. lead acid batteries

According to ResearchandMarkets, the "advantage of lithium-iron phosphate batteries compared to lead acid batteries is an important factor for the growth of the lithium-iron phosphate batteries market." Rising policy support for electric cars – as more and more

national government set Net Zero emission targets – also help provide growth for the lithium-iron phosphate batteries market.

Strict environmental rules in the EU has played a vital role in the development of lithium-iron phosphate batteries, notably in the automotive and industrial sectors as well as for emergency power.

In the power generation sector, rising renewable energy deployment has increased the need for batteries to provide vital balancing energy to stabilise the grid. Analysts also pointed out that the military uses li-ion batteries for emergency power – as do hospitals, data centers and some IT companies and the event industry. ■

RFB systems emerge as rivals to dominant Li-ion batteries

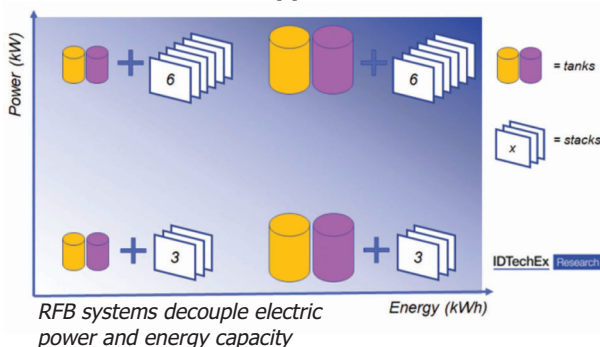
Lithium-ion based batteries are still dominating the stationary energy storage sector but a rising number of companies try to develop different technology types. Among the Li-ion batteries competitors, the Redox Flow Battery (RFB) system – based on flowing two liquids as electrolytes across the electrode – is seen as an attractive approach.

The RFB principle, developed by researchers in Cambridge, UK, functions by letting two liquids with electroactive species flow across the electrode which creates a chemical reaction that generates electricity.

Longer storage time

Though Li-ion batteries are expected to dominate the market for the time being, analysis carried out by IDTechEx finds that Redox is emerging as a "promising competitor." That's because RFBs can store energy for longer than the average 4 hours of a Li-ion system.

"The larger the amount of electrolyte, the bigger the amount of energy stored in the battery, analysts explained, while the electric power output of a RFB is defined by the size of the electrode stack and the kinetics of the chemical reaction." In



contrast to Li-ion batteries, RFB batteries have a decoupled energy and power capacity which allows a bigger customisation of this kind of system.

Vanadium used as electrolyser

Looking into electrolysers, there are different types of electroactive species which have been investigated to increase the efficiency of RFB systems.

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Investors flock to Europe's distributed solar and energy storage market

With over 124 GW of coal, gas and nuclear capacity to be displaced in Europe by 2030, investment in new solar combined with energy storage is set to surge. The rising diversification of asset ownership in distributed energy storage could unlock a 40-GWh market, with some analysts anticipating 12x market growth in this decade.

“With distributed solar market passing 128 GW by 2026, Europe's residential and non-residential storage segments will grow significantly,” Wood Mackenzie's lead analyst for energy storage, Anna Darmani commented. In her view, “investments outside cramped markets such as Germany, Italy, UK, will unlock 14 GWh of distributed storage demand by 2030.”

Strong policy targets and carbon mandates are expected to support robust solar deployment, while technology costs continue to decline. Analysts forecast the share of photovoltaics' (PV) in Europe's power supply will reach around 30% by 2030, passing 450 GW capacity through sector expansion.

Germany and Spain are driving solar power deployment, installing around 56 GW

and 33 GW from 2020 to 2030, respectively; followed by France, Italy and Netherlands with more than 20 GW this decade. Wood Mackenzie offers an energy storage data hub as an on-demand tool for investors and utilities to identify new markets and opportunities, track the competition and navigate the ever-changing policy landscape.

Green hydrogen policy incentivises solar PV

“There are enormous opportunities for non-traditional power market participants at a time when the sector is evolving.

Green hydrogen policy developments could also incentivise further solar PV deployment with the EU looking to install 40 GW of renewable electrolyser capacity by 2030, while hybrid technology auctions



across the continent should also boost solar storage deployment,” said Wood Mackenzie research analyst for solar, Daniel Tipping.

While falling costs and rising power prices should support deployment, Europe's rooftop solar potential is still relatively untapped. “Further policy pledges would help investment,” he noted, indicating that France and Germany recently mandated solar installation for specific newbuilds. ■

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The first and most used Redox Flow Battery chemistry is the Vanadium redox flow battery, which is today the most studied and manufactured technology of its kind.

Researchers stressed that all RFB battery types, the vanadium technology – and similarly the All-Iron RFB one – use vanadium as the electroactive species, though with different oxidation states.

Costly material, low efficiency

However, the high cost of vanadium as a raw material and the low round-trip efficiency of the RFB solution are main drawbacks, analysts at IDTechEx noted. “The electrolyte alone accounts for 30% to 40% of the overall technology cost. To reduce the effect of vanadium cost on the overall sys-

tem, an increasing number of companies started collaborations with vanadium mining companies,” they pointed out.

Apart from the Redox Flow Battery manufacturers themselves, some mining companies are also looking into this technology such as Bushveld Minerals in South Africa. The miner is actively promoting the adoption of vanadium flow batteries all over Africa, and also backed the merger between two VRFBs manufacturers, the English redT and the American Avalon Battery. Two years ago, Bushveld Minerals bought a major stake in Enerox-CellCube, previously known as Gildemeister AG.

Rival technology types

Apart from vanadium as the electroactive medium, the zinc-bromine technology is the second in the rank of adopted technologies. Technically different from vanadium-based RFBs, the zinc-bromine battery (ZBB) is based on a solid zinc electrode and a liquid bromine electrolyte, which gives this technology a higher energy density than VRFBs. Analysts noted that with the Australian Redflow this technology is slowly acquiring its share of the flow battery market.

All-iron Redox flow batteries are another rival technology. Developed by the American company ESS, the promising all-iron RFB is characterised by the use of iron as electroactive species in both electrolytes (catholyte and anolyte). The low-cost iron-

electrolyte brings a large advantage in terms of cost, although other limitations, such as hydrogen evolution, affect these kinds of batteries.

Organic flow batteries, yet another type, are technically similar to a Vanadium-based RFB but employing an organic electrolyte. “While the vanadium flow batteries employ an inorganic electrolyte based on vanadium salts, the ORFB – or sometimes called ‘Metal-free Flow Battery’ – are based on organic electrolytes such as quinone, pyridine, or ‘TEMPO’ (2,2,6,6-tetramethyl-1-piperidinyloxy) molecules,” analysts explained. Various companies are developing this kind of flow batteries, including the German Jena Batteries and the French Kemiwatt.

Hydrogen-bromine flow battery

Already on the scene for a few years, the hydrogen-bromine flow battery is one of the future redox flow batteries that are now rapidly approaching commercialisation on a wider market. The Dutch company Elestor is developing his technology, and in 2019 received a multi-million capital boost from Koolen Industries and EIT Innoenergy, already an earlier investor in Elestor.

The Dutch manufacturer is also involved in the European MELODY project, related to the development of a sustainable redox flow battery technology that can effectively reduce the costs of electricity storage to support large-scale. ■

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Acciona Energia advances H2 projects in Australia and Mallorca

Acciona Energia, headquartered in Madrid, is helping Stanwell Corporation to develop a large green hydrogen plant in Queensland, Australia. The Central Queensland Hydrogen Project (CQH2) – a 3,000 MW electrolysis complex – is intended to produce 100 tons per day of hydrogen by 2026 and will be scaled up to 900 tons per day of hydrogen by 2031.

A feasibility study on the CQ-H2 project is being implemented by a consortium led by Stanwell Corp, together with the Japanese companies Iwatani, Kawasaki Heavy Industries, Kansai Electric Power and Marubeni, and the Australian group APT Management Services (APA).

Demand for green hydrogen is growing fast, with analysts anticipating the market to grow 33.8% annually, expanding from \$0.58 billion in 2020 to \$0.78 billion in 2021. According to MarketsandMarkets estimates, the market will reach \$2.94 billion in 2025 at a CAGR of 39.4%.

Pilot project in Mallorca

In Europe, Acciona is also busy developing green hydrogen projects. The group will start up the first industrial-scale green hydrogen generation plant in Spain before the end of 2021, with a production of more than 300 tons per year, on the island of Majorca, together with Enagás, Cemex and IDAE.

The plant is the core of the Green Hysland project, an innovation project to promote a green hydrogen ecosystem in Mallorca that will serve as an example for other islands, co-funded by the European Commission's Fuel Cell and Hydrogen Joint Undertaking (FCH JU).

The Power to Green Hydrogen Mallorca industrial project would see the hydrogen utilised through multiple applications around the island, such as fuelling buses and rental cars powered by fuel cells via a hydrogen filling station to be built for this purpose, generating heat and power for commercial and public buildings, and as an ancillary energy source for ferries and port operations.

JV with Plug Power

Teaming up with the American group Plug Power, the Spanish green energy pioneer created

the joint venture AccionaPlug to jointly enter the green hydrogen market in Spain and Portugal.

AccionaPlug combines Plug Power's electrolysis technology and expertise in hydrogen for mobility with Acciona Energías' track record in managing renewable technology projects around the world, with more than 11.2GW installed, and its position as the largest independent marketer of 100% renewable energy in Spain and Portugal. ■



CQ-H2 project, a staged 3,000 MW electrolysis plant in Queensland, Australia.

Sunrise Power and XCMG to produce H2-fuelled cars in China from 2022

Sunrise Power and Xuzhou Construction Machinery Group (XCMG) will build a new clean energy commercial vehicle factory in Ordos City, China. The partners agreed to spend 2.3 billion Remimbi (US\$360m) on the new plant, intended to produce H2-based power systems and vehicles. The first 200 H2-fuelled cars are due to roll off the production line in spring 2022.

Giga Carbon Neutrality (GNC), a California-based clean tech company, will produce the first swing of H2-fuelled vehicles at the new plant in Ordos, given that it secured a contract to supply 200 hydrogen and battery EV powered heavy trucks to the local government in Ordos City. Home to over 2 million people, the city is situated in

China's autonomous region Inner Mongolia.

Ordos is a mining town, where many people become rich quickly in the coal boom of recent years. Now, the Chinese central government is supporting steps to invest in more sustainable energy sources, notably solar PV, wind power and hydrogen.

In November, GCN announced its intention to launch a full range of 21 battery-electric and hydrogen fuel-cell vehicles by the end of 2023, which will be configurable to a wide range of commercial use cases.

The first vehicles – all built at Ordos – are available to order now for delivery in early 2022. Work to build the new plant and bring it to its full capacity is expected to be complete in 2023. ■



Satellite image of Ordos City, Inner Mongolia

Howden and Chart Industries join forces on hydrogen

Howden and Chart Industries have agreed to intensify their collaboration on hydrogen by incorporating Howden gas compression systems into Chart's hydrogen offerings. The aim is to develop cost-effective solutions and provide customers with tailored aftermarket support.

Glasgow-based Howden manufactures highly engineered fans, compressors, heat exchangers, steam turbines, and other air and gas handling equipment. Since October 2019, Howden has been a portfolio company of KPS Capital Partners.

By working together, the two companies will leverage their manufacturing capabilities and be closer to regional hydrogen projects. Many hydrogen ventures have sprung up as power generators and the transport sector is embracing the fuel as a zero-carbon alternative to coal and natural gas. Chart expects multiple projects will move to commercialization before the end of 2030. ■

EU taxonomy held up by German-French spat over gas vs nuclear power

Germany's incoming government is struggling to align the financial sector with more stringent emission reduction targets while adhering to European guidelines. The EU taxonomy on sustainable finance is meant clarify sustainable investment standards but the implementation currently held up as Germany and France disagree over the sustainability rating of natural gas and nuclear power investments.

France, as well as several Eastern European countries, want to build a series of small-scale nuclear reactors to ensure stable electricity supplies as markets need to absorb growing volumes of inherently intermittent electricity from wind and solar PV installations.

Germany, in contrast, adamantly opposes such proposals and remains committed to its unilateral exit of nuclear energy. The Atomic Energy Act stipulates that the last reactor generating electricity in Germany will have to shut down by 2022 at the latest.

Changes to CO2 pricing

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. In a recent report, they argue that higher CO2 prices combined 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.

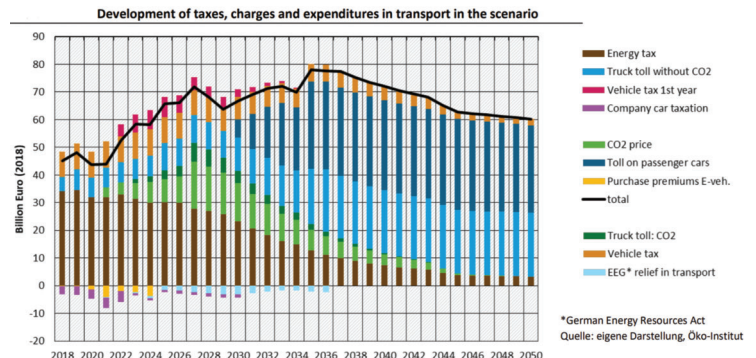
The authors stated that, by the end of the decade, the CO2 price should reflect "the true societal costs of climate protection," and that this should be made affordable to consumers by scrapping the renewables levy. They also argued that the private use of company cars should be taxed far more heavily.

"The taxation of our mobility stems from the fossil age," said Dr Wiebke Zimmer, deputy head of the Resources & Mobility department at the Öko-Institut. "It no longer fits the requirements for sustainable, equi-

table, individual mobility and must therefore be realigned."

Tackling transport emissions

Emissions from road traffic and the wider transport sector have remained "stubbornly high," analysts warned. This is mostly because efficiency gains in car engines which tend to lower fuel consumption and related emission have been overcompensated by the rising use of heavier cars. ■



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ExxonMobil plans for Net Zero emissions in Permian Basin by 2030

US oil major ExxonMobil has pledged to eliminate routine flaring of associated natural gas in its Permian Basin operations by the end of 2022. Electrification of Exxon's upstream operations in New Mexico and Texas will include low-carbon power sources – wind and solar power as well as hydrogen co-firing – in an effort to reach Net Zero emissions.

At the end of Q3-2021, ExxonMobil reported producing 500,000 barrels of oil equivalent per day from its unconventional assets in the Permian Basin, accounting for more than 40% of the company's U.S. net production. "As production increases in the Permian, more emissions need to be mitigated accordingly – costs associated with lower-emissions technology are included in Exxon's corporate plan through 2027.

ExxonMobil said its 2030 net zero goal for the Permian Basin requires "well-designed policies and advances in technology that increase availability and reliability of carbon-neutral power in the region, including wind and solar." Through long-term power purchase agreements (PPAs), the company helps finance the development of new wind and solar power projects in the region.

To tackle upstream emissions, methane monitoring devices will be deployed around Exxon's oil and gas production facilities across the Permian Basin as the company strives to boost output its unconventional gas production. These plans are part of the corporate-wide effort to reduce Upstream greenhouse gas emissions intensity by 40-50% by 2030, compared to 2016 levels.

Satellite surveillance of methane emissions

Electrifying day-to-day upstream operations, as well as continuing investments in methane mitigation and detection technology will be vital to curb emissions. Moreover, Exxon has committed to eliminate routine flaring and employ emissions offset

technology to make its operations more sustainable.

Satellite surveillance and a network of ground-based sensors will be used for continuous monitoring, along with aerial flyovers that identify leaks for rapid repairs.

Aim to eliminate all routine flaring

By year-end 2021, ExxonMobil anticipates reduced flaring volumes across its Permian Basin operations by more than 75% compared to 2019. The company plans to eliminate all routine flaring in the Permian by year-end 2022, in support of the World Bank's Zero Routine Flaring initiative. The company is also securing alternative natural gas delivery points across the basin to minimize non-routine flaring.

