ETN looks into ammonia and hydrogen co-firing of CCGTs

Partners of the European Turbine Network (ETN) are looking to flexibilize combined-cycle power units by partly running them on green hydrogen or ammonia. Energias de Portugal (EDP) will demonstrate the concept of hydrogen co-firing at its 1.2 GW Ribatjo power plant near Lisbon.

To develop such Power-to-X-Power solutions, ETN and its cooperation partners have embarked on the FLEXnCONFU project, short for FLEXibilize combined cycle power plant through Power-to-X solutions using non-CONventional Fuels. The project has a total budget of 12.6 million Euros and runs from April 2020 to the end of March 2024.

Co-firing reduces Opex

Hydrogen and ammonia, produced at low cost from excess supply of wind and solar power, can be stored and used as a cheap fuel by retrofitted combined-cycle gas power stations. Co-firing capability reduces the plant’s operating cost which can help increase their current low operating-hours.

To level the combined-cycle load, excess thermal electricity can also be converted into hydrogen or ammonia for re-use in the same power plant, if and when needed to respond to varying demand.

The new FLEXnCONFU layout is improving the fuel flexibility of gas-fired power plants and their overall efficiency. It can be retrofitted to combined heat and power units, flexible combined-cycle units or integrated coal gasification unit.

Trials at Ribatejo CCGT start in March 2023

To demonstrate the economically viable solutions, EDP will install a Power-to-Hydrogen system in a real operating environment at its Gas Power Technology

2nd QUARTER 2020

Gas turbine market forecast to top $10 billion by 2026

Rising need for renewables grid-integration will propel up the market value of gas turbines beyond $10 million by 2026. According to Global Market Insights, turbine technology with 70 MW to 200 MW capacity will be particularly in high demand and see annual installments exceed 10 GW over the next five years.

Deployment of these medium-sized turbines is spurred by the need to repower existing infrastructure, or set up new integrated gasification combined cycle (IGCC) and combined cycle power with over 60% efficiency.

As combustion systems adopt a multi-fuel approach, combining natural gas, propane and distillate oil. Analysts expect these technical variations across combustion systems will enhance the product applicability and further increase demand.

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Ribatejo combined-cycle gas power plant (3 x 392 MW), situated some 30 kilometers northeast of Lisbon. The three units, powered by Siemens V94.3A gas turbines in single shaft configuration, have a combined capacity of 1.176 MW.

Installation and commissioning of the developed technologies at Ribatejo plant will start in September 2021. Siemens, the subcontractor for the project, will handle the retrofit of the combustion chamber as other components. The actual trial runs to demonstrate the hydrogen co-firing are scheduled to start in March 2023.

**Micro-turbine trials with ammonia**

At the same time, a Power-to-Ammonia system will be installed at a micro gas turbine operating in a smart grid context at the Savona lab. In addition, tests with up to 100% ammonia co-firing at a heavy-duty gas turbine will be performed at Cardiff University’s combustion lab.

The consortium behind the FLEXnCONFU project is led by RINA Consulting. Partners include EDP, Backer Hughes, Cummins affiliate Hydrogenics, Proton Ventures, Tirreno Power, ENGI Laborelec, ICI Caldaie, MAS Advanced Technologies for Power and Energy as well as several European research institutions.

“Hybrid power units need other profitability metrics than LCOE”

Lowest levelized cost of energy (LCOE), a widely-used metric to compare the profitability of power sources, is “not the right approach” when it comes to hybrid units, according to the U.S. National Renewable Energy Laboratory (NREL). “A paradigm shift is underway,” NREL said, stressing hybrid plants that include energy storage need to be rewarded for providing flexibility and grid ancillary services.

In its latest paper, entitled “Research Opportunities in the Physical Design Optimization of Hybrid Power Plants,” NREL looks at the opportunities utilities can have when moving beyond the traditional LCOE focus for hybrid renewable energy systems.

Hybrid plants combine multiple generation assets, e.g. energy storage technologies, wind, solar power and gas-fired generator sets. When producing electricity, they can shift between the various power generation technologies, which provide more predictable and controllable power output to help enhance grid system reliability.

**Capitalizing on various fuel options**

“By combining generation assets - notably storage, solar, and wind - into ‘hybrid power plants, an individual plant owner can develop economies of scope in terms of land usage, infrastructure costs, and operational expenditures. This increases the assets’ system value by capitalizing on revenue streams through forward capacity markets (where present), ‘dispatchable’ operation in markets with time-varying energy pricing, and ancillary service markets,” NREL researchers, led by Katherine Dykes, wrote in the paper.

