EnergyTech
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H2 Infinity and Beyond: Future Hydrogen Promise Driving Industrial Energy Transition Deals

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H2 INFINITY AND BEYOND: FUTURE HYDROGEN PROMISE DRIVING INDUSTRIAL ENERGY TRANSITION DEALS

NA+ AI: SPECTRAL, ESSENCE COMPANY COLLABORATING ON SODIUM-ION & HYDROGEN FOR CLOUD-BASED DATA FACILITIES

The combination of sodium-ion batteries and H2 on demand is designed to enable Spectral's decentralized cloud and edge computing platforms to achieve between 2.5 and 3 MWh power capacity, which the company considers as crucial for artificial intelligence (AI)-driven workloads and quantum infrastructure.

BY ROD WALTON, ENERGYTECH MANAGING EDITOR — ORIGINALLY PUBLISHED FEBRUARY 11, 2025

Image credit: ID 349979196 © Abrarsabit4 | Dreamstime.com

Sodium-ion (NA+) battery chemistry is emerging as a potential future rival to the currently dominant lithium-ion, and two companies are partnering to try and merge NA+ energy storage, on-site hydrogen production and edge computing technologies to power data centers.

Deep quantum technology platform Spectral Capital is collaborating with Energy Tech LLC (no connection to this publication) on deploying advanced sodium-ion energy storage and hydrogen-on-demand systems. This combination is designed to enable Spectral's decentralized cloud and edge computing platforms to achieve between 2.5 and 3 MWh power capacity, which the company considers as crucial for artificial intelligence (AI)-driven workloads and quantum infrastructure.

Energy Tech LLC is a company within parent company Essence Global, which is working on commercial-scale hydrogen-on-demand (HoD) technology to generate on-site power. Spectral and EnergyTech are combining technologies to potentially deliver enough net energy to aid grid resiliency as well as on-site power.

"Energy efficiency, including battery back-up optimization and a reliable battery supply that allows on-site energy generation from multiple sources can give Spectral key advantages in lowering net energy costs for its planned data centers," said Spectral President, Jenifer Osterwalder, in a statement. "Our lean data center footprint, with 1,504 servers planned per center, . . . means we can select sites that wouldn't be suitable from a power viewpoint for large data centers."

Spectral has identified 16 global regions for deployment as part of its Vogon Cloud initiative. Among these regions are Florida, New Zealand and Indonesia, which Spectral Capital and Energy Tech have selected as locations for sodium-ion battery production and decentralized cloud infrastructure expansion.

"By leveraging our proprietary Energy Arbitrage platform. . .we can dynamically balance energy loads, exploit real-time market fluctuations, and optimize cost-efficient power distribution across our global network," said Sean Michael Brehm, chairman of Spectral Capital. "This ensures that our decentralized AI and quantum cloud operations remain both resilient and economically optimized."

Sodium, noted by the chemical symbol Na (for the Latin 'natrium') is the sixth most abundant element in the Earth's crust. Despite this, one of the roadblocks to commercializing sodium-ion (NA+) battery technology has been that the performance of the sodium-containing cathode declines with repeated discharge and charge.

Researchers at the U.S. Argonne National Laboratory announced recently they have enhanced sodium-ion batteries by preventing cracks in the cathode particles during the synthesis process. This improvement could create what the researchers hope is a cost-effective and sustainable future alternative to lithium-ion batteries for electric vehicles and the grid.

Lithium-ion currently makes up close to 90% of battery storage capacity both in the stationary and transportation electrification sectors. The technology is abundant, but it possesses shorter duration capacity and may be a supply chain challenge in the future.

Another benefit of sodium-ion, under Energy Tech LLC's technology, is higher thermal stability

and less risk of thermal runaway—or fires—for which lithium-ion is known by a few high-profile examples. The battery storage and HoD facilities will be designed to handle Spectral's AI, hybrid cloud and quantum workloads, according to the reports.

Hydrogen contains no carbon in its chain and thus does not emit CO2 when combusted in power generation applications. Although hydrogen is not mined, it can be generated by separating the H2 from either water, through electrolysis, or methane gas through steam reforming, the latter of which is more carbon intensive.

Green hydrogen is a classification of H2 generated through electrolyzers powered by carbon-free resources such as solar, wind, hydro, nuclear or battery energy.

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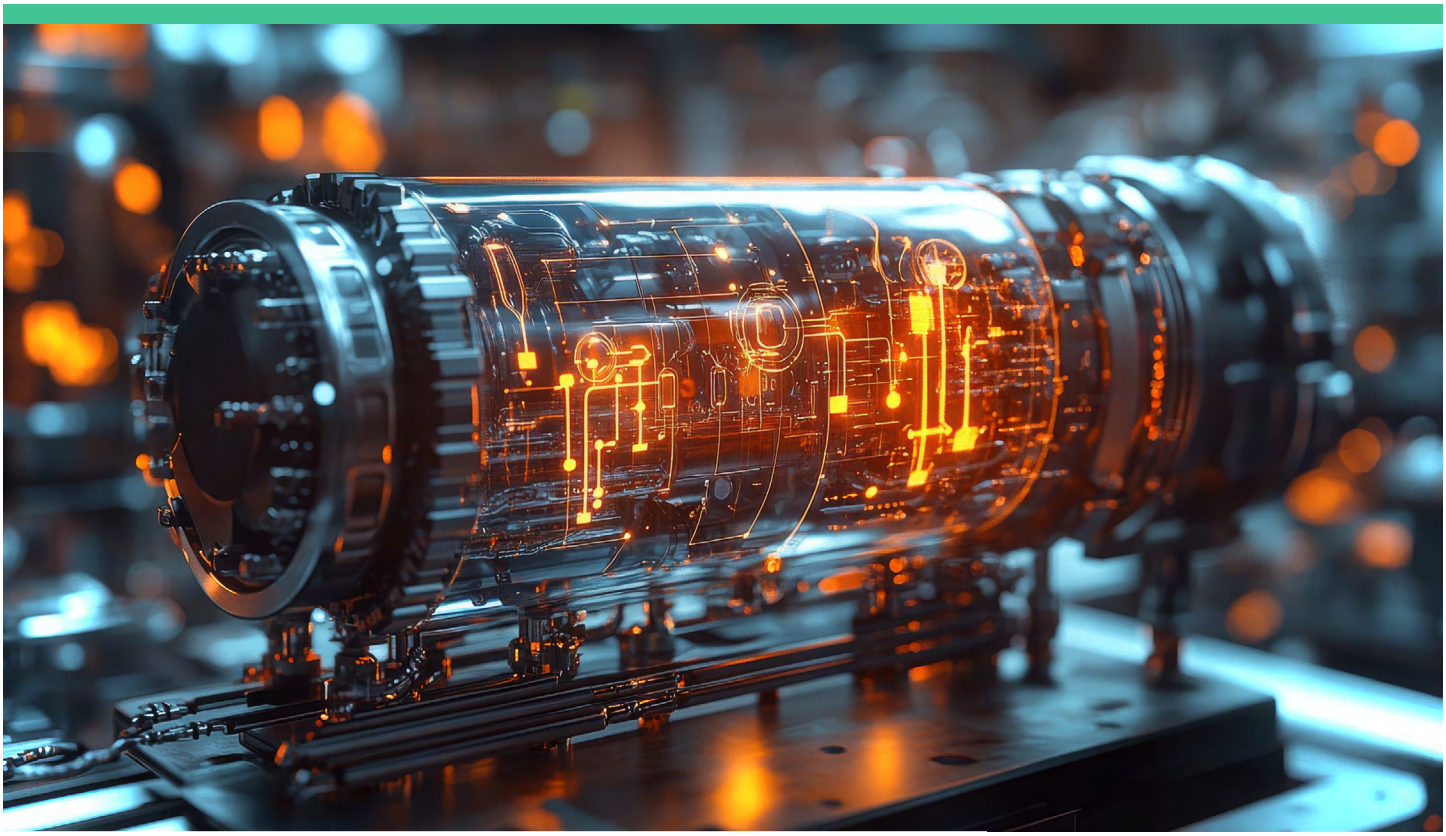
FUELCELL ENERGY, IDAHO NATIONAL LAB STUDYING HYDROGEN GENERATION FROM NUCLEAR POWER

The testing will focus on the potential of advanced small modular reactor (SMR) designs of 200 to 500 MW in tandem with FuelCell Energy's utility-scale solid oxide electrolyzers. Both nuclear reactor power generation and hydrogen are carbon-free energy resources.

BY ROD WALTON, ENERGYTECH MANAGING EDITOR — ORIGINALLY PUBLISHED FEBRUARY 10, 2025



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A U.S-based hydrogen production technology firm is working with the federal Idaho National Laboratory to study how electrolyzers can interact with nuclear power generation to create energy-dense and carbon-free energy resources.

The project with FuelCell Energy will utilize its solid oxide electrolysis cell (SOEC) system in testing at the U.S. Department of Energy's national lab in Idaho. The project will study how hydrogen production operations can help nuclear plants diversify and increase profitability by alternating to generate both electricity and hydrogen.

The testing will focus on the potential of advanced small modular reactor (SMR) designs of 200 to 500 MW in tandem with FuelCell Energy's SOEC utility-scale electrolyzers. Both nuclear reactor power generation and hydrogen are carbon-free energy resources, but hydrogen is considered green only if the electrolyzers are powered by zero-carbon resources such as wind, solar, hydro or nuclear.

Image credit: FuelCell Energy

No SMR nuclear projects have been fully developed or commercialized yet, although SMR startups are working with industrial companies and tech firms such as Microsoft, Google and Oracle on developing baseload, clean energy connections.

"Pairing FuelCell Energy's electrolyzer with nuclear plants is an excellent example of the 'all-of-the-above' energy strategy that is necessary to meet the needs of a strained electric infrastructure," company CEO Jason Few said in a statement. "Nuclear energy is a baseload power source that when paired with FuelCell Energy's electrolyzer can ensure that every kilowatt of power is converted into a usable or stored energy resource."

The FuelCell electrolyzer, which splits the hydrogen from water, will be the largest studied at the Idaho National Lab, according to the release. The electrolyzer project is designed to produce 150 kilograms of hydrogen per day and use only about 250 kilowatts of nuclear-generated electricity.

The process starts with de-ionized water mixed with reclaimed de-ionized water from the unit's chiller. That water is then sent into a steam vaporizer and boiled through a series of heat exchanges before going into SOEC's 16-stack module to convert the steam into hydrogen.

The collaboration also will simulate the benefits of 100% energy efficiency by using waste heat from the nuclear power plant. The Idaho National Lab, which is managed by the Battelle Energy Alliance, long has been a national testing ground for nuclear reactor technology.

The FuelCell Energy modular electrolyzer was shipped to the national lab site from the company's Connecticut headquarters on two flatbed trucks. The hydrogen produced from this electrolysis will also aid in other Idaho National Lab research on e-chemical synthesis, hydrogen turbine co-firing for power generation, and heavy-duty vehicle refueling.

Federal and private research is working on developing and scaling hydrogen as a carbon-free alternative to gasoline, diesel and methane natural gas both in power generation and transportation.

Hydrogen possesses a relatively high energy density of 120 megajoules per kilogram on a lower heating basis, but is less energy dense on a volumetric basis, according to DOE statistics. The U.S. Inflation Reduction Act offered 30% investment tax credit and production tax credits on clean hydrogen production.

Hydrogen otherwise can be produced from steam reforming methane gas, which is more carbon-intensive than electrolysis.

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GE VERNOVA COMPLETES VALIDATION TESTING FOR 100% HYDROGEN MIX IN NEW INDUSTRIAL GAS TURBINES

Recent research conducted at GE Vernova's Advanced Research Center in New York and at the Global Technology Center in Greenville focused on improving micromixer and axial fuel staging for hydrogen capability.

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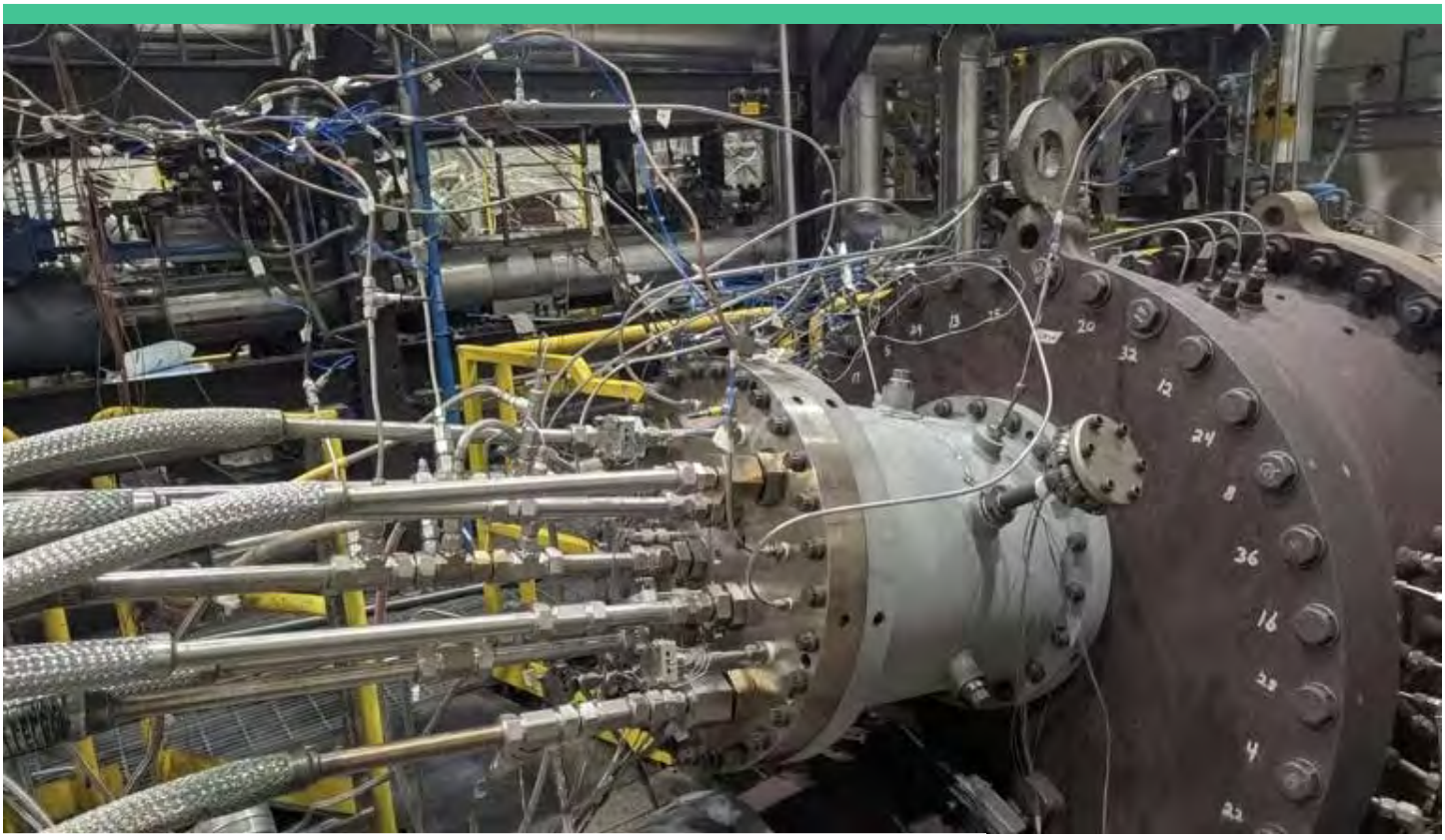

Image credit: GE Vernova

Power manufacturer GE Vernova has completed a validation test campaign of an advanced Dry Low NOx (DLN) hydrogen combustion technology for B- and E-class gas turbines at Global Technology Center in Greenville, South Carolina.

The campaign was successfully operated on natural gas and hydrogen blends and on 100% hydrogen with dry emissions below 25 parts per million (ppm) nitrogen oxide (Nox). GE Vernova plans to provide the new DLN system for new and existing B- and E- gas turbines by 2026.

While combustion dynamics or noise is a challenge with hydrogen operation, the company says the prototype performed effectively in the category with relatively low levels, when operating on pure hydrogen. The technology was found to deliver higher availability and longer maintenance intervals in comparison to current DLN combustors operating on natural gas, crucial for industrial customers depending on gas turbines to power their operations reliably.

A new micromixer-based fuel air pre-mixer is the basis to the prototype combustor capability. GE Vernova's research on micromixer technology started as part of collaboration with the U.S. Department of Energy.

Recent research conducted at GE Vernova's Advanced Research Center in New York and at the Global Technology Center in Greenville focused on improving micromixer and axial fuel staging for hydrogen capability. This research culminated with the construction of a full size 6B DLN combustor prototype and testing in full scale conditions (pressure, flow, temperature) in the combustion test facility in Greenville, SC.

GE Vernova's industrial gas turbines (B- and E-Class) are highly robust fleets, with an installed base of approximately 2,800 units. Hydrogen combustor options are available with ratings up to 100 percent hydrogen, however existing combustors use a diluent like water to manage emissions.

The new H2 DLN combustor technology is expected to present several benefits as compared to the existing systems, including a reported 4 to 7% increased efficiency in combined cycle heat rate.

Hydrogen does not contain carbon in its formula so does not emit CO2 when combusted. To be created truly green hydrogen, it must be generated from electrolyzers powered by carbon-free resources such as wind, solar, hydro or nuclear.

PLUG POWER'S $1.66B LOAN GUARANTEE COMMITTED TO BUILDING SIX GREEN HYDROGEN PRODUCTION PLANTS

Plug Power plans to build up six green hydrogen-electrolyzer plants with the LPO loan funds. Early in 2024, Plug commenced operations on its electrolytic liquid hydrogen production plant in Georgia.

BY ROD WALTON, ENERGYTECH MANAGING EDITOR — ORIGINALLY PUBLISHED JANUARY 17, 2025

Image credit: Plug Power

Hydrogen fuel cell and infrastructure provider Plug Power has now closed on a $1.66 billion federal loan guarantee that will enable it to finance construction of green hydrogen production facilities across the U.S.

The loan guarantee from the U.S. Department of Energy's Loan Programs Office, announced in the last days of the hydrogen-friendly Biden Administration, finally delivers on a LPO application made by Plug in 2020. The company generates green hydrogen, which does not emit carbon dioxide, from electrolyzers which are powered by carbon-free generation such as solar, wind, hydro or nuclear.

Plug Power plans to build up six green hydrogen-electrolyzer plants with the LPO loan funds. Early in 2024, Plug commenced operations on its electrolytic liquid hydrogen production plant that is designed to produce 15 metric tons per day in Woodbine, Georgia.

"Finalizing this loan guarantee with the Department of Energy represents a significant step in the expansion of our domestic manufacturing and hydrogen production capabilities, which create many high-quality jobs throughout the U.S.," said Plug CEO Andy Marsh in a statement. "In addition to reducing carbon emissions and enhancing the resilience of the U.S. energy grid, we believe the hydrogen economy aligns closely with national security interests, ensuring that the U.S. remains at the forefront of energy technology development and deployment on a global scale."

The first plant to be built through DOE financing is Plug's green hydrogen facility in Graham, Texas. The electrolyzers at that plant will be powered by an adjacent wind energy farm.

Plug Power currently has other hydrogen generation facilities in Charleston, Tenn., and in Louisiana. Together with the Woodbine facility, those plants can produce up to 45 metric tons of green hydrogen per day.

Other commercial green liquid hydrogen projects led by Plug Power include collaborations with TC Energy, Renault, Lhyfe, Airbus, Delta and Amazon, among others. Plug Power's project pipeline also totals about 69,000 fuel cell systems and more than 250 H2 fueling stations.

Hydrogen is an energy-dense gas which can help decarbonize power generation and transportation, according to proponents. It already is produced for industrial purposes although the U.S. Gulf Coast, but much of that output is generated through steam reforming of methane natural gas, which is carbon intensive.

The DOE goal under the Biden Administration has been to develop a nationwide system called the Regional Clean Hydrogen Hubs Program (H2Hubs). The funding aimed at that deployment comes from $8 billion through the Bipartisan Infrastructure Law passed by Congress and signed in 2021.

The Biden era DOE has committed to hydrogen as part of the decarbonization plans for the commercial and industrial sectors. The federal "Clean Hydrogen Commercial Liftoff" report acknowledges the criticality of hydrogen in manufacturing, petrochemical processes and transportation.

The Liftoff program has reportedly been on track to scale green hydrogen production nationwide from less than 1 million metric tons to at least 7 million metric tons per year by 2030, according to the report.

Many in the long-haul trucking industry contend that hydrogen fuel cells offer more power and range, as well shorter refueling times, than battery-electric powertrain technology.

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DATA CENTER ENERGY DEMAND AT SPEED OF LIGHT: BLOOM ENERGY REPORT

Load from new data center customers could reach 80 GW by 2030. This could be a big opportunity and a massive and complex problem, too. Microgrids and on-site power can help.

BY ROD WALTON, ENERGYTECH MANAGING EDITOR — ORIGINALLY PUBLISHED JANUARY 21, 2025

Image credit: ID 69060264 © Vladimir Timofeev | Dreamstime.com

It doesn't take a whole lot of artificial intelligence to understand the energy industry has a reality check on data centers ahead.

Numerous industry forecasts predict—warn, might be a better term—that data center capacity and energy demand could more than triple by the end of the decade. A new report by on-site power technology firm Bloom Energy estimates that the load from data center customers could reach 80 GW by 2030.

This could be a big opportunity for several players on the energy transition front, from distributed energy resources to small nuclear startups to microgrid developers—but it is a massive and complex problem, too, according to the Bloom Energy report citing sources such as McKinsey and Reuters. Bloom's research team talked to a variety of data center industry insiders.

"In hearing from these leaders, we were surprised by the pace of change and the growing expectation that onsite power generation will play a greater role in powering data center projects," the Bloom Energy report reads. "Leaders expect approximately 30% of all data center sites to use some onsite power by 2030, 2.3 times more than just seven months prior. We find that new data center announcements corroborate this expectation."

Some 13% of current data centers utilize some form of on-site power, according to the report. What will drive the upward trend in on-site power will be a scaling up of data center energy load not envisioned by electric utility planners only five years ago.

Tech giants such as Meta, Oracle, Amazon Web Services, Google and Microsoft certainly have sustainability in mind for the types of energy they want powering their data centers and AI training models. At the same time, on-site power must deliver on several other criteria such as time to power, cost, load flexibility and power density, the Bloom Energy report reads.

The hyperscale data center industry is already known for using on-site power generation—from both natural gas and diesel gen-sets—as backup power. In the future, the specter of potential utility-scale resource inadequacy could compel companies to consider and/or sign contracts for gas turbines, natural gas and potentially hydrogen fuel cells and, finally, small modular nuclear reactors.

None of the latter are operational or even built yet, but SMRs could offer the promise of baseload and carbon-free power. Many of the biggest data companies such as Google, Amazon Web Services and Microsoft are contracting with nuclear generation firms now with the idea of small nuclear power by the mid-2030s.

"Data center leaders are showing growing optimism about emerging technologies such as geothermal power, small modular reactors and gas generation with carbon capture and sequestration (CCS)," reads the Bloom Energy study. "We are seeing these technologies appear in long-term roadmaps as companies work toward sustainability commitments.

Operational U.S. data center capacity is currently estimated at around 25 GW. Some 20 GW of new projects have already been announced, but industry researchers forecast another 35 GW likely will be announced within the next few years.

Electric utility reports back up the pace of this growth. In one of its quarterly earnings

calls last year, Midwest utility holding company AEP reported some 15 GW of data center load commitment within its service territory alone.

Bloom Energy manufactures solid oxide fuel cells (SOFC) for customers in the utility, commercial and industrial sectors. Among its recently announced contracts is an order from AEP this year for 100 MW in SOFCs this year, with the potential for up to 1 GW in fuel cells to meet future data center energy demand.

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SINGAPORE ENERGY AUTHORITIES GIVE PACIFICLIGHT POWER GO-AHEAD ON HYDROGEN-READY 600-MW GAS TURBINE PLANT

Singapore is trying to keep pace with its plan to phase out coal-fired power completely by 2050. Coal-fired power is only 1.2% of Singapore's current electricity generation resource mix.

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Image credit: ID 70830058 © Lefteris Papaulakis | Dreamstime.com

H2 INFINITY AND BEYOND: FUTURE HYDROGEN PROMISE DRIVING INDUSTRIAL ENERGY TRANSITION DEALS

Singapore electricity utility PacificLight Power (PLP) has been awarded the right to build, own, and operate a hydrogen-ready combined cycle gas turbine (CCGT) facility on Jurong Island.

Approved by the nation's Energy Market Authority (EMA), the facility is scheduled to begin operations in January 2029. It will have capacity of at least 600 MW and will help strengthen Singapore's energy security, enhance grid stability as well as advance the nation's transition towards a low-carbon future.

Singapore is trying to keep pace with its plan to phase out coal-fired power completely by 2050. Coal-fired power is only 1.2% of Singapore's current electricity generation resource mix.

The CCGT plant, to be built on a greenfield site, will include a battery energy storage system, highlighting PLP's commitment to adopt solutions enhancing system stability while reducing operational costs and environmental impact.

"We are honored that EMA has selected PacificLight to deliver two critical projects: the 100-MW Fast Start Project in April 2024 and now the right to develop a new power plant," Yu Tat Ming, CEO of PacificLight Power, said in a statement. "By integrating hydrogen-ready and battery storage technologies, the new facility will position PacificLight to transition to a low-carbon future. We are committed to delivering the new plant safely and on schedule."

The plant will be capable of using at least 30% hydrogen at inception and will have the ability to burn 100% hydrogen in the future. The greenfield site on Jurong Island is enough to accommodate a second CCGT unit and has the potential for future integration of CCUS technology.

The new plant is followed by PLP's existing 830-MW CCGT facility and 100 MW of Fast Start capacity, under construction and expected to commence operations in the second quarter of 2025.

Hydrogen does not contain carbon in its molecular chain but must be generated either by steam refoming of methane natural gas, which is carbon intensive, or by electrolyzers which split the H2 from water.