REIVAX

E-BOOK

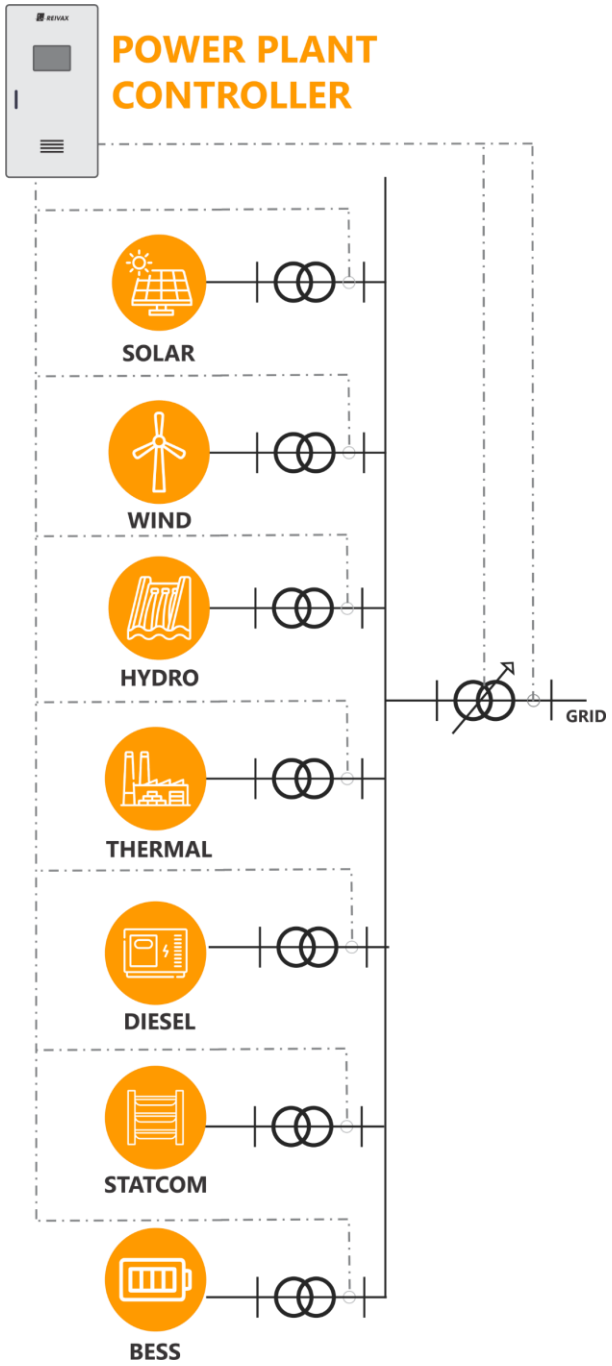
PPC

POWER PLANT CONTROLLER

PHOTOVOLTAIC | WIND | HYBRID | BESS

*The recent inclusion and expansion of renewable energy in the global electricity generation market requires **proper control, monitoring, and operation** to ensure system stability and harmonious functioning.*

With its extensive experience and expertise in primary control, REIVAX expands its reach by offering the robust and flexible **Power Plant Controller (PPC)** and advanced SCADA Elipse automation for centralized power plants.



APLICATIONS

BLACK
START

FREQUENCY /
VOLTAGE REGULATION

TRANSMISSION
RELIEF

PEAK
SHAVING

ENERGY
ARBITRAGE

REIVAX

DISTRIBUTED GENERATION AND **CENTRALIZED GENERATION**

Considering the possibility of small-scale energy generation, such as residential systems, it is important to define the difference between small-scale and large-scale generation.

DISTRIBUTED GENERATION (DG)

Different owners and multiple point of interconnection

Challenges in secondary control: Greater difficulty in managing and coordinating distributed generation.

Limited Power: Typically has a capacity of less than 5 MW.

DISTRIBUTED GENERATION (DG) AROUND THE WORLD

Greece and Mexico	≤ 0.5MW
UK, Ireland, Nevada	≤ 1MW
Oregon	≤ 5MW
Texas	≤ 10MW

REIVAX OPERATES HERE

CENTRALIZED GENERATION (CG)

Production in large facilities (solar plants, wind farms, etc.) and by a single owner.

Geographical proximity of generation units.

Centralized control by the PPC.

Capacity greater than 5 MW.

In compliance with the Grid Codes and commercialization standards.