To date, feasibility studies for most power plant projects are being designed with Power Purchase Agreement (PPA)-type structure in mind, focused on LCOE optimization. However, NREL researchers pointed out that such an approach is “sub-optimal” for hybrid power system.

“The complexity and uncertainty involved in the physical design optimization of hybrid power plants goes beyond current practice,” the report concludes, “... and creates opportunity for research and innovation to realize the full potential of future hybrid power plants with low cost and high value to the electric grid system.”

Growing environmental awareness and a subsequent trend to sustainable energy also spurs demand for hybrid power solutions, combining flexible gas turbines, renewables and energy storage.

**Upstream sector drives demand**

Rising upstream spending, notably in un-conventional oil and gas resources, are expected to drive the related gas turbine market to an estimated $1.2 billion, growing at 3.5% annually through 2024. Major suppliers in this sector are GE, Siemens, Mitsubishi Heavy Industries, Solar Turbines, and Kawasaki Heavy Industries.

Gas turbines for mechanical drive is will witness highest growth from use in the offshore platforms and for remote exploration. By turbine size, the ‘1-20 MW’ turbine will remain most widely used but the turbine size ‘20 MW and above’ will see the highest growth, as the industry prefers high efficiency over a small turbine footprint.
Battery-making capacity set to double by 2021, topping 278 GWh

Global battery manufacturing capacity is seen surge as energy storage is increasingly installed in conjunction with fast-start gas engine gensets and renewables. By 2021, battery making is forecast to more than double to 278 Gigawatt-hours (GWh), up from 103 GWh at present.

At least 10 new plans for building gigafactories were revealed over the past six months. Tesla’s Elon Musk, the most aggressive green energy investor, announced plans for “probably four” new gigafactories: one near the German capital Berlin, a second is already in the works in Shanghai, China, and some others ones are in planning in Sweden, Hungary and Poland.

Some smaller-scale investors have teamed up on the East Coast. a consortium including Boston Energy and Innovation (BEI), Charge CCCV, C&D Assembly, Primet Precision Materials and Magnis Resources confirmed it will build a 15 GWh a year plant on IBM’s former Huron Campus manufacturing site in New York.

In Thailand, Energy Absolute aims to invest $2.9 million in a battery manufacturing site with a production capacity of 1 GWh per year, and potential to be expanded to 50 GWh by 2020.

Germany’s carmaker Daimler has dedicated $500 to its subsidiary Accumotive to expand its lithium-ion battery production from currently 80,000 units up to around 320,000.

In Australia, Energy Renaissance is advancing plans for a battery factory in Darwin, with production capacity of 1 GWh of batteries a year.

Growing investment appetite amid falling costs

Cost for battery production is falling rapidly as manufacturers bring large gigafactories on-line, although the price for raw material is going up. Lithium now makes up more than 10 percent of the cost of making a battery cell, and pricing for lithium has doubled from $5,000 per ton to $10,000 per ton.

By 2030, Bloomberg New Energy Finance anticipates battery pack prices to drop to $73 per kilowatt-hour, down from a volume-weighted average of $273/kWh in 2016.

“This is an average, though,” said Logan Goldie-Scot, head of BNEF’s storage practice. “We’re already seeing pack prices below $200 per kilowatt-hour.”

“Institutional investors are waking up and ready to invest in storage,” commented Randolph Mann, President of esVolta.

The California-based energy storage project developer recently secured a $140 million loan from CIT, Siemens Financial Services, CoBank, ACB and Key Banc to fund construction and operations of the “esFaraday” portfolio. These eight energy storage units, with 480 MWh combined capacity, will deliver reliable back-up power and ancillary services to the Californian grid, backed up by long-term contracts with electric utilities and load serving entities.

Raw materials for batteries could face supply crunch by 2025

Electrification of transport has propelled up demand for batteries, increasing the risk that battery metals – cobalt, lithium, and nickel – will face a supply crunch by the mid-2020s. If automotive manufacturers realize their pledge to “go completely electric” by 2050, demand for battery metals would skyrocket – as would the electricity-use of these vehicles.

Total passenger electric vehicle (EV) car sales, including hybrid electric vehicles (HEV), were up by over 24% last year, with hybrid vehicles making up over 60% of EV sales. Wood Mackenzie expects global electric car sales (with a plug) to account for 7% of all passenger car sales by 2025, nearly 14% by 2030 and 38% by 2040.

“Battery pack sizes continue to trend larger through the medium term, resulting in overall greater battery demand. We have seen the first announcements of the commercialisation of NMC 811 cells in EVs. Unsurprisingly, China was the first mover here, but the likes of SK Innovation are intent on the mass production of 811 cells before the end of 2019,” said Gavin Montgomery, Wood Mackenzie Research Director.

“If adoption gains speed, there will be a rising nickel demand at the expense of cobalt, and to a lesser extent, lithium,” he forecast.

Weak prices defer mining

Spot prices for lithium carbonate have fallen by just under US$7,000/t since June 2018, and analysts see some weakness in realized prices for lithium which is expected to persist through the second quarter of 2019. But things are bound to improve, in Mr. Montgomery view: “Lithium’s use in every lithium-ion battery type means it will have double-digit annual growth, making up over 80% of total lithium demand by 2030.”

Like lithium, cobalt prices have softened over H1 2019, with analysts warning the low prices may defer some mine projects. Moreover, swing supply coming from China is likely to keep a lid on any major price upside. “Although cobalt continues to look challenging in the long-term, the increased adoption of high-nickel batteries in EVs means the emerging deficits look slightly more achievable than previously expected,” he said.

Nickel, another battery metal, is mostly being produced in Indonesia. Although the battery sector share of nickel demand is much smaller than other metals, getting the quantity of nickel that EVs will need by the mid-2020s will be a challenge. According to Wood Mackenzie, “a low nickel price has hindered any project development and with lead times often up to 10 years,” analysts stress that “investment needs to happen now.”
For the product launch, PowerPHASE has been focusing on applications on GE’s 7FA turbines, the company said in a technical presentation seen by Gas to Power Journal.

**Storing compressed air**

The Storage Engine, a flexible version of its compressed-air energy storage (CAES) plant, is based on a repowered gas turbine. It combines the company’s compressed-air technology with its FastLight energy storage solution, which is designed to convert 10% of the output of any gas turbine into energy storage.

The technology is based on a repowered gas turbine whereby the compression process has been amended and replaces with fuel-driven compressors. The system captures excess electricity and stores it in the form of compressed air in dedicated cylinders, for later use. When discharged, the stored energy can generate between 90 MW and 400 MW for a limited number of hours.

**Functionality of peaking plant**

“The unique feature of the Storage Engine is that is functions as a peaking gas turbine by displacing a series of electrical and fuel-driven Turbophase compressors when the stored compressed air has run out,” Kraft explains. The novel way of energy storage enables to quickly supply megawatts of power to the grid.

Turbophase is essentially a modular air injection system, using a four- or five-stage intercooled centrifugal air compressor to make air-flows more efficient than in a traditional gas turbine and increases output by 10-20%. The system enhances the mass airflow by injecting air into the compressor discharge, which reduces the power needs per pound or air, compared to traditional axial air compressors.

Considering the small footprint of Turbophase unit, the add-on energy storage unit can be configured in a modular way to suit the various needs of utility customers. Florida-based PowerPHASE has over 100 patent and is striving to use its air-compression technologies to help solve the intermittency challenge of renewable power supply through energy storage. CEO Bob Kraft claims the company’s new Storage Engine comes at less than a tenth of the cost of battery-based energy storage.

**Demand Power raises over $70m funding to deploy batteries & UPS**

Canada-based Demand Power, a behind-the-meter energy storage company, has secured $71 million (€63.9m) in equity and project finance from a group of investors, led by Star America. The funds will be used to deploy industrial-grade batteries and uninterruptible power supply (UPS) on customer sites, with the first project due onstream by the end of 2020.

The novel approach of combining large lithium ion-batteries and an UPS system ensures stable onsite electricity supply for manufacturers and data centers, while reducing energy costs. The systems will first be rolled out at customer sites in Ontario and may later spread throughout North America.

Star America, the lead investor, manages capital from U.S. pensions, insurance firms, asset managers and construction firms. As a developer and manager of greenfield infrastructure assets, Star America said it had been “impressed by Demand Power’s management and their commitment to delivering innovative energy solutions.”

Christophe Petit, President of Star America said the deployment of Demand Power’s energy storage solutions will “lower energy costs, improve grid resiliency, and reduce energy consumption from the highest emission sources during peak use periods.”