"Our goal of net zero for Scope 1 and Scope 2 greenhouse gas emissions is one of the most ambitious and wide-reaching in the Permian Basin," said Bart Cahir, senior vice president of unconventional at ExxonMobil. "Throughout the value chain, our people are working hard to help reduce the greenhouse gas emissions associated with the products that enable modern life."

Early achievements

Year-end 2021 results are expected to show a reduction of 15-20% in greenhouse gas intensity from Upstream operations compared to 2016 levels, four years ahead of schedule. This is supported by an anticipated reduction of 40-50% in methane intensity and 35-45% in flaring intensity compared to 2016.

To validate its emissions-reduction efforts, ExxonMobil is working with non-profit MIQ through a pilot program initially focused on Poker Lake facilities in New Mexico. Natural gas will hereby be certified, based on factors including methane intensity and then marketed to customers starting from early 2022. ■

NEWS NUDGES

Ethatec uses CO2-free power to produce ethanol

ESG Clean Energy has signed a letter of intent (LOI) with Ethatec to use ESG's patented CO2-free gensets to its ethanol production. Ethatec uses waste from bakeries and pizza factories which is being crushed and then mixed with water and enzymes and heated in a multi-stage mashing process to saccharify the starch. It is then cooled and fed into fermentation tanks, where yeast is added. For alcoholic fermentation of the sugar. After 72 hours, the mixture is fed to a distillation system where ethanol is obtained.

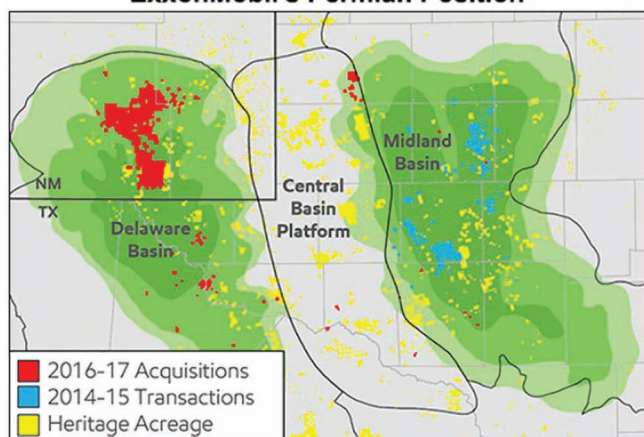
Industry wary about new German energy policy

The German industry is closely watching how the new coalition government will implement its clean energy policies. Security of supply is a major issue given that the coal exit date has been pushed forward by eight years to 2030, while electrification of transport and hard to abate industries is set to push up demand substantially. To decarbonise traffic, over 15 million electric cars are meant to be on the roads by the end of this decade.

Anax helps Magellan mine bitcoin under US\$12m deal

Ohio-based Magellan Scientific has entered a long-term accord, worth US\$12 million, with Anax Power to generate zero-emission electricity from natural gas flows for Magellan's distributed data centres, using 500 kW Anax turboexpanders. This green power will be used to lower the carbon-intensity of bitcoin mining and help US interstate pipeline operators and utilities accelerate their net-zero emission goals.

ExxonMobil's Permian Position



Note: Over 140,000 boe/d net across 1.8M acres in the Permian.

Source: ExxonMobil Corp.





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GE 9HA turbines ordered for hydrogen-blended gas power plant in China

Japan's largest LNG importer and power producer JERA is forging ahead with the construction of three new LNG-fuelled units (600 MW each) at Anegasaki Power Station, in Ichihara City. The new units will replace the decommissioned steam power units 1-4, and JERA said it aims to commission the new cleaner-burning units in 2023.

Together with the existing steam generation units 5 and 6 (600 MW each), the start-up of the three new LNG-fuelled units (650 MW each) will bring the total capacity of Anegasaki Thermal Power Station to 3,150 MW.

LNG has become the main fuel source for Japanese power producers, as more stringent emission regulation is forcing utilities to shut down ageing coal-fired power units or convert them to run on natural gas. As a gas portfolio player, JERA has both the capital and fuel at hand to convert much of its power plant fleet to run regasified LNG, which needs to be imported.

