An integrated power system provides a smart and reliable energy future in the Portuguese Azores

Island grids present a unique set of challenges, particularly the need for resilient and sustainable energy systems to provide critical power needs. In the case of Graciosa, an island in the Northern Azores archipelago, a heavy reliance on fossil fuel consumption and imports, coupled with a growing concern for climate change, put the island's energy security at risk. Graciosa, a UNESCO-classified 'World Biosphere Reserve', needed a solution to a reliable energy future.

The inauguration Graciólica, a project by HowardScott, took place on 20 February 2020. The President of the Government of the Azores, Mr. Vasco Cordeiro, was in attendance to celebrate the groundbreaking project.

A hybrid approach to island grid energy generation

Wärtsilä developed a hybrid approach to support Graciosa's island grid energy generation. Delivered to Graciólica Lda and local utility Eletricidade dos Açores (EDA), the Graciosa Hybrid Renewable Power Plant integrates a 6 MW / 3.2 MWh energy storage system, 1 MW of solar, 4.5 MW of wind power, and 4.6 MW of existing diesel generators with the local grid.

For optimal energy distribution, Wärtsilä's smart energy solution combines storage and island grid Island+ optimisation to enable maximum renewable penetration, lowers reliance on imported liquid fuels and significantly reduces greenhouse gas emissions.

First, the solution is an energy storage system. Storage brings islanding capabilities to provide backup energy to meet spikes in demand and to manage the frequency and quality of the supplied power, plus storage is also needed to overcome the intermittency of renewable sources.

Second, the solution focuses on optimisation. The entire system is optimised and monitored by GEMS, an advanced energy management software system, which operates as the island grid controller. The energy management platform uses artificial intelligence and machine learning technology to optimise energy generation based on load patterns and (weather) forecasting. GEMS does both individual asset control as well as system balancing—optimising multiple generation assets—to maximise renewable energy penetration and decrease the cost of diesel power generation. Wärtsilä will also provide GEMS software maintenance services under a five-year agreement.

Demonstrating the potential of energy storage on islands

The Graciosa project demonstrates the potential of energy storage on islands to provide entire populations with smart energy security with 100% renewable power capacity.

"Today, about 17 percent of global energy generation comes from renewables, but as we move towards higher renewable energy penetration levels, energy storage becomes a critical asset," said Risto Paldanius, Director, Business Development, Energy Storage and Optimisation, Wärtsilä. "Utilities and independent power producers are increasingly turning to energy storage systems to integrate renewable sources into their baseload generation to build more efficient, reliable and environmentally sound hybrid power systems."

In operation since August 2019, the Graciosa Hybrid Renewable Power Plant has already made the island greener by boosting renewable energy consumption. The total cumulative days where the island has run at 100% renewable energy penetration (REP) is 49 days, with an average REP of 58%. Not only does an increase in the use of renewables reduce the island's carbon footprint, but the hybrid island grid's ability to optimise assets also greatly impacts the cost of energy going forward. The investment likewise decreases the island's reliance on imported fuels by 60%, eliminating the need for approximately 190,000 litres of diesel per month.

The Graciosa Hybrid Renewable Power Plant has already enabled Graciólica to increase the use of its renewables from 15% to 65%.

A case for integration

This project represents the journey towards a 100% renewable energy future with a completely integrated power system on an island grid combining energy storage, engines and renewables. Four different types of assets—storage, wind, solar, and diesel generation sets, each a challenge in itself—come together on Graciosa to create a reliable and cost-effective energy architecture that delivers significant environmental benefits.

While the project was not without its challenges, requiring delivery across several phases, Graciólica highlights Wärtsilä's unique capabilities to provide a comprehensive and integrated package that enables the renewable-modernisation of island grids using a variety of generation assets.