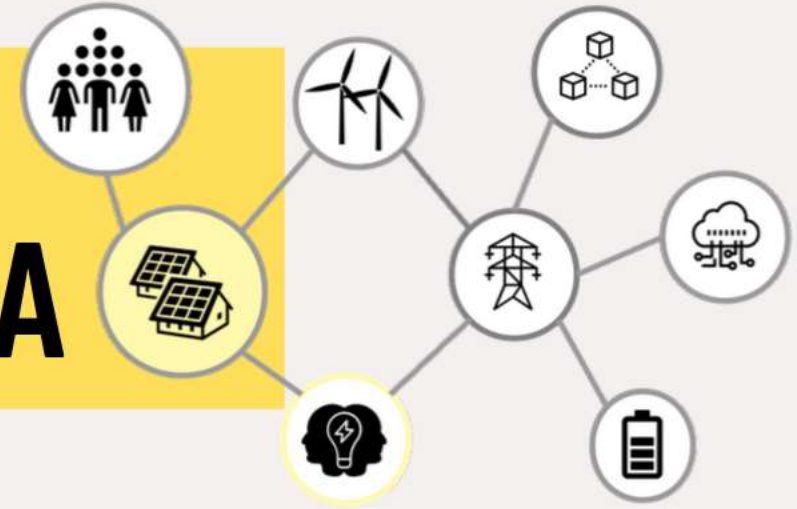


CONFERÊNCIA COMUNIDADES DE ENERGIA



Pavilhão do Conhecimento, Lisboa | 9 de Outubro de 2019

Dom Hughes
Duarte Silva
Scott Macaw



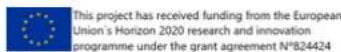
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prosumers for the energy transition



This project has received funding from the European Union's Horizon 2020 research and innovation programme under the grant agreement N°7562056.



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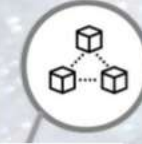


This project has received funding from the European Union's Horizon 2020 research and innovation programme under the grant agreement N°824424

BEACON Bridging European & Local Climate Action

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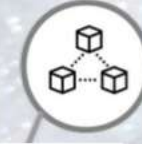
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CONHECIMENTO**
CENTRO CIÊNCIA VIVA



Agenda

1. Graciosa Electrical Power System;
2. Introduction to Gracióllica and project major timelines;
3. A special project – why ?;
4. Energy Management System (EMS) layers of control;
5. Power Quality and System Improvements overview;
6. Battery performance over first 57 days of operation;
7. Renewable Penetration rates in Graciosa Network;
8. Renewable penetration profile for August and September 2019
9. Graciosa island micro-grid SLD demonstration;





Graciosa Electrical Power System



Diesel Power Plant:

- 6 engines: 2x 750kVA; 1x 762kVA; 1x 1100 kVA 2x 1287 kVA;

Battery Power Plant:

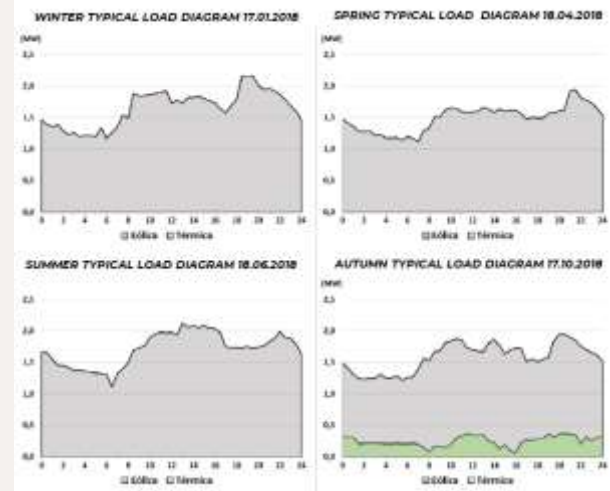
- 7.5 MW of rated power;
- 2,6 MWh of usable capacity
- 45600 LTO battery cells
- 3 independent Energy storage System (ESS) units

Wind Farm:

- 5 x 0,9 MW E-44 Wind turbines

Solar Farm:

- 4000 solar panels;
- 40 SMA Sunnypower inverters, 25 kW of rated power each one









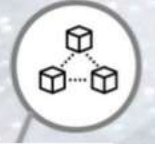
Graciosa Distribution Network:

- 15 kV voltage level
- Island peak load of 2,2 MW peak load and 1,2 MW of valley load
- Net Energy Production of 13,44 GWh in 2018;

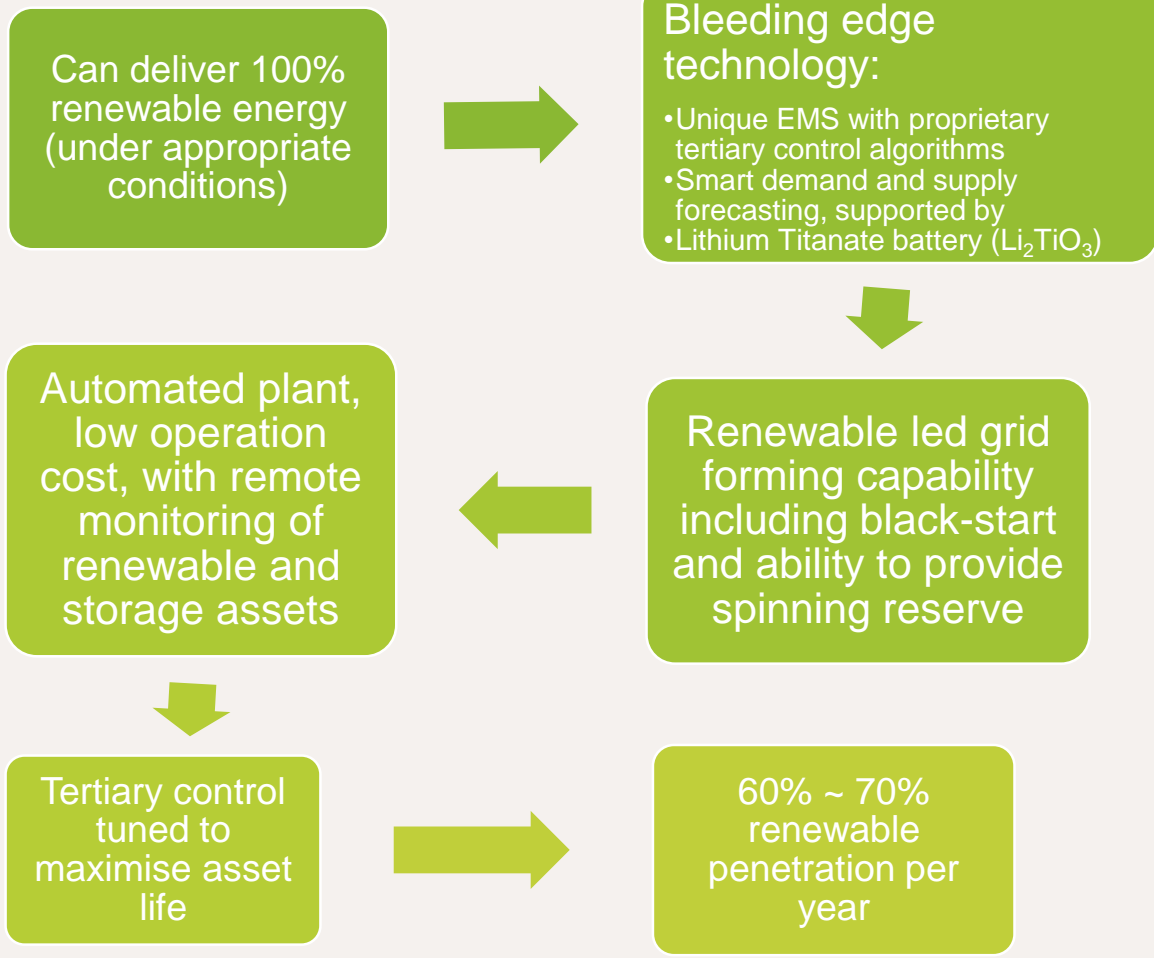


Introduction to Graciólica and project major timelines

-  SPV formed to build a hybrid power plant on Graciosa
-  Project conceived c. 2005
-  PPA signed 2013
-  HowardScott invested c. €12m in 2015
-  Physical assets largely complete 2016
-  HowardScott took responsibility from original developer Dec 2017
-  Development of new EMS solution and installation of new physical assets on site in 2018
-  Realization of the endurance tests in the end of 2018 and final completion in July 2019
-  Commercial operation day (COD) started on 21st of August 2019