Hydrogen and Ammonia co-firing

The cost of LNG imports, combined with environmental rules, has prompted JERA to also look into hydrogen co-firing. Several pilot projects are underway to adapt the combustion process of gas-fired power station in order to partially run on hydrogen

which causes no emissions when burnt.

Ammonia, another zero-carbon fuel, is being used to operate Unit-5 of JERA's Hekinan thermal power station. Together with IHI Group, the company is seeking to demonstrate the large-scale utilization of ammonia in thermal combustion where the green fuel is meant to ultimately make up a fifth of the heating value.

The project is running for about four years, from June 2021 through to March 2025, and aims to achieve an ammonia co-firing rate of 20% at Unit 4 of Hekinan power station in the fiscal year 2024.



Overview of Anegasaki Thermal Power Station after new units 1 through 3 start commercial operation

Unit no.	Generation capacity	Generation type	Fuel	Start of operation
New unit 1	650MW	Gas turbine and steam	LNG	2023 (planned)
New unit 2	650MW			2023 (planned)
New unit 3	650MW			2023 (planned)
Unit 5	600MW	Steam	LNG	April 1977
Unit 6	600MW			October 1979
Total	3,150 MW			

The small-scale ammonia co-firing at Unit 5 are serving as a blue-print for the envisaged combustion of larger ammonia volumes at Unit 4. To that end, IHI needs to develop a co-firing burner that allows for a seamless switch between thermal fuels such as coal and natural gas and emissions-free ammonia. ■

Sergipe I CCGT delivers non-stop power for northeaster Brazil since July

Centrais Elétricas de Sergipe (CELSE) 's Port of Sergipe I Complex has been providing uninterrupted electricity since July 2021. Powered three 7HA.02 gas turbines, the 1,500 MW combined-cycle power plant is GE's second H-class turnkey project in Brazil, covering up to 15% of regional electricity demand in the country's North-East.

Flexible to dispatch, the 1,500 MW plant is well placed to backup hydropower in the Amazonas region of Brazil which tends to suffer extended periods of draught in recent years.

Occupying more than 200,000 square meters near the coastline, Port of Sergipe I Complex has helped to support capacity and to compensate for reduced hydroelectric power during this year's lower-than-expected rainy season. As a result of the drought, Brazil had lost hydropower output equal to the energy consumed by the city of Rio de Janeiro in just five months.

CCGT enhances Brazil's supply security

Glauco Maximiano de Campos, CEO of CELSE said: "The Port of Sergipe I Complex project represents a milestone for Brazil, adding to the system a large-capacity plant that operates in a safer, more reliable, flexible, and efficient way, which brings stability to the country's electricity matrix and helps to reduce the risk of rationing and/or blackouts."

GE had been contracted to deliver, in-

stall and commission the plant under a full EPC agreement. To that end, the American OEM has provided gas power plant and grid construction, as well as associated grid interconnection systems, in addition to controls software and analytics and service agreements.

Plant powered by three HA turbines

Equipment supplied by GE includes three 7HA.02 gas turbines powering three H65 generators, a STG-D650 steam turbine powering a W90 generator, three Heat Recovery Steam Generators (HRSG) which are triple pressure reheat drum and auxiliary installations, such as cooling towers. GE also built the infrastructure needed to transport the energy produced by CELSE to the Brazilian interconnected system: 33 kilometers of overhead power lines and a 500kv substation that steps up the power into high voltages for long-distance transmission.

Repairs and scheduled mainte-

nance of the plant are covered by a 25-year O&M contract. In addition, GE Digital's Remote Operations, Asset Performance Management, Operations Optimization; and Cybersecurity Digital Solutions seek to predict and potentially reduce unplanned downtime, and improve power plant productivity. GE's software solutions provide direct support to the GE O&M team in the plant's operation.

GE has a longstanding presence with more than 100 years in Brazil, where its E equipment helps power approximately 30% of the energy produced, and about one-third of all energy generated throughout Latin America. ■



Night-time view of the 1.5 GW Port of Sergipe I Complex

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