

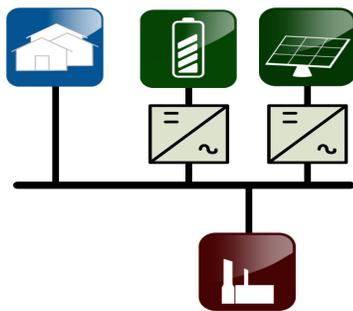
A PERFORMANCE ASSESSMENT OF GENERATION UNITS IN HIGH ALTITUDE MICROGRIDS

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MOTIVATION

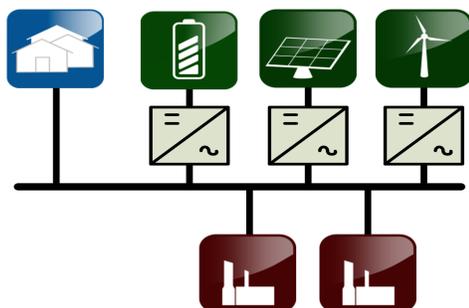
Microgrids have become an appealing candidate for the electrification of rural or remote locations throughout the globe. Usually, geographic location with difficult access is one of the most common. In the particular case of Chile, the usual location of a remote community is in the mountains, presenting a high altitude. The altitude to which the equipment is exposed presents several challenges due to the unavailability of of-the-shelf components designed for such altitude. This poster presents an analysis of the performance of two microgrids located in Chile, namely Ollagüe and Huatacondo microgrids. Findings will include the analysis of battery energy storage, inverter-based generation and fuel-based generation systems. For comparison purposes, the theoretical performance reported in the datasheets of the generation units (PV panels, diesel generators, and battery storage systems) are considered as baseline.

ESUSCON MICRO-GRID



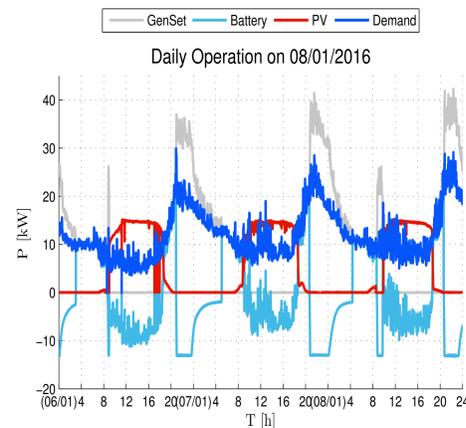
The Esuscon microgrid, supplies energy to the small town of Huatacondo, Chile. This town is located in the Atacama desert, at 2300 [m] over the sea level. this system has been operating since may of 2010. This grid counts with a solar power plant with a HTSAT tracking system, a battery storage system, a diesel generator. the system provides energy to 30 houses without interruptions. The diesel generator of this grid usually operates at 35% of it's nominal power, due to a anual event where the load increases about three times.

OLLAGÜE MICRO-GRID



The Ollagüe microgrid, is located at 4000[m] over the sea level in the Atacama desert, it supplies energy to the Ollagüe, which is located in the frontier of Chile and Bolivia. This system was built by Enel Green Power has been operating for about a year. This grid counts with a solar power plant without tracking system, a battery storage system, two diesel generator and a vertical wind turbine.

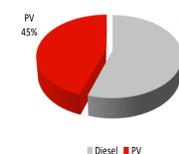
ESUSCON OPERATION CHARACTERISTICS



System Specifications

- Solar plant: 22 [kW]
- Genset: 120 [kW]
- Bess: 40 [kW]- 120 [kWh]

Renovable producción

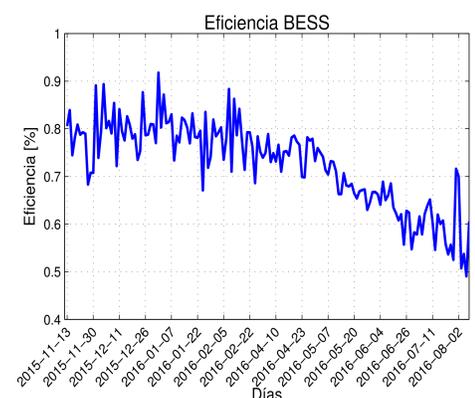


Solar comparison

- Real System (Altitude 2300[m])
- Annual Energy Production: 48,403 [kWh]
- Capacity Factor: 25,1%
- Equivalent sea level system
- Annual Energy Production: 44,512 [kWh]
- Capacity Factor: 23,1%

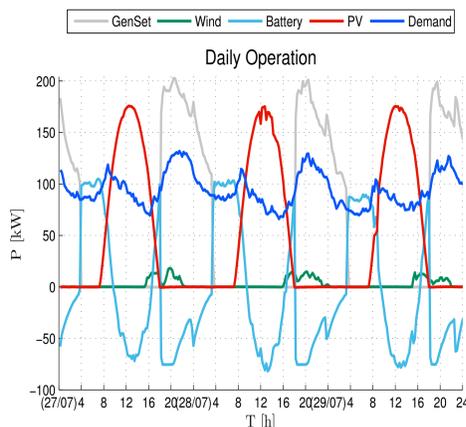
Genset comparison

- Real System (Altitude 2300[m])
- Annual Energy Production: 54,095 [kWh]
- Diesel Consumption: 21,785 [Lt]
- Equivalent sea level system
- Diesel Consumption: 18,004 [Lt]



Since the Esuscon micro grid is located at 2300[m] over the sea, some particular effects can be observe in the operation of the grid, for example the diesel consumption increase has 20% in comparasion to a sea level unit, but the solar power output has increased in 8%. This is explained by the lower density of the air, higher radiation levels, and lower temperatures. Since the batteries reached the end of their life cycle, the efficiency of the bess system has greatly decreased, and the batteries are behaving more like a load. Before this occurred the system did not suffer from any remarkable effect from the altitude.

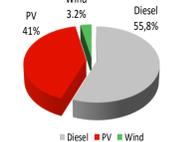
OLLAGÜE OPERATION CHARACTERISTICS



System Specifications

- Solar plant: 200 [kW]
- Gen set: 410 [kW]
- Back up Gen set: 275 [kW]
- Bess: 200 [kW]- 752 [kWh]
- Wind turbine: 30 [kW]

Renovable producción

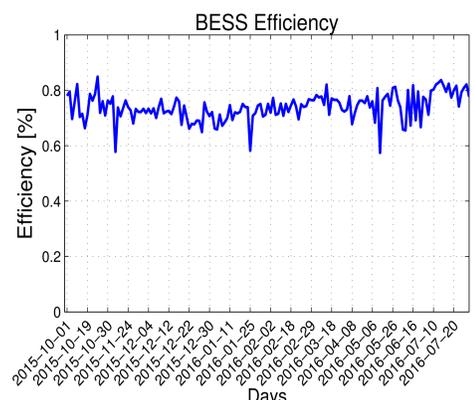


Solar comparison

- Real System (Altitude 4000[m])
- Annual Energy Production: 449 [MWh]
- Capacity Factor: 28,5%
- Equivalent sea level system
- Annual Energy Production: 422 [MWh]
- Capacity Factor: 24,1%

Genset comparison

- Real System (Altitude 4000[m])
- Annual Energy Production: 453 [MWh]
- Diesel Consumption: 123,398 [Lt]
- Equivalent sea level system
- Diesel Consumption: 101,146 [Lt]



Ollagüe located at 4000[m] over the sea, there fore the same effects that are seen in Huatacondo are present in this grid, in this case the diesel consumption has increased in 21% and the solar production in 6%. Also a lower air density affects the efficiency since the mass of air available to dump heat decreases but is compensated by a lower air temperature.