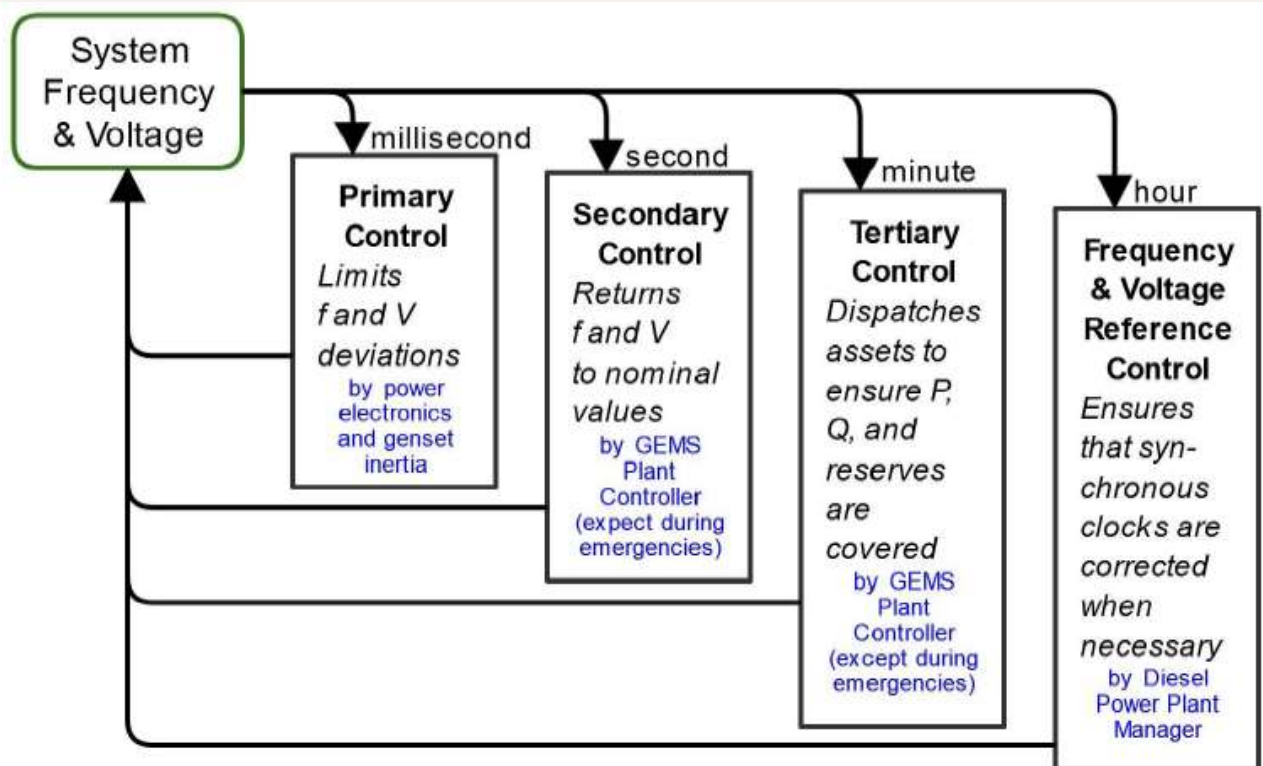


A special project - why?





