

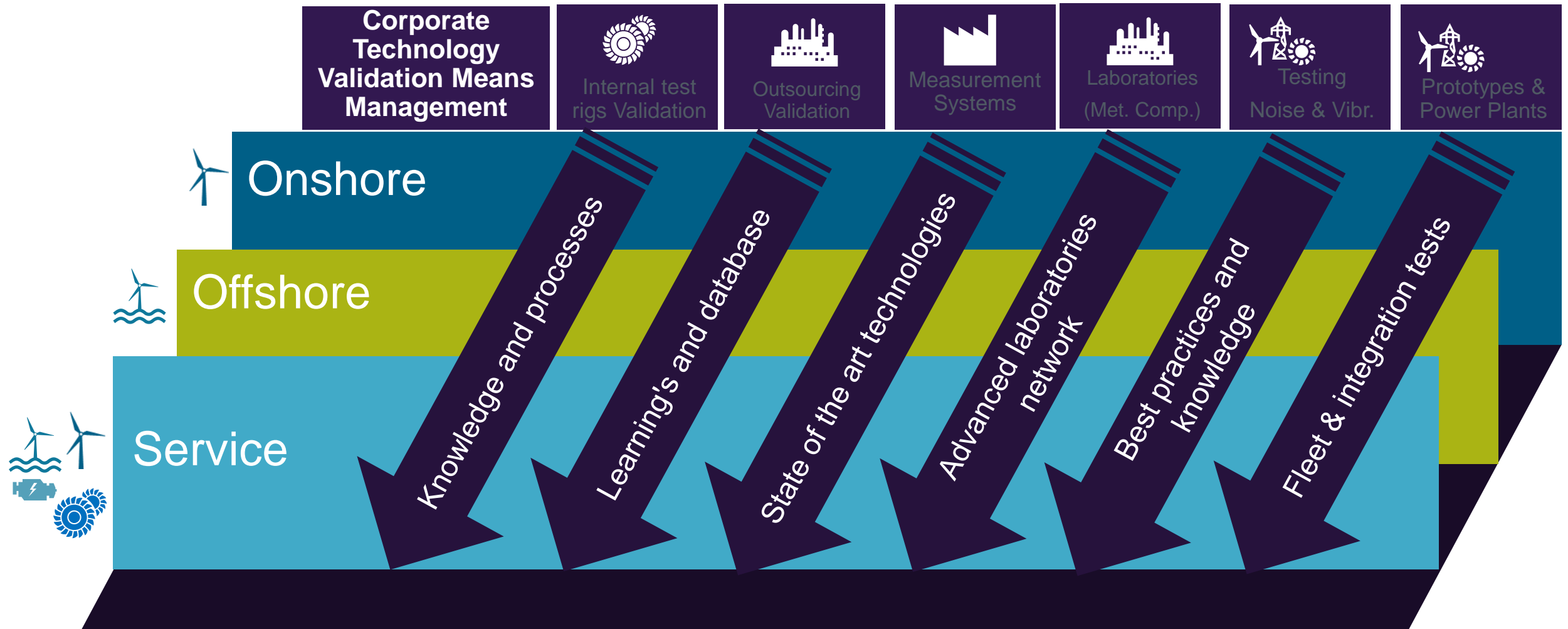


La Plana Hybrid Facility Test Plant

11 March 2021

Corporate Operations & Governance Infrastructure Services Validation Means Management

RELIABILITY and PRODUCT PERFORMANCE as Validation and Verification strategy (V&V)



Test Plant Overview

La Plana Test Plant

La Plana R&D hybrid facility has been in operation for over 3 years. The project is designed to enhance and expand the development and performance of our hybrid solutions.

The site is used in the following ways:

1. As a Test Bench:

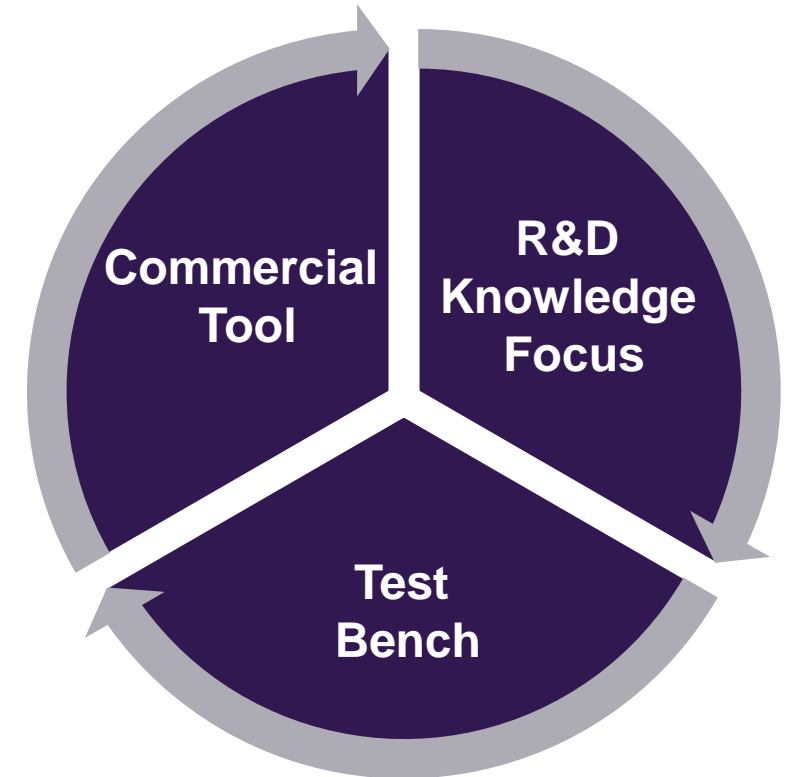
Before any new asset is commissioned by our internal customer, we are able to validate it in a real environment, minimizing as much as possible any risk .

2. For Research and Development:

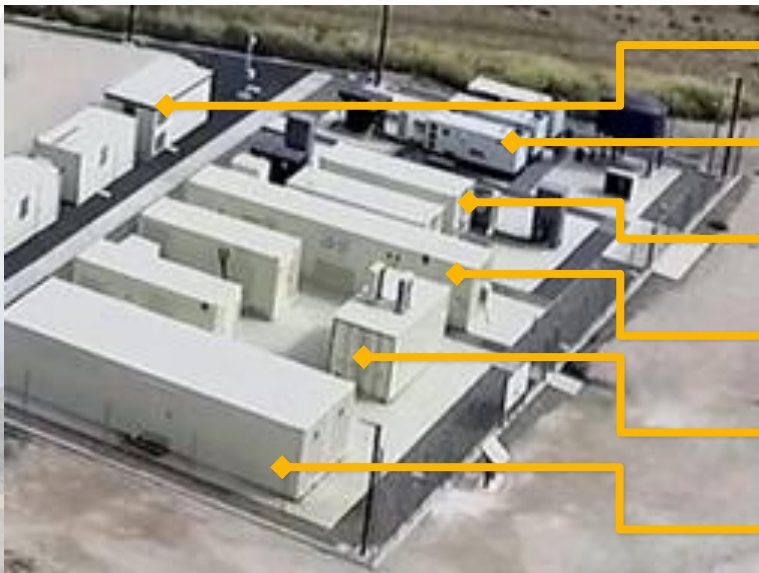

The facility incorporates a range of energy generation and storage technologies, and test scenarios. This strategy provides many options for in-depth study and enhancing technical expertise within the SGRE team.

3. As a Commercial Tool:

Several tours are conducted each month, giving customers the opportunity to view and assess our hybrid solution capabilities.



Assets Overview

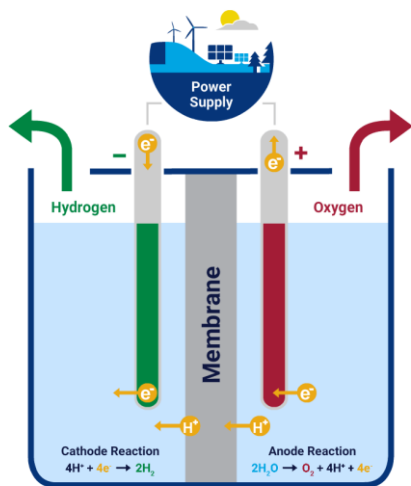


- Switchgear Center
- Diesel Power Plant
- Loads
- Control Center
- Lithium-ion BESS
- VRFB

Wind Turbine	850 kW
Photovoltaic	245 kW _p
Diesel	3 x 222 kW
Lithium Storage	572 kW (4C) – 143 kWh
Vandium Storage	200 kW (1C) – 400 kWh
Load	1100 kW – 372 kVAr

La Plana Test Plant

- Hybrid tests can be performed with any combination of the devices listed in the chart.
- In addition to what is installed, other devices could be commissioned, and to integrate more energy systems, such as H₂ stacks or new technologies photovoltaic systems, and so on.



Types of Energy

<ul style="list-style-type: none">• Photovoltaic solar energy• Wind energy• Diesel energy	
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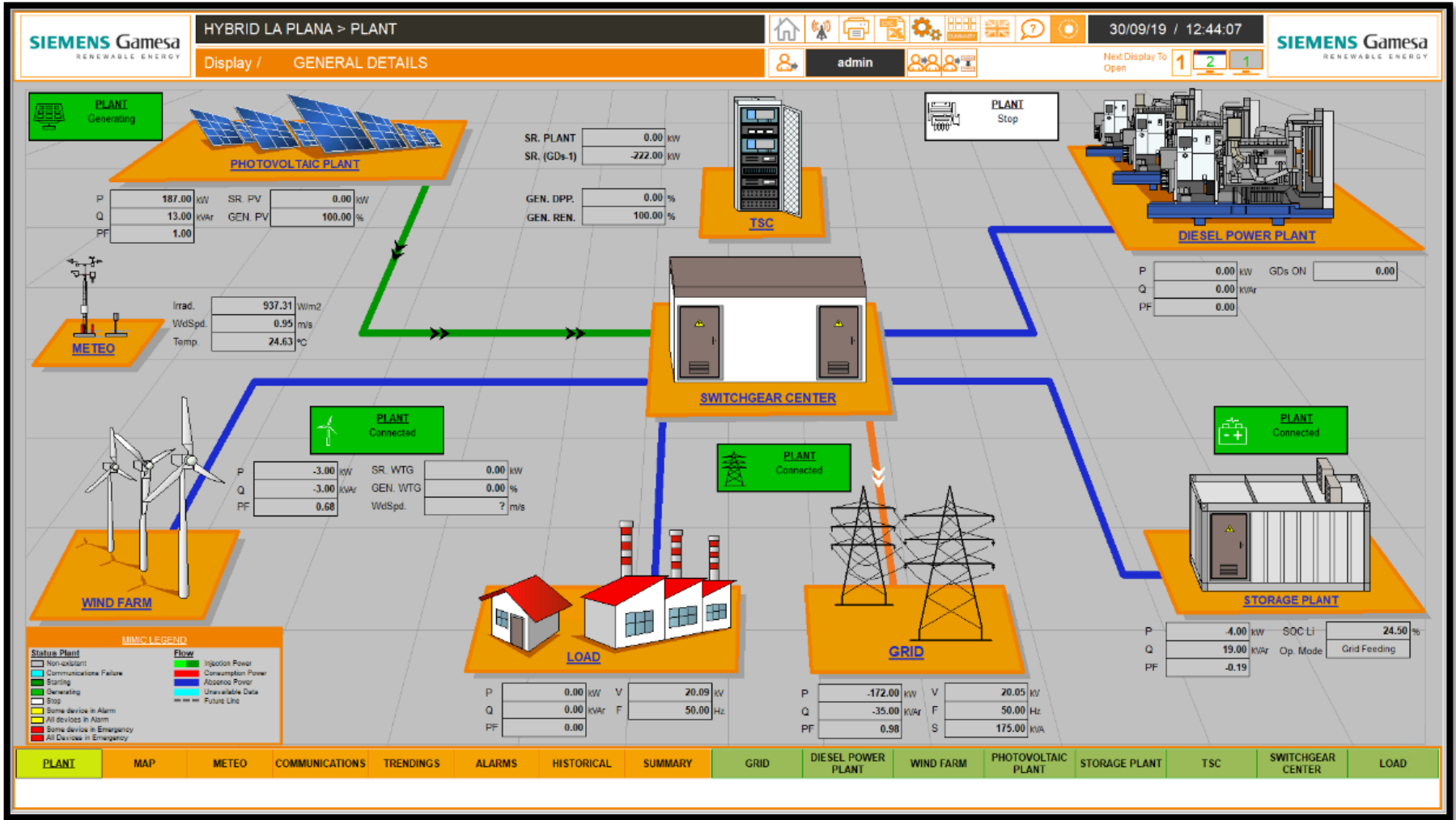
Storage Systems

<ul style="list-style-type: none">• Lithium battery• Vanadium redox flow battery (VRFB)	
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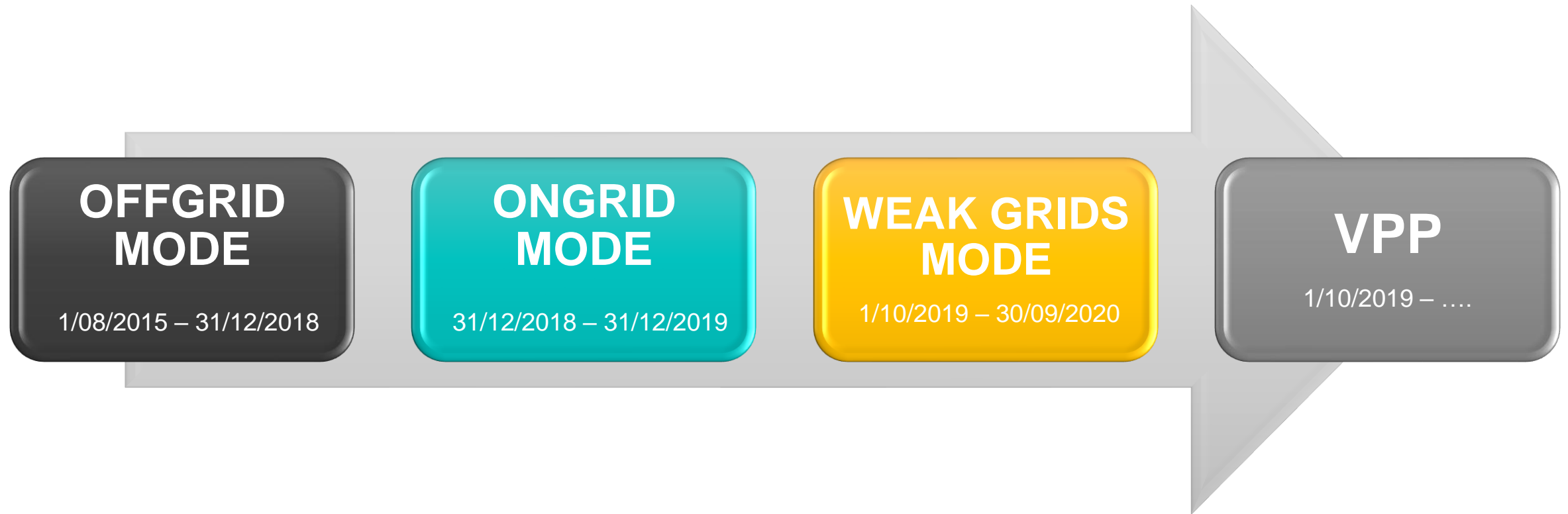
Test Scenarios

<ul style="list-style-type: none">• Offgrid• Ongrid	
<ul style="list-style-type: none">• Weak grids• Virtual power plants (VPP)	

La Plana Test Plant



Test Site Controller Roadmap



La Plana as a Test Bench

One of the main capabilities is the possibility of validating control solutions for the integration of renewable energy sources or the incorporation of new generation or storage technologies.

1. Control solutions:

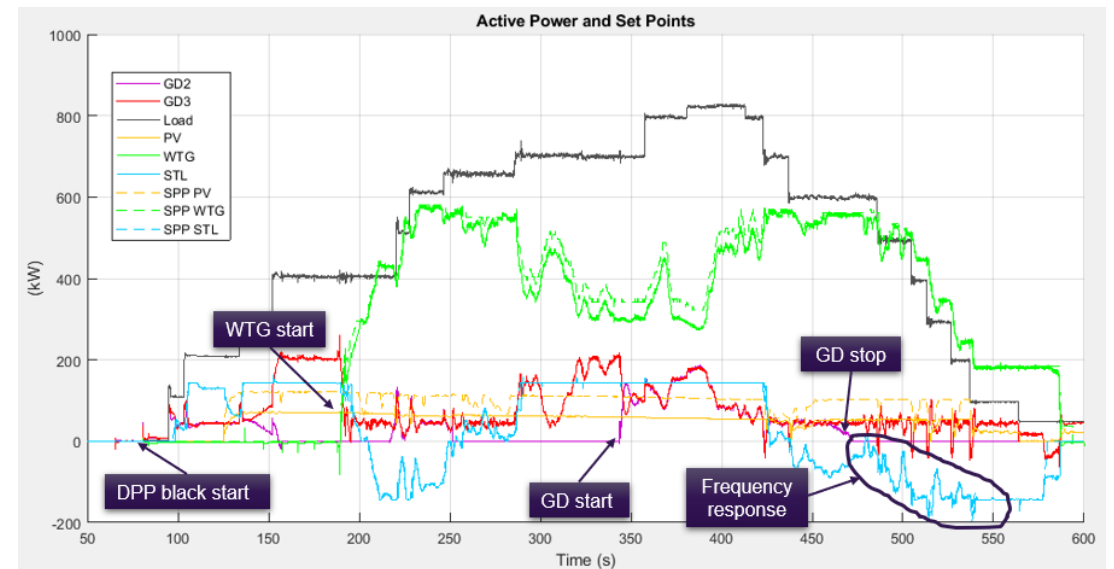
Possibility to validate hybrid plant controllers.

2. New assets:

Capacity to introduce new technologies for energy generation or storage before implementing them in a hybrid farm.

3. Auxiliary devices:

Testing and validation of new field devices: measurement equipment, network electronics, SCADAs or PLCs.



La Plana as a Research and Development Facility

The facility is used for the development of new applications and business opportunities in the company. At the same time, to obtain knowledge of different technologies that have been incorporated to participate in projects both at European and national level.

▪ Development of control solutions:

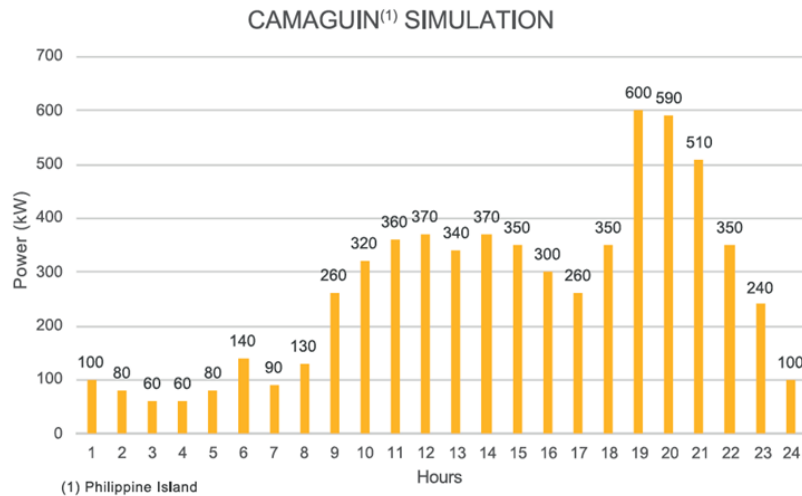
- **MUSE GRIDS European Project:** controller for intelligent energy dispatch.
- **TALENT European Project:** distributed network control using a cloud system composed by a Virtual Power Plant controller.
- **HIGREEW European Project:** Development and integration of new flow battery controller.
- **Blockchain:** It is a decentralized system for the exchange of value with the following main characteristics: Distributed Ledger, Immutable Transactions, Use of Cryptography.
- **Digital Twin:** It can simulate with the necessary detail the operation of power plants in different aspects (electrical, control or communications).



La Plana as Commercial Tool

Another fundamental pillar within the company is commercial support. The facility has been visited by some of the SGRE customers, helping to demonstrate the SGRE portfolio.

1. Customized on-site testing with different modes of operation.

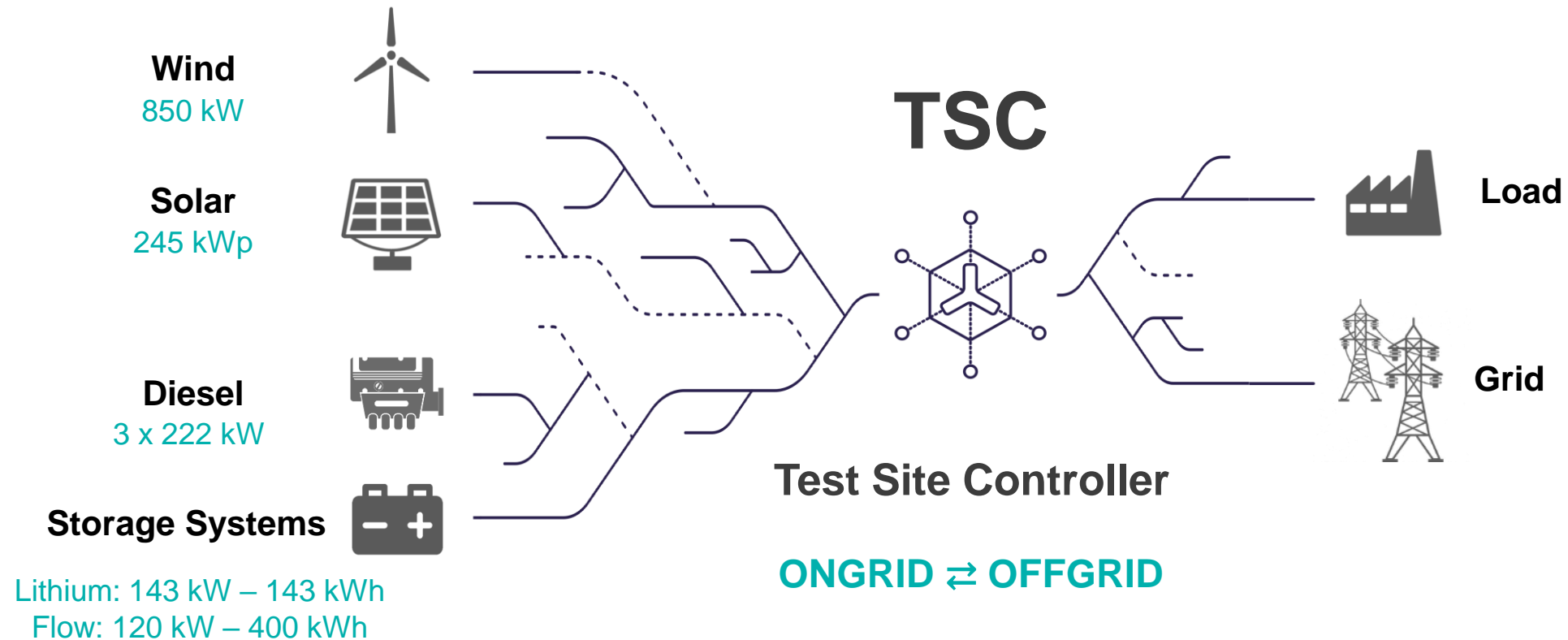


2. Possibility to see different containerized solutions in situ with easy implementation in different scenarios.

Test Site Controller (TSC)