**Software to supplement storage**

Several rival developers are rushing to develop and launch new solutions for software and storage for real time behind-the-meter energy management. Demand Energy, not to be confused with Demand Power, had a similar business plan and offering before being bought by Enel in 2017.

Greensmith, another software and energy storage integrator, was acquired by Wärtsilä in the same year. The behind-the-meter energy storage startup Stem is reportedly up for sale, attracting significant buyers’ interest.
Siemens and Uniper promote use of ‘green hydrogen’

Germany’s largest utility Uniper and Siemens have agreed to jointly produce green hydrogen, derived from renewable energy, for use in Uniper’s existing gas turbines and gas storage units. The share of hydrogen co-firing is meant to be gradually increased in both gas- and converted coal-fired power plants.

The focus of the work is to define what role hydrogen can play in the future evolution of Uniper’s coal power plants, Siemens stated. Coal-to-gas conversion and subsequent hydrogen co-firing would help substantially reduce emissions at ageing lignite and hard coal-fired plant, allowing extending the life time of these assets.

Net-zero emission by 2035

Complying with the German government’s coal exit plan, Uniper agreed to close or convert its coal-fired power plants in Germany and ultimately all of Europe by 2025 at the latest. Uniper’s coal-exit plan is instrumental for the utility to reach its goal of reducing CO2 emissions in the European generation segment from 22 million tons today to net-zero emissions by 2035.

Today, Uniper already produces around 24 Terrawatt-hours (TWh) of carbon-free electricity with its hydroelectric and nuclear power plants in Germany and Sweden. Under its new strategy it intends to gradually increase the share of ‘green hydrogen’ in its conventional gas business, in both power generation and energy trading.

Coal-to-hydrogen conversions

“Brownfield transformation” projects, as carried out by Siemens, help decarbonize coal-fired power plants and curb emissions from gas-fired plants, often by adding energy storage solution on site and allowing for hydrogen co-firing.

By building infrastructures for Power-to-X, Siemens is contributing to cross-sector decarbonization. The German manufacturer offers all core technologies for a long-term CO2-free energy supply – from power and heat generation by renewable energies or gas-fired power plants, to power transmission and distribution, to efficient electrolysis for hydrogen production.

Power-to-gas technology makes ‘green hydrogen’ possible has been pioneered by Uniper in its Falkenhagen plant, built in 2013, followed by another one in Hamburg in 2015. Uniper added a methanisation plant to the Falkenhagen plant in 2018 and is now forward cross-sector industrial projects together with refineries and the automotive industry.

“After the coal phase-out and the switch to a secure gas-based energy supply, the use of climate-friendly gas will be a major step towards successful energy system transformation. We are ready to invest, accelerate the decarbonization of our portfolio (…), and act openly in terms of technology by working with partners like Siemens,” said Uniper CEO Andreas Schierenbeck.

“We are only at the beginning,” Siemens board member Jochen Eickholt cautioned. Brownfield transformation and the design of the green hydrogen value chain can show that a CO2-free energy supply is possible and makes sense under real conditions and using existing plants. “Our future lies in hydrogen. This is what we are committed to as a company,” Eickholt underlined.

Marubeni looks into ammonia co-firing at thermal plants

Japanese manufacturers Marubeni and IHI Corp are conducting a feasibility study on ammonia co-firing in thermal power plants run by JERA, Japan’s leading LNG importer and power producer. Ammonia stores hydrogen at low cost and can be directly used as a fuel to generate electricity.

As ammonia does not emit carbon dioxide at the time of combustion, the co-firing of this fuel can greatly reduce emissions at thermal power plants.

The Marubeni-led technical study - running through to the end for February 2021 - prepares a trial for direct usage of ammonia as a fuel in JERA’s thermal power plant. Researchers are also scrutinizing the economics of equipment cost, operational expenses as well as the cost for producing and transporting ammonia to the power stations.

The trial runs of ammonia co-firing are in line with Japanese government’s efforts to implement hydrogen-based energy projects. Dubbed NEDO, the research project seeks to develop multi-burner ammonia co-firing technology for pulverized coal boilers, which can later be amended for use in gas-fired power units.

JERA is looking to find out the necessary capital investment to retrofit its existing plants with the novel ammonia co-firing technology, once it is ready for commercialization. To this end, it is allowing researchers to carry out tests and trial runs at some of its thermal power plants.

Australia-based Woodside Energy is also participating in the study, striving to identify challenges related to realizing large-scale ammonia production lines.
DOE grants $28m to develop ultrahigh temperature turbine materials

The U.S. Department of Energy has freed up $28 million in funding for research on ultrahigh temperature materials that can operate in high stress environments of a gas-turbine blade. Novel alloys and coatings are meant to further enhance turbine efficiency.

Turbin blades are currently made of single crystal nickel (Ni)- or cobalt (Co)-based superalloys. After many years of refinements, their development has plateaued. Researchers are hence trying to leverage and integrate recent advances in alloy design and modeling, refractory alloys, advanced manufacturing technologies, and high-throughput testing to realize significant improvements in the operational capability of gas turbines.

**Turning up the heat**

The temperature capability of current state-of-the-art blade materials has improved steadily over the past few decades to 1100ºC, through incremental microstructure and chemistry refinement.

The ULTIMATE program targets enabling gas-turbines blades to operate continuously at 1300ºC in a material test environment—or with coatings, with turbine inlet temperatures of 1800ºC or higher. ULTIMATE stands for Ultrahigh Temperature Impervious Materials Advancing Turbine Efficiency, and is part of the ARPA-E program series.

The use of novel materials can boost temperature and potentially increase gas turbine efficiency up to 7%, improving power plant economics. By 2050, such a 7% efficiency improvement in gas turbines used for U.S. electricity generation could save up to 15-16 quads of energy, researchers expect.

The actual research will be conducted in two phase, covering proposed for a maximum of 18 and 24 months. In phase I, project teams will demonstrate proof of concept of their alloy compositions, coatings, and manufacturing processes through modeling and laboratory scale tensile coupon (sample) testing of basic properties. In phase II, approved project teams will investigate selected alloy compositions and coatings to evaluate a comprehensive suite of physical, chemical, and mechanical properties as well as produce generic small-scale turbine blades to demonstrate manufacturability.
MHPS combines solid oxide fuel cell and micro gas turbine

Mitsubishi Hitachi Power System (MHPS) has been striving to combine is solid oxide fuel cell, called MEGAMIE, with a micro gas turbine to stabilize and increase power output. "The toughest challenge," researcher Yoshinori Kobayashi recalled, "was to figure out how to build a robust power unit with ceramics which are essential for such fuel cells to function."

Each MEGAMIE unit uses a cell stack—a cylindrical substrate tube designed to trigger reactions for power generation. Cell stacks are made entirely of ceramics and take about a year of development.

The pressurizing system MHPS uses in MEGAMIE combines the delicate ceramics with a gas turbine that must withstand extreme temperature and pressure conditions. These different components had conflicting properties but they had to be integrated into a single complex system. "Many industry-leading players and research institutes have tried to commercialize similar fuel cells," Kobayashi noted, "but combining these technologies proved to be too difficult."

**Two-stage power gen process**

Power generation takes place in two stages within the MEGAMIE system: within the solid oxide fuel cell (SOFC) itself and within the micro gas turbine. Heat is removed from the high-temperature turbine exhaust gases to produce steam or hot water.

Versatile in fuel use, MEGAMIE can run on multiple types of fuel gases—from city gas and LPG in local infrastructure to methane gas from sludge, food waste and agricultural waste. The system can also leverage pressurized gas, as in conventional power systems which use gas turbines.

"Pressurized gas produces more power," Kobayashi explained. "When you look at the shape of the cell, you notice it needs to be sealed only at two locations at both ends of the cylinder. That is sufficient to shield the fuel flowing inside the cell from the air outside. With fewer sealing locations, the cell could be more readily combined with gas turbines."

**Cost barriers and quality challenges**

Cost is one of the barriers to greater market penetration. The first commercial 250 kW class MEGAMIE started operation in 2019 at the large Marunouchi Building, but going forward, "MEGAMIE must be offered at a much more reasonable price to increase adoption across the globe," MHPS noted. To that end, preparatory for mass production of the cell stack have been underway with NGK Spark Plug, a top ceramic manufacturer.

Increasing production yield and ensuring quality control throughout the supply chain were other big challenges. The "balance of plant" (BOP) was of particular concern, and for MEGAMIE, this term applies to micro gas turbines, heat exchangers, piping, valves, and electrical components.

Kobayashi needed to ascertain that the suppliers of BOP components would be willing to provide the parts in good condition even as the fuel cell had yet to go to market. "To ensure the quality of all raw materials, you have to deploy your people to the manufacturers' factories," he said. "Project members also kept talking to the partners. They negotiated costing of the BOP components and made improvements to boost the performance of the SOFC."

Another issue is how to ensure safe and efficient operations. Polymer electrolyte fuel cells used for automobiles work within a relatively low-temperature range of 60-100°C; thus, start/stop functions would not pose major difficulties. However, SOFCs work in temperatures as high as 900°C, and take much longer to start or stop.

NKT builds ceramic fuel cell stacks for MHPS

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 (laminate 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.

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Nokia digitalizes Poland’s power grid to help connect smart meters

Nokia is deploying the world’s first 450 MHz private wireless LTE network for the Polish power grid operator PGE Systems to enable wireless connectivity for up to 14 million smart meters and 35,000 SCADA connections. The 450 MHz band is being adopted across Europe.

The Poland-wide rollout follows the successful trial of a 450 MHz proof of concept (PoC) network in operation since April 2019. The smart grid supports PGE’s wide-area operations of energy distribution system operators (DSOs) across Poland.

The 450 MHz band has excellent propagation properties, generous power levels, according to Nokia. It is the band of choice for the support of machine-to-machine communications in the energy sector, including smart meters and wireless SCADA connections e.g., with wind turbines. In the future, the network may also manage distributed energy sources, such as decentralized gas generator sets and energy storage.

Poland is keen to digitalize its energy grid in order to integrate more renewables and distributed energy sources, which require ubiquitous, reliable and safe communications, explained Andrzej Piotrowski, Vice-President of PGE Systems.

“The Nokia PoC has demonstrated that it will meet our needs in terms of coverage, service quality, resilience and long-term availability,” he said. Moreover, private wireless networks in the 450 MHz range are applicable for various industries, including energy and telecommunication.

Nokia has over 6,000 employees in country working in our R&D centers, developing 4.9G and 5G technologies. Hence, the Finish manufacturer is well place to support for the digitalization of the Polish electrical grid.

Off-grid power gensets get $2 billion investment boost

Regulated kilowatt-hours were historically a low risk and low return business but the global boom in low-cost renewables have turn things around. An estimated 420 million people now use standalone off-grid solar and another 47 million people rely on mini-grids, supplied by decentralized gas gensets and renewables, for access to electricity.

Public-private partnerships have sprung up, such as Konexa in Nigeria or TP Renewable Microgrid in India, and smart subsidy programs such as SMART RBF for mini-grids have evolved as follow-ons to integrated energy access planning.

Combining solar, gas and storage to cut costs

Distributed hybrid plants – mainly solar PV, increasingly combined flexible gas gensets or battery storage – now have highly convincing economics compared with diesel-fuelled plants. Nearly 3.5 GW of renewable of hybrid power units are is operational or under development for powering mining applications, nearly half of which will power mines already off the grid or those looking to improve on unreliable grid power.

“The market for off-grid renewables holds a lot more promise beyond lighting unit households or reducing costs and fuel variability for remote, diesel-dependent industries,” said senior research analyst Benjamin Attia, suggesting the technology shifts the utility business mode towards customer-centricity.

Decentralised power solutions, based on hybrid units are well positioned to discharge hundreds of GWs of diesel generation, particularly where off-grid units and incomes are large enough to support modular system upgrades. “The last decade saw the birth of a trillion-dollar market opportunity,” he said, “but the 2020s will reveal the true pace of change.”

Integrating off-grid gensets with centralized plants

Though future grid will be increasingly renewable, low-cost, digitally-managed and eventually demand-following, low energy access countries’ urgent need for large utility-scale generation and grid infrastructure upgrades cannot be overstated. “Therefore, the most game-changing growth factor for the off-grid renewables sector will be centralised and integrated electrification planning,” Attia pointed out.

New tools, based on machine learning, are being developed to estimate least-cost electrification scenarios, map existing grid infrastructure, gauge future electricity demand as well as customers’ willingness to pay for upgrades.

Smart grid market in ASEAN to reach nearly $3bn by 2024

Roll-out of smart grids to help integrate decentralized power sources and energy storage is accelerating across the Association of Southeast Asian Nations (ASEAN). ResearchAndMarkets anticipates the market will grow at a rate of 18.76% to reach $2,950 million by 2024.

Rising share of renewables energy can lead to congestion and complexity within the grid. Smart grids, along with fast-ramp gas gensets and energy storage, alleviate these issues and facilitate easier grid balancing.

However, the speed and scope of smart grid rollouts vary significantly across the different ASEAN countries. Singapore and Malaysia are frontrunners, owing to constant product innovation, expansion of automated technologies in small-scale holdings and favorable government support for renewable energy and related technologies.
GE energizes largest STATCOM scheme in Europe for National Grid

GE’s Grid Solution business has energized a dynamic reactive compensator, installed for UK’s National. The utility-grade static synchronous compensator (STATCOM) delivers up to 975 Mvar, adding inertia to stabilize the grid which helps facilitate operations of the 1 GW Nemo Link interconnector to Belgium.

The Hybrid STATCOM technology has been deployed over three separate substations – Bolney, Ninfield and Richborough – along the transmission network in southeast England. With less than 90 millisecond response time, three units delivers dynamic reactive power range from -300 Mvar inductive (absorbing vars) to +675 Mvar capacitive (injecting vars) with availability of 95%, as per customer requirement.

Stabilizing Nemo Link
The DRC compensators support help National Grid enhance regional voltage stability for the UK-Belgium HVDC interconnection, also known as Nemo Link. The Interconnector commenced operation at the end of January 2019 and is capable of delivering more than 1 GW of bi-directional power between the two countries.

The UK has been using Nemo Link to import cheap electricity from the Continent. Over 5,889 Gigawatt-hours (GWh) of electricity were imported to the UK in the first year of operations and nearly 176 GWh to Belgium through a “near real-time” power trading system.

Near ‘real time’ power trading
Electricity traders can choose from a variety of products to move electricity back and forth between the two countries across the English Channel. Capacity can be bought closer to real time through hourly nomination gates. This “closer to real time service” enables traders to respond quickly to sudden changes in supply and demand, thereby reducing the potential for spikes in power prices.

“By enabling the market to react immediately to rapid changes in supply and demand, Nemo helps to better balance an energy system that is more reliant on intermittent wind and solar energy,” explained Jon Butterworth, President of National Grid Ventures. “In the coming years, interconnectors like Nemo will play an increasingly important role,” he forecast with reference to the TSO’s aim to “share renewable energy resources across borders” to reach net-zero carbon emissions by 2050.

For National Grid, Nemo Link is the third interconnector to Europe next to the IFA link to France and BritNed to the Netherlands. Three further projects are under construction to France, notably IFA2 due operational 2020, the North Sea Link to Norway due operational 2021, and the Viking Link to Denmark due onstream in 2023.

By 2030, some 90% of electricity imported via National Grid’s interconnectors is meant to originate be from zero carbon sources.

Off-grid power gensets get $2 billion investment boost

Investment in energy access accelerates with nearly $2.1 billion corporate monies spent on off-grid power generation capacity between 2010 and 2019. However, this Capex might still not be enough to reach universal electricity access globally by 2030.

Regulated kilowatt-hours were historically a low risk and low return business but the global boom in low-cost renewables have turn things around. An estimated 420 million people now use standalone off-grid solar and another 47 million people rely on mini-grids, supplied by decentralized gas gensets and renewables, for access to electricity.

Public-private partnerships have sprung up, such as Konexa in Nigeria or TP Renewable Microgrid in India, and smart subsidy programs such as SMART RBF for mini-grids have evolved as follow-ons to integrated energy access planning.

Combining solar, gas and storage to cut costs
Distributed hybrid plants – mainly solar PV, increasingly combined flexible gas gensets or battery storage – now have highly convincing economics compared with diesel-fuelled plants. Nearly 3.5 GW of renewable of hybrid power units are in operational or under development for powering mining applications, nearly half of which will power mines already off the grid or those looking to improve on unreliable grid power.

“The market for off-grid renewables holds a lot more promise beyond lighting unlit households or reducing costs and fuel variability for remote, diesel-dependent industries,” said senior research analyst Benjamin Attia, suggesting the technology shifts the utility business model towards customer-centricity.

Decentralised power solutions, based on hybrid units are well positioned to displace hundreds of GWs of diesel generation, particularly where off-grid units and incomes are large enough to support modular system upgrades.”The last decade saw the birth of a trillion-dollar market opportunity,” he said, “but the 2020s will reveal the true pace of change.”
New York power plant uses excess energy to mine Bitcoin

Greenidge Generation, a gas-fired power plant operated by Atlas Holding in upstate New York, is using ‘behind-the-meter’ electricity to mine the crypto-currency bitcoin. With 7,000 mining rigs, using 14 MW of on-site power, the plant can generate up to 5.5 bitcoins per day worth about $45,000.

The Greenidge plant currently runs at 30 MW during low-demand hours and 106 MW at peak, so there is plenty of untapped capacity around the clock. Bitcoin mining is seen as a win-win situation. It allows the peaking power plant turn a profit at times of low electricity demand and helps create more tax revenue for the town of Dresden, NY.

**Betting on both bitcoin and energy markets**

Kevin Zhang, director of Greenidge’s blockchain strategies, said in a statement the initiative would provide potential investors with “unique exposure to both the crypto-currency and energy markets.” Adding the bitcoin mining rigs is part of a $65 million upgrade of the power plant, including its fuel conversion from coal to natural gas.

The global bitcoin network operates around the clock and Dale Irwin, CEO of Greenidge, stressed the plant is used to such commitments. “As a power plant operator, running assets reliably 24/7, on 365 days per year is in our DNA,” he said. “By partnering with crypto-currency experts, we’ve created a truly ‘one of a kind’ project and we’re excited to continue to grow.”

Though mining works for gas-fired plants, the operator cautioned that it might not make sense for renewable energy sources where it’s best to store excess electricity for later. Should the Greenidge plant face more electricity offtake, the bitcoin mining would quickly lose attractiveness.

Technicalities around Bitcoin mining mean it gets more and more difficult to generate the crypto-currency over times. So the windfalls, Atlas enjoys today might be much more difficult to reap in the years ahead.

**IEA warns of Bicoins’ massive energy use**

Concern is mounting after media reports claimed that bitcoin is on track to consume as much electricity as the United States in 2019 and all of the world’s energy by 2020. In contrast, academic estimates put bitcoin’s electricity consumption at just between 0.1% and 0.3% of global electricity use.

Blockchain removes the need for banks as a central authority to verify and log transactions and replaces this with a computers network, running some particular blockchain software. The lack of a centralised, trusted authority means that blockchain needs a “consensus mechanism” to ensure trust across the network. In the case of bitcoin, consensus is achieved by a method called “Proof-of-Work” (PoW), where computers on the network – “miners” – compete with each other to solve a complex math puzzle.

This process of Bitcoin mining is highly energy-intensive. Looking ahead, IEA analysts point out that bitcoin mining is a “highly mobile industry” which can migrate quickly to areas with cheap electricity. Hereby, localized hotspots could prompt electricity shortages and spikes in power prices which may prompt a strong backlash from regulators and the wider public.

**Cutting the cost energy management through blockchain**

Blockchain, a digital ledger that creates and stores records that are linked together in a chain, offers the energy industry an opportunity reduce operational risk and transactional cost in trading, supply chain management and retail. The incorruptible digital record might also be used to increase compliance.

The technology enables the direct exchange of assets or tools, such as money, contracts or intellectual property rights, in a secure way without the involvement of intermediaries. In fuel retailing, for example, the technology would facilitate payments directly from a driver’s blockchain ‘wallet.’ Elsewhere, customers might source their power directly from an energy supplier, with no need for third party involvement.

Together with virtual power plants, blockchain could also be a powerful tool allowing consumers to trade any excess power generated from their solar photovoltaic or fuel cell-powered home, without the need to use a utility or centralized grid.

Challenges remain, however, notably around the issue of scalability in the event of increased demands for storage, energy consumption, bandwidth and computational power. Security is also a concern, as demonstrated by a major hack in 2014 of the company handling the majority of Bitcoin transactions at that time.

**LO3 uses blockchain to link Marubeni plants**

Marubeni and LO3 Energy, an energy-tech firm, have launched a virtual market place in Japan, using blockchain to connect several of Marubeni’s small-scale power units and test simulated transactions. Ultimately, the JV partners want to create a utility-scale network with associated trading platform. In the United States, LO3 pioneered its transactional platform by setting up a microgrid in Brooklyn, New York.

The system uses standard electricity meters, combined with blockchain-enabled TAgE computers, to measure useable energy and power quality to activate energy transactions. The actual electrons flow through the normal power transmission network, while the private, permissioned blockchain manages the transactional element – the definition of the energy source and the contract agreement to pay for it.
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