



Island Energy

Providing battery energy storage solutions to industrial and utility clients since 1909



**STATIONARY
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**SPECIALTY BATTERY
SYSTEMS**

Islands and other remote locations have historically relied on diesel fuel generators to supply most (if not all) of their electricity and manage their grid. However, this expensive and outdated practice is quickly being replaced as affordable battery energy storage and sophisticated control systems enable these communities to introduce clean and sustainable forms of energy generation like wind and solar PV.



Leclanché and its network of equipment suppliers and project partners work hand-in-hand with island utilities and remote customers to design, construct, and finance reliable sustainable energy solutions.

Island Energy Management is Unique

Island electricity generation and grid management presents a number of unique challenges and opportunities. Most islands do not have their own fossil fuel resources, so they are reliant on expensive diesel fuel imports. Yet many islands are rich in renewable energy resources such as wind and sunshine and even ocean tides. Given these resources it would appear that going renewable would be an easy choice, but the small size and isolation of island grids presents a new challenge. Because the island grid is relatively small, and because there is no larger utility grid to synchronize with, small fluctuations in load or renewable energy output can have significant ramifications. Indeed, a passing cloud could be enough to adversely impact the grid. Solar+Storage solutions, which include battery energy storage systems, a sophisticated energy management system, and advanced inverters, are ideal for smoothing out this variability and allowing island energy users to enjoy the same financial and environmental benefits as larger grid-connected users.

Benefits of a Renewable Energy-Based, BESS-Supported Island Energy System

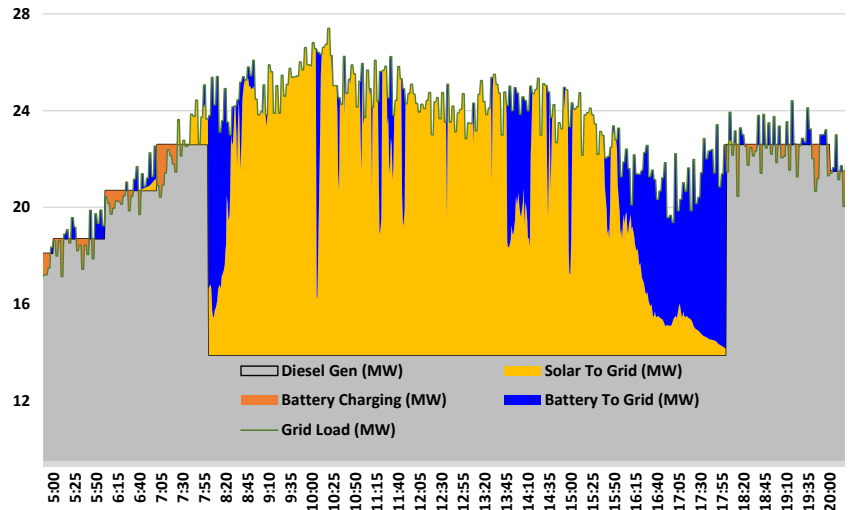
- Reduces Energy Costs
- Improves Grid Reliability
- Enhances Resilience/Recovery
- Decreases Reliance on Diesel
- Reduces Emissions
- Diversifies Risk
- Localizes Economic Value

Batteries are the Key to Island Energy

Even before the introduction of renewable energy and energy storage, island electricity grids are effectively microgrids. Relying primarily on diesel generators, island energy managers adjust their electricity output to match demand and maintain grid frequency. A battery-based microgrid control system takes over this responsibility and makes the grid “smart”. In real-time, the energy management system can measure electricity demand and deploy the various generation and energy storage assets in an optimal fashion. For example, when there is adequate sunshine to meet demand with solar PV, the control system will direct any excess electricity into charging the battery. When solar output decreases, the control system discharges the battery to meet demand, and, if necessary, gives the diesel generators sufficient time to ramp up.



Solar+Storage Provides Fast-Response Load Balancing & Reduces Diesel Generation Costs



This graphic illustrates how a battery energy storage system (BESS) can control multiple generators (solar PV and diesel) in an island grid to manage ramp-rate control, provide peak shifting into the evening hours, and minimize diesel consumption.



Project Highlights...

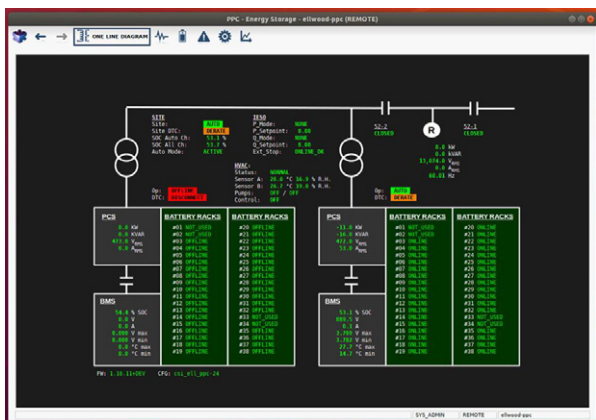
Graciosa is a small island in the Atlantic and is part of the Portuguese Azores. Leclanché built a **7.4 MW/3.2 MWh** battery energy storage system coupled with a new solar PV plant and wind farm.

This hybrid **microgrid** provides the island with clean renewable energy and will **decrease Graciosa's annual diesel consumption by more than 65%.**

Key Technical Considerations

A critical consideration when designing an island energy system is ensuring that the integrity of the grid system is maintained. We consider a number of grid stability related factors in our designs, including:

Grid-Following or Grid-Forming - On traditional grids, renewable energy resources follow the grid, injecting energy without disturbing frequency or voltage. This works since the inertia on the grid means frequency changes slowly. However, on an island grid there is less inertia, and the RE resource is displacing the diesel gensets responsible for keeping frequency and voltage stable. To overcome this, Leclanché utilizes cutting-edge grid-forming inverters that act dynamically, like the generators they are displacing, to the point that they can actually improve grid stability.



Fault Tolerance - Island energy systems must be immune to equipment failures. Leclanché designs its systems to be resilient to grid faults, generator and inverter failure, and battery/electronic equipment failure. As a rule we design critical infrastructure have N+1 redundancy.

Energy Management System - The Leclanché EMS plays a critical role in the performance and reliability of the island energy system. The EMS functions that directly contribute to enhancing fault tolerance are Stability Management, Generator Dispatching, Contingency Management, Data Analytics, and Scheduling.



Leclanché provides complete battery energy storage solutions (BESS) and energy management systems (EMS) for a wide range of customers and applications, including:

- Solar+Storage and Microgrids
- Front-of-the-Meter Utility Scale Storage
- Grid & Ancillary Services
- Behind-the-Meter C&I Energy Storage and Load Management
- EV Fast Charging Stations



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WE ARE IN CHARGE