EMS Layers of Control



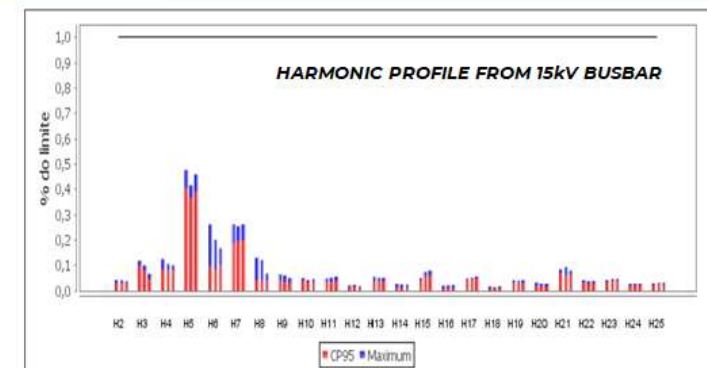
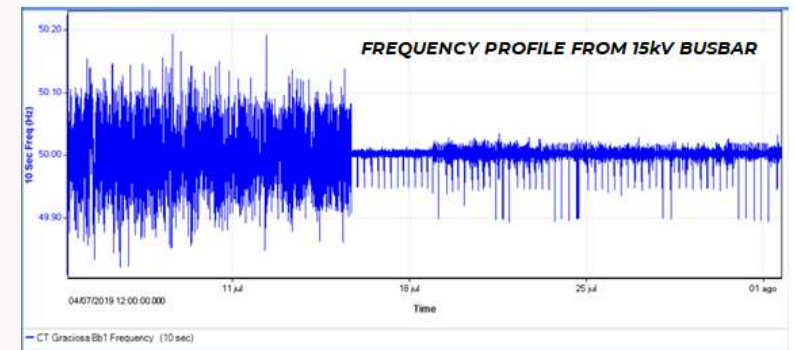
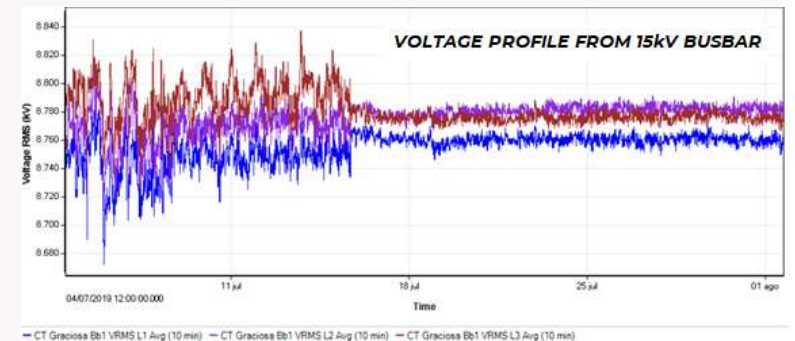
Objetives:

1. Capability of providing voltage and frequency regulation and spinning reserve to the island network;
2. Maintain or even improve network stability and security of supply;
3. Maximize renewable energy usage;
4. Minimize engines operating cost;
5. Enhancement of power quality;



Power Quality and System Improvements Overview

- **IMPROVEMENT OF QUALITY OF SUPPLY**
(e.g. voltage profile and frequency profile);
- **IMPROVEMENT OF CONTINUITY OF SUPPLY**
(So far three load shedding's have been avoided due to the running diesel engines to trip offline);
- **RELIABLE AND ROBUST SYSTEM RESPONSE FOLLOWING SHORT-CIRCUITS EVENTS** (Short-circuits in the island load feeders cleared in ~300 ms following restoration of voltage and frequency to their nominal values);
- **VERY HIGH RENEWABLES PENETRATION RATES OBTAINED IN ISOLATED POWER ELECTRICAL SYSTEMS;**





Battery Performance over first 57 days of operation

AC Energy discharged per ESS unit: 32,44 MWh

Average cycles per day = AC energy discharged / Usable capacity / number of days
= 0,66 cycles/day