Overview

It is a real-time controller whose main objective is to reduce the cost of generation in hybrid plants (LCoE) by targeting to achieve the maximum integration of renewable energy in optimal conditions.



Features

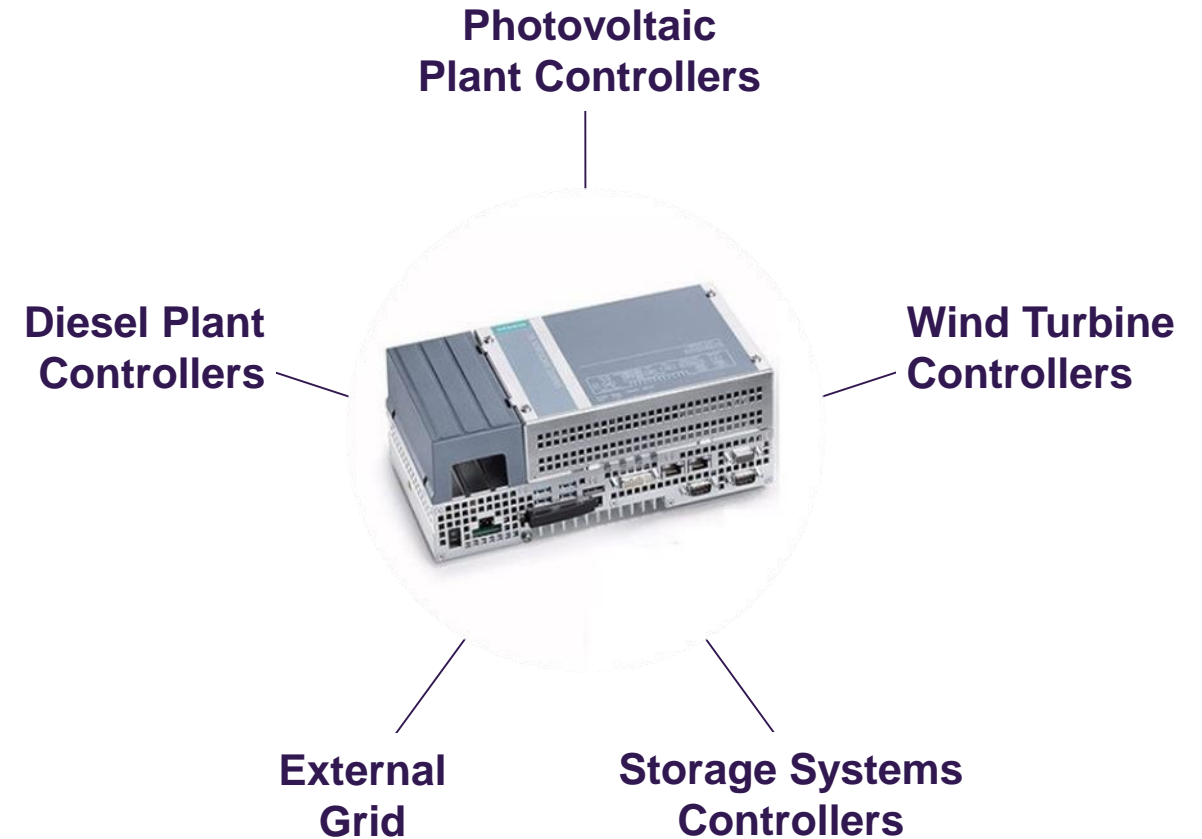
TSC Generation Plant Management

OFFGRID – ONGRID mode includes the following subsystems:

- Diesel power plant
- Wind farm
- External grid
- Photovoltaic plant
- Storage systems

Controller provides

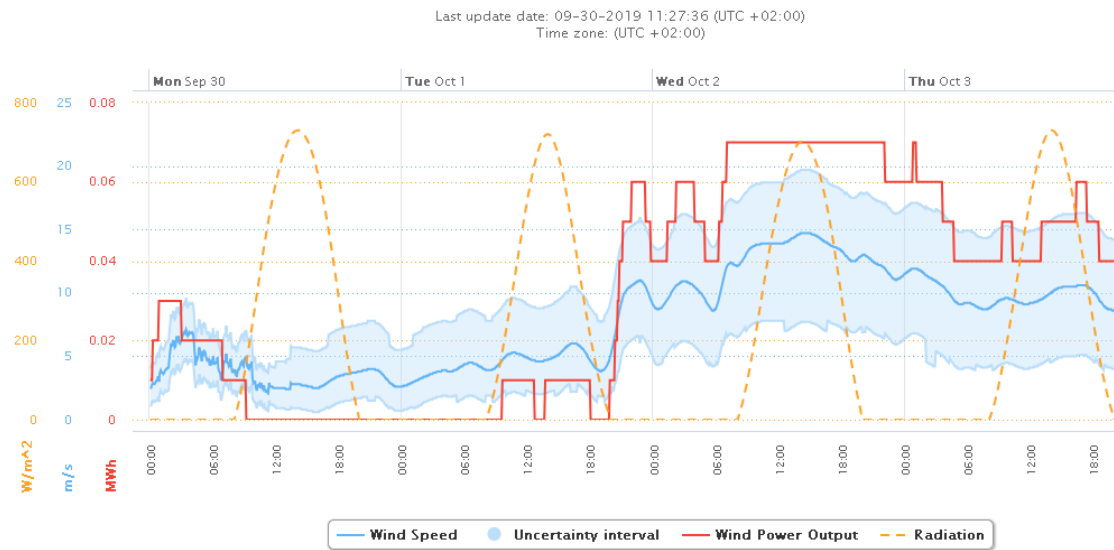
- Flexibility to adapt to different kind of projects
- Easy remote maintenance
- Rugged design for industrial applications



Meteorological Forecast

MEGA

The TSC is able to receive and manage data about the meteorological forecast of the localization using **MEGA**, SGRE’s meteorological forecasting tool.



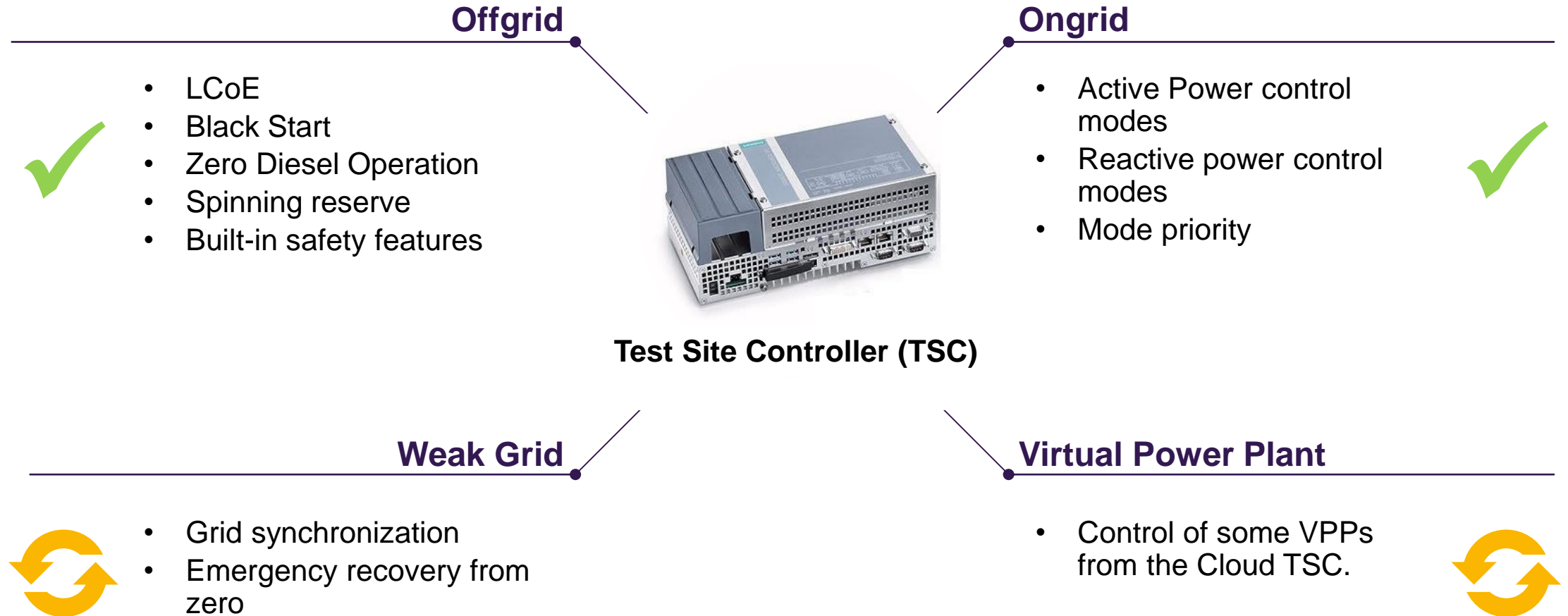
Dispatch energy forecast

This forecast is used for calculating the optimal power for the charge and the discharge of the storage systems. It is used also for the “dispatch energy forecast”.

One-week **dispatch energy forecast** using the meteorological data forecast from MEGA. The output data is displayed on the SCADA. The control performed in the simulation is the same as the control of the real plant.

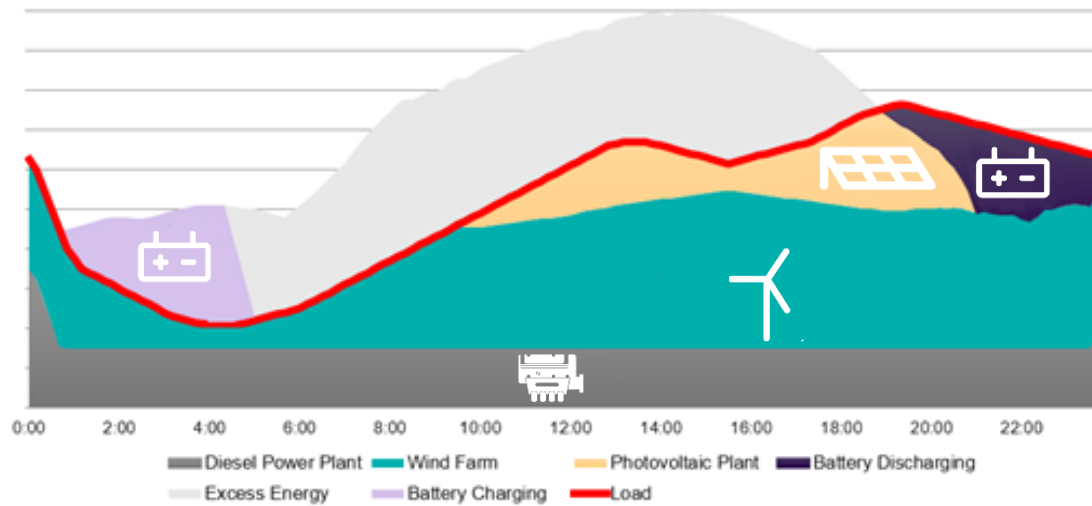
Configuración		Programación	
Acceso		Descarga fichero	
Usuario	MEGA_LAPLANA	Ruta archivos	C:\DATOS_MEGA
Contraseña	*****	Formato fichero	
Nombre archivo descargado		Formato archivo	Csv
Prefijo	Plana	Idioma	Español
Formato	dd/MM/YYYY	Últimas Operaciones	
		Número registros	1

Control Modes



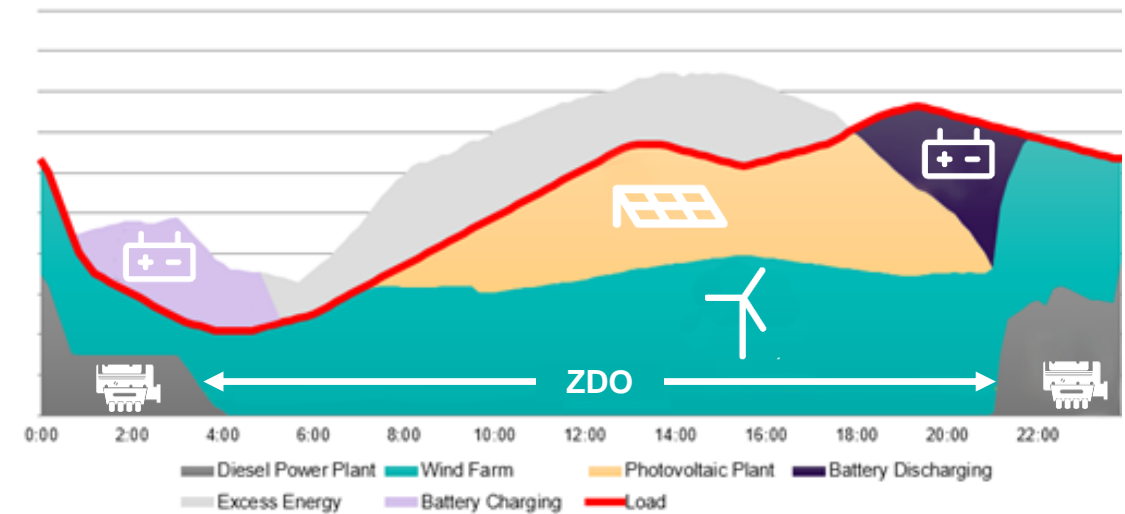
OFFGRID mode: Zero Diesel Operation (ZDO)

Hybrid Plant without ZDO



- Diesel groups generate the grid (voltage and frequency control).
- The TSC minimizes diesel consumption, taking the generators to their technical minimum power (Objective: Minimize LCoE).

Hybrid Plant with ZDO



- In order to optimize the LCoE, each project studies the implementation of the ZDO mode in those time zones where the energy demand can be covered with the battery and the renewable energies.
- In order to turn off the diesel groups as much as possible, the batteries would have to be sized to give the peak power of the load, and the renewable would have to be oversized to produce 100% of the energy needed in time.

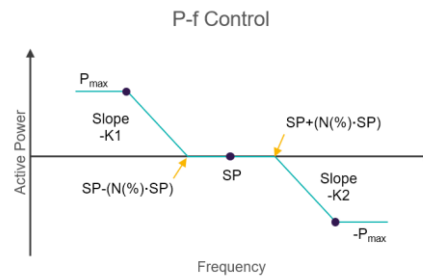
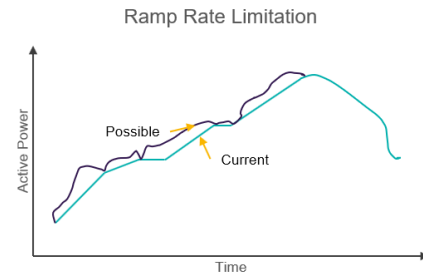
ONGRID mode

The TSC works as an Ongrid Hybrid Plant Controller using different P and Q control modes to meet network and customer requirements.

Active Power modes

The different P control modes:

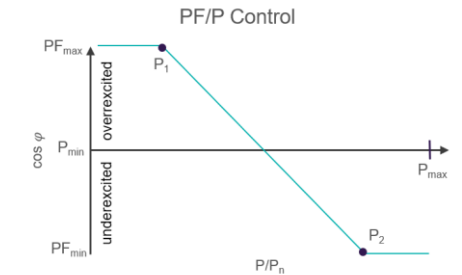
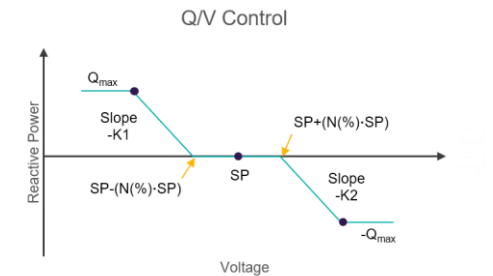
- P Available
- Ramp Rate Limit
- Delta Control
- Balance Control
- Smoothing Control
- P Limited
- P-f Control
- Peak Shaving
- P Ensured



Reactive Power modes

The different Q control modes:

- PF Control
- Q Control
- V Control
- Q with $P = 0$
- Q/V Control
- PF/P Control
- S Limited
- Q Standby

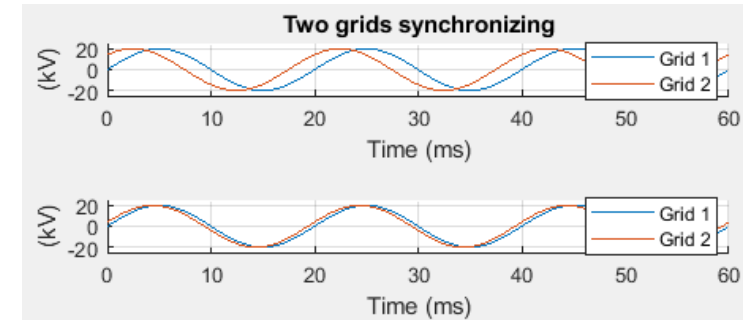
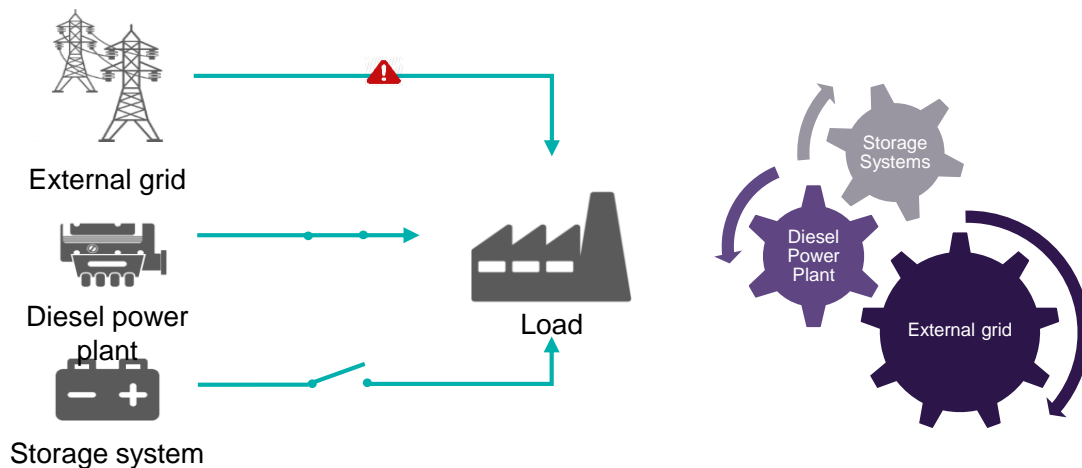


WEAKGRIDS mode

In La Plana hybrid facility there are three grids. These grids can be managed by the TSC:

- External grid.
- Diesel power plant grid.
- Grid generated by ZDO mode.

The TSC will be able to toggle between them and support a weak grid.

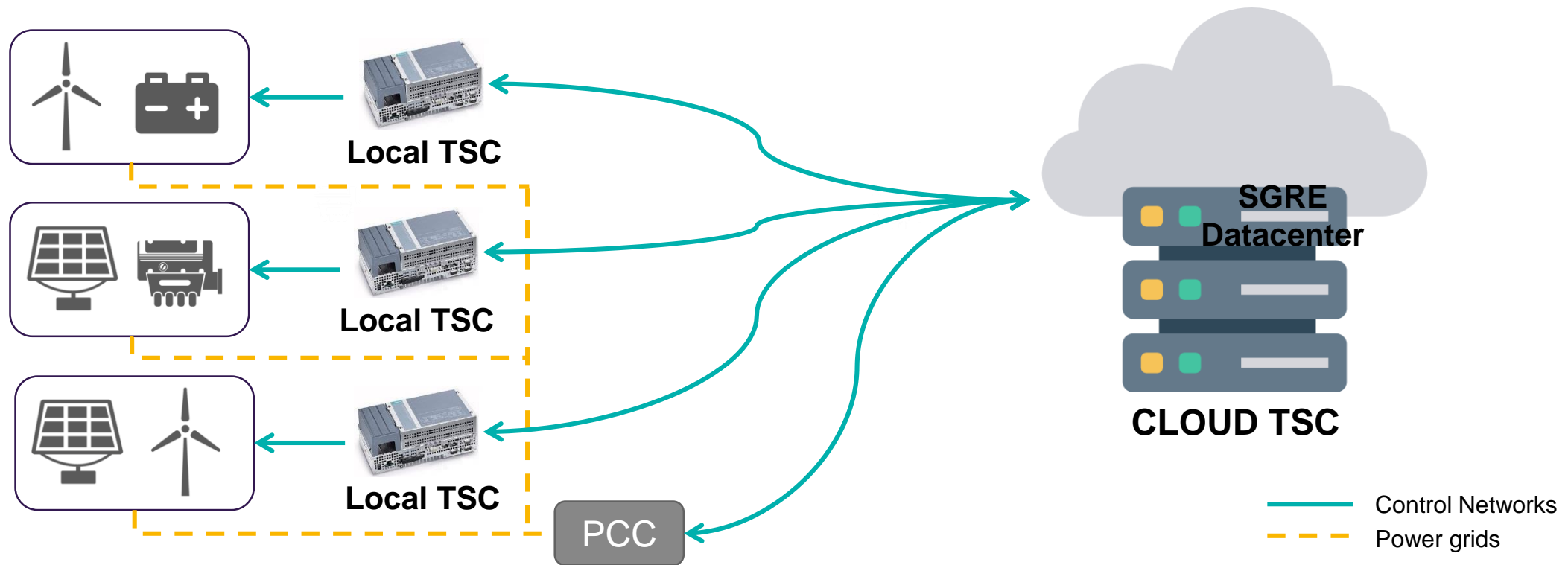


TSC will ensure the power supply of the load in case of an external grid failure. It will have two approaches:

- **Hot standby:** A storage system or the Diesel power plant would be connected and synchronized to the grid and in case of a grid failure that generation asset would work as voltage source.
- **Cold standby:** In case of a grid failure a storage system or the diesel power plant would start and would work as voltage source.

Virtual Power Plant

The Cloud TSC will be able to communicate and command isolated power plants, commanded by a TSC, from the cloud as if they were only one power plant.





Thank you!

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