

Creating a winning hand

Micro- and mini-grids based on renewables are seen as the route to electrifying regions like Africa, where many people have no access to electricity. This thinking has led several reciprocating engine manufacturers to tie-up with energy storage providers aimed at delivering hybrid solutions for remote sites and rural communities.

Junior Isles

As the cost of electricity from wind and solar in particular continues to fall, renewables are being touted as a solution to electrifying the African continent's many countries that still have no access to electricity.

Certainly the use of renewables is gaining momentum in Africa as those countries see the possibility of bringing electricity to rural communities through microgrids based on renewable energy, thus avoiding the need to extend the national grid. It is a trend that is also one of the drivers behind the move by several genset companies to tie-up with energy storage companies to offer hybrid solutions for the renewable energy space.

In 2017, Wärtsilä closed its acquisition of energy storage company, Greensmith Energy Management Systems, while engine rental company, Aggreko, bought Younicos. More recently, in a move to expand its position in the micro-grid market, Rolls-Royce acquired a stake in Berlin-based energy storage start-up Qinous.

Commenting on Africa and the move towards an electricity system based on renewables, Qinous co-founder and Head of Business Development Busso von Bismarck said: "I strongly believe Africa will leapfrog the traditional approach to electrifying countries through grid extension, simply because it is much cheaper to do it in a decentralised way... energy storage alongside solar or wind – will play a major part in such a development."

Established in 2013, Qinous has developed a standardised package that is well suited to the needs of many of the off-grid communities found in African countries and other emerging markets, and could also be used in commercial and industrial applications. In Africa, the company is already active in Madagascar, Tanzania, Kenya and is in talks in Mali.

"The idea is to offer a turnkey solution where everything is integrated in a container, including the micro-grid management, that can be installed quickly. This is how we think the issue of micro-grids in remote areas should be addressed," said von Bismarck. "Our focus is in the 30 kW to the single digit megawatt power range, and addressing this market is only economically viable with standardised products."

Rolls-Royce's investment in Qinous makes sense on several levels but mostly because it enables a traditional technology such as reciprocating engines, which are commonly found in African countries, to be integrated with renewable-based microgrids. Not only does such an approach bring cleaner electricity, it also lowers the cost of energy and introduces reliability into the system.

"The genset producers and suppliers have understood that there is no way to carry on with business as usual, mainly because solar has become cheaper than anyone could have ever imagined. We can now produce solar electricity at around 4-8¢/kWh; diesel [generation] is

around 30+ ¢/kWh," noted von Bismarck. "But you can only integrate solar into a diesel micro-grid to around 15 to 20 per cent on an annual average without energy storage. If you want to go further, you need to be able to switch off the genset during the sunshine hours and allow a 100 per cent solar penetration... but you need the genset to form a stable grid. You therefore need another device to takeover the role of the genset – this is the energy storage system."

Matti Rautkivi, Director of Sales & Marketing at Wärtsilä Energy Solutions, has a similar outlook on the rationale for renewables and storage but expanded on how diesel engines fit into the picture. He used Senegal as a good example of how African countries can make the transition to renewables-based electricity systems through the use of engine-based technology.

Currently, Senegal's electricity access rate is 64 per cent and there are 1.1 million homes without power. While 90 per cent of its urban population has access to electricity, power only reaches 44.5 per cent of the rural community, according to data from USAID (United States Agency for International Development).

The country is largely reliant on oil products such as imported crude for electricity, yet it is one of only a handful of places on Earth that has the resources to produce substantial amounts of wind and solar power at the same time. According to the Ministry for Renewable Energies, solar irradiation is above 2000 kWh/m²/year for Global Horizontal Irradiation and above 1800 kWh/m²/year for Direct Normal Irradiation for most of the country. There is also substantial wind energy potential along the coastal strip between Dakar and St. Louis.

Notably, the government has made power sector development a key component of its Plan Sénégal Emergent, which aims to make Senegal an emerging economy by 2025. Priorities include lowering the cost of generation by reducing dependence on imported liquid fuels and increasing electricity access – particularly in rural areas.

Senegal is one of about 70 power systems modelled by Wärtsilä to assess the optimal and most economical generating mix for various countries. Rautkivi said: "For Senegal, our study looks at what would be the optimal from 2018 to 2038 and what should be built – whether it should be new coal plant, new LNG, HFO or renewables. All the models show that Senegal should invest in significant amounts of renewable energy – it should build, easily, up to 80-90 per cent."

According to Rautkivi, renewables are already cheaper than the country's coal fired generation. He stressed, however, that it is not purely an issue of cost. The generation system also has to be capable of dispatching reliable power.

"That's why we have done this system-level analysis for Senegal. You need to provide reliability as

well as the lowest cost of electricity."

He says that the company's analysis shows that incorporating gensets into the system provides the optimal path to a 100 per cent renewable system that is reliable, sustainable and affordable. "Building HFO or gas plants provides the system flexibility and reliability today but also leaves room for renewables."

His thinking is that this approach basically enables a massive increase in renewables in a way that does not result in the problems seen in China, which is increasing renewable capacity but at the same time is still building base load coal plant. He

"hugely more expensive" than a hybrid renewables-genset system, which also delivers flexibility. He noted that solar plus storage would start to become competitive from around 2027, when the cost of storage falls to around \$125-150/kWh.

Countries like Senegal, however, where there are blackouts due to the gap between supply and demand, do not have the luxury of waiting for costs to come down. This is why Rautkivi believes they should invest in flexible genset-based generation as it provides the path to 100 per cent renewables in the most economic and optimal way.



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explained: "Coal fired generation is inflexible by its nature, so that's why they can't add more renewables into the system or, if they do, there is the 30 per cent curtailment rate, which we are already seeing today.

"That's why we do this modelling – to find the most economical way to get to 100 per cent renewables. And building flexible capacity is key."

Again looking at Senegal, he says that the HFO plants that are running in base load today will change their operation as more renewables come on to the system, running less to provide system flexibility in the future.

Rautkivi therefore believes that the days of adding significant amounts of large inflexible generation in Africa are numbered. "Every power system will have a significant amount of renewables in the future. If only solar is available, it will take a little bit longer to get to 100 per cent renewables because we will have to wait until energy storage technologies become cheaper. But even if we only had solar PV [without storage], we can say that 30 per cent of electricity should come from solar-only systems."

There are those that would argue that fossil fuel systems, engine-based or otherwise, have no place in a world that needs to decarbonise as fast as possible, and countries should immediately pursue renewables plus storage and other forms of dispatchable renewable energy. Rautkivi noted, however that this would be

Wärtsilä hopes its purchase of Greensmith will position it to serve markets like Africa now and in the future.

In addition to capturing opportunities globally, based on short duration battery storage projects, Rautkivi says right now there are opportunities for hybrid solutions where the company already has an installed base. These, he said, are in, for example, the mining sector, on islands, or in countries like Senegal. Earlier this year Wärtsilä installed a 130 MW Flexicycle power plant as part of Senegal's strategy to increase its energy production, while in the medium term, reducing the cost of electricity for consumers. Importantly, it says the plant will provide the flexibility needed to facilitate the integration of intermittent renewable energy into the country's network.

Rautkivi said: "In the next phase we will start to see the solar-energy storage packages, where we provide that block of renewable energy that can be shifted to the evening or morning periods."

With the price of renewables driving the change, making the case for a renewables-based system in Africa is becoming increasingly easier. Rautkivi concluded: "If people have to pay extra for sustainability in developing countries, it will be a challenge but if it comes with affordability there is less resistance against the change; then we have a winning hand."