Number of cycles over 20 years = 4830,93 cycles

Total of energy discharged over 20 years = 12,46 GWh

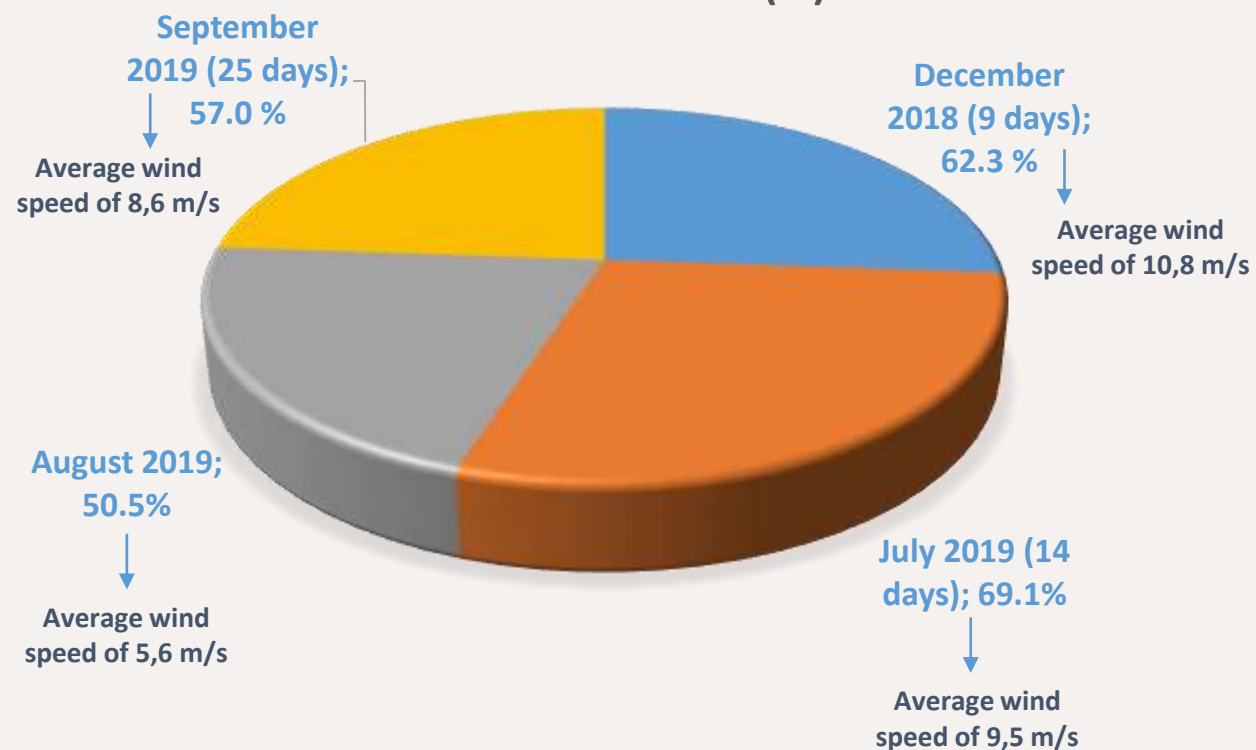
Maximal battery degradation guaranteed by battery provider

Calendar Year	Design Capacity [kWh]	Usable Capacity [kWh]	Usable Capacity (% of BoL Capacity)	Operational requirements	
				Maxim Energy Throughput DC [kWh]	Maximum number of Full Cycles
0	3200	>=2591	100%	0	0
1-20	3200	>=2332	>=90%	28.8 GWh	<=4500
	3200	>=2202	>=85%	32.0 GWh	<=5000

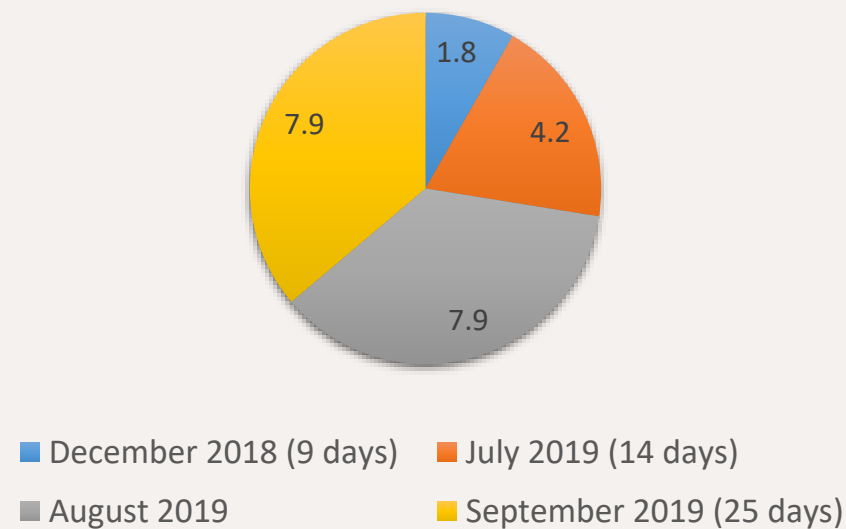




RENEWABLE PENETRATION RATE IN GRACIOSA NETWORK (%)



TOTAL OF 100% RENEWABLE PENETRATION (DAYS)

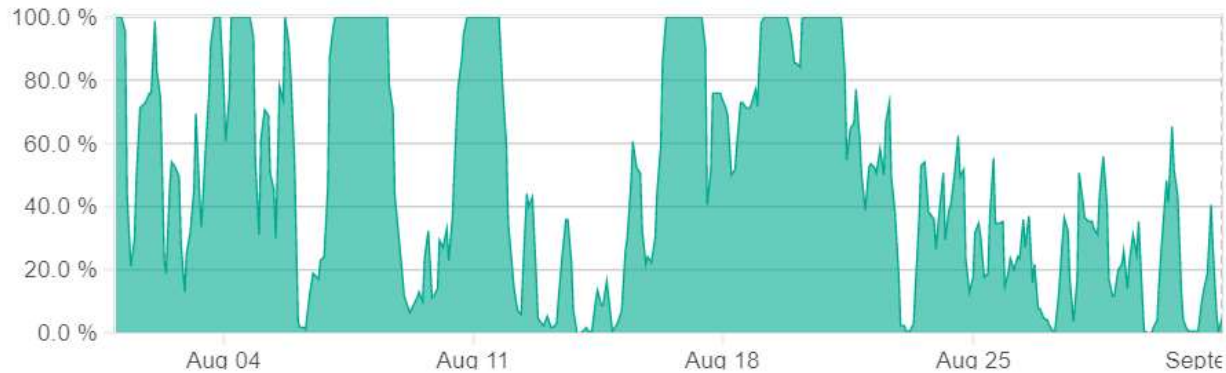




Renewable penetration profile for August and September 2019

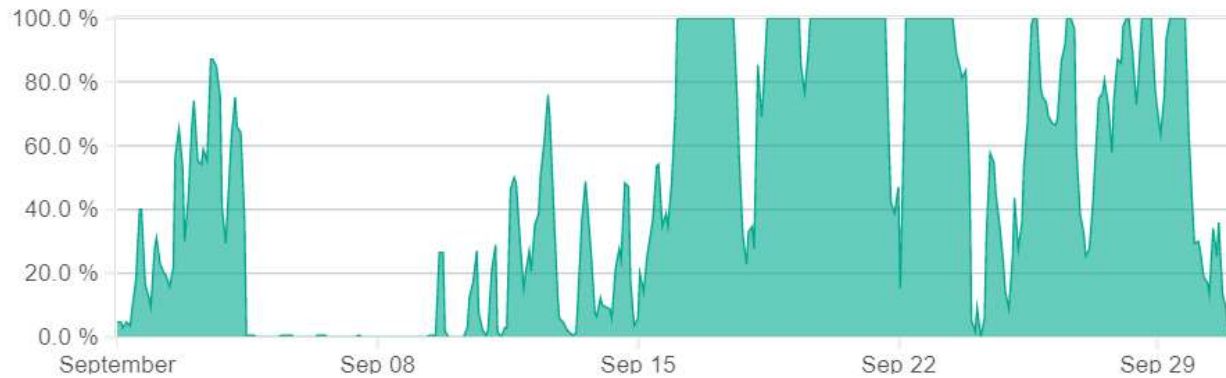
RE Penetration

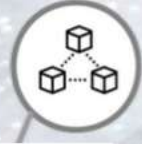
— Micro Grid Renewable Power Penetration Min: 0.09 %, Max: 100.00 %



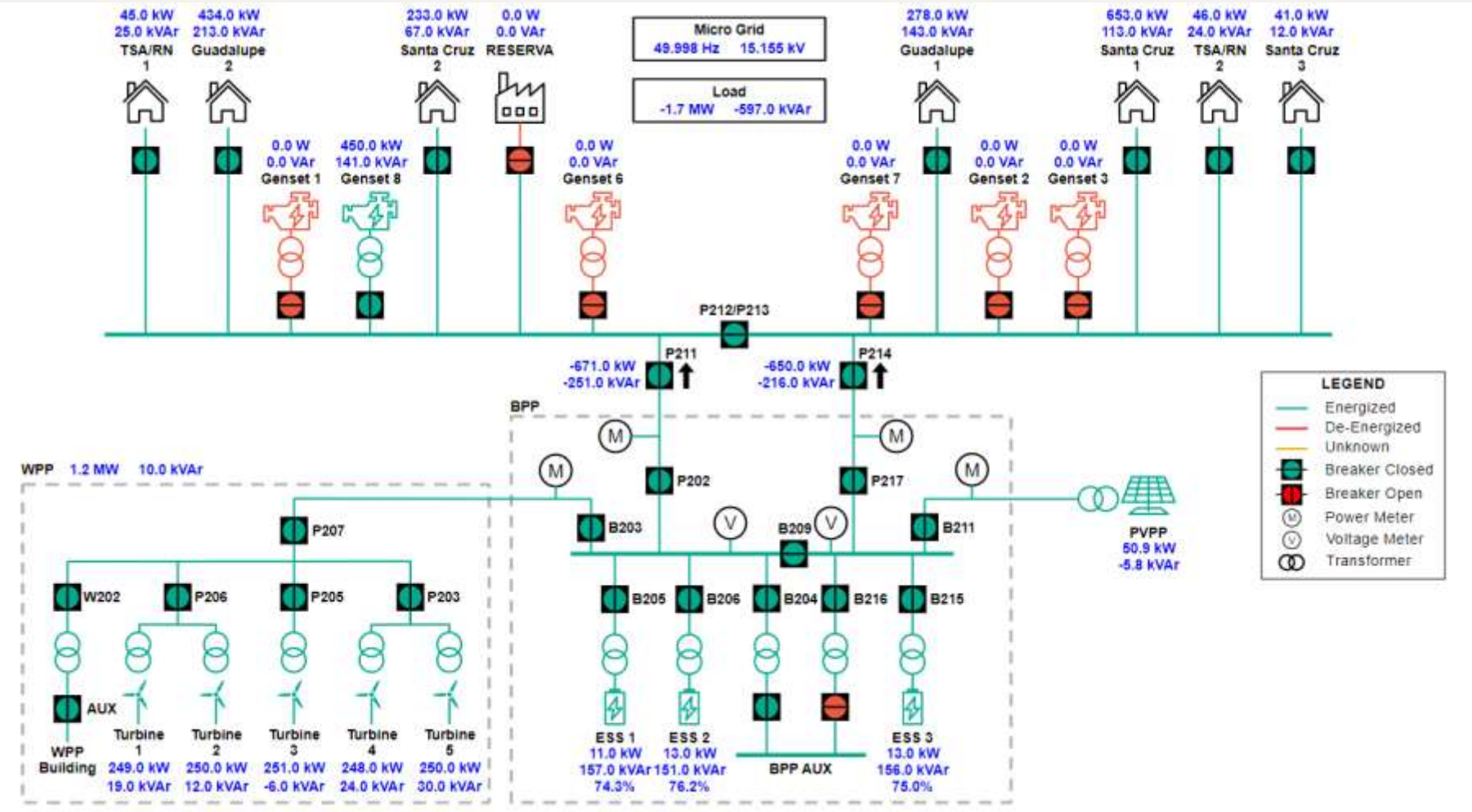
RE Penetration

— Micro Grid Renewable Power Penetration Min: 0.00 %, Max: 100.00 %

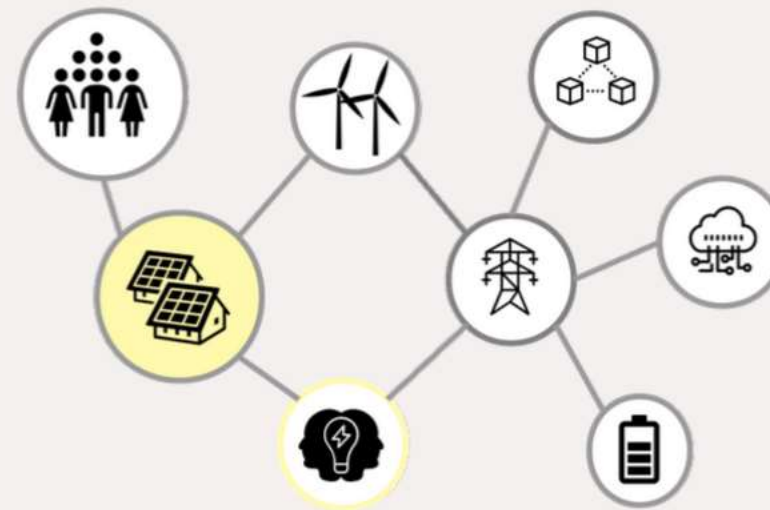




Graciosa island micro-grid SLD demonstration



THANK YOU! ANY QUESTIONS?



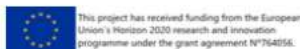
Contact me for more information:  **Duarte Conde Silva**

 **duarteconde@graciolicahybridplant.com**

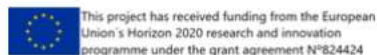
 <https://howardscott.com/>



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