For large power plants, control and monitoring require advanced solutions.

REIVAX is the ideal partner to meet these needs with efficiency and precision.

REIVAX

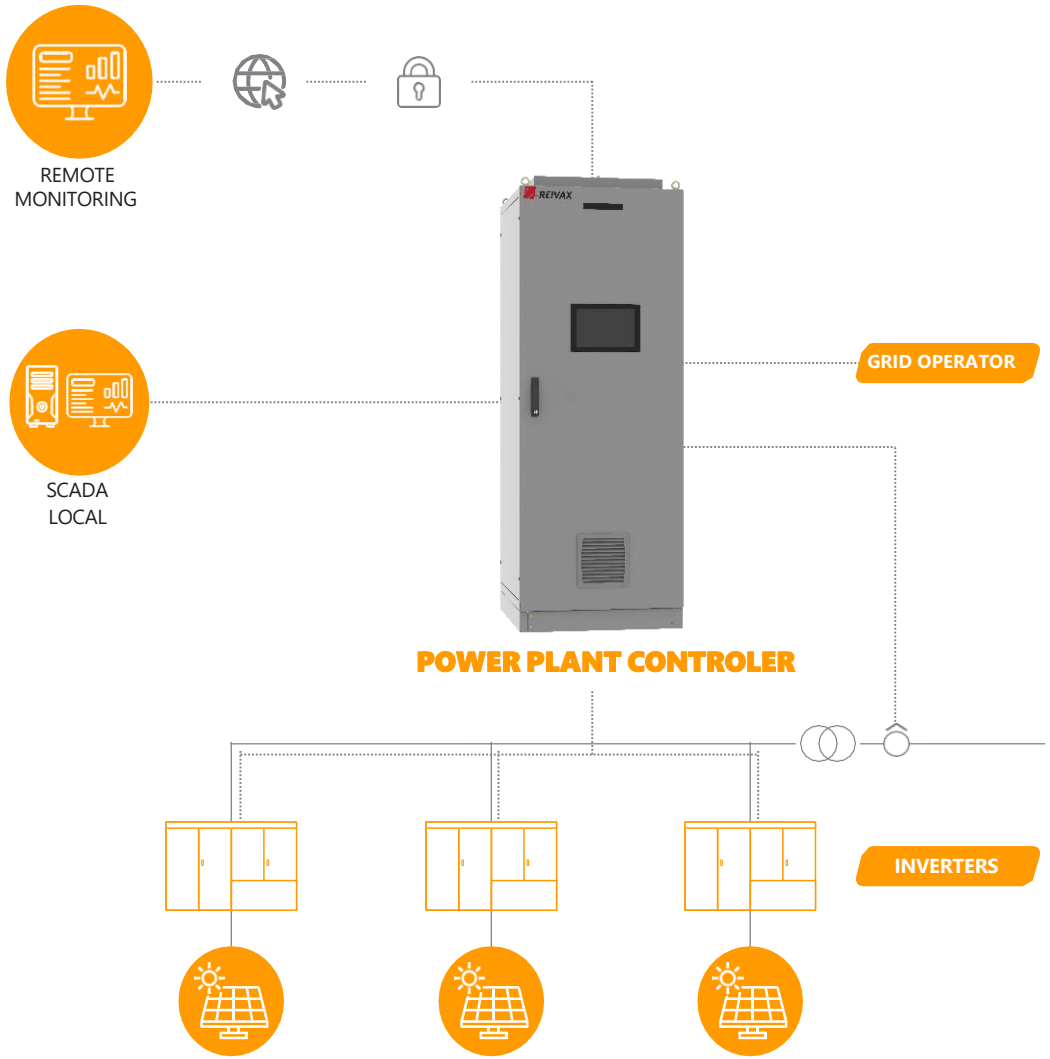
PPC PV

POWER PLANT CONTROLLER PHOTOVOLTAIC

PPC | PV

POWER PLANT CONTROLLER
PHOTOVOLTAIC

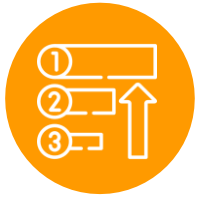
The **Photovoltaic Power Plant Controller - PPC | PV** specifically coordinates solar inverters (Centralized or String) and other PPCs, organizing the joint operation of the equipment, enabling the plant to achieve its objectives regarding the connection point with the electrical system, in compliance with the Grid Code.



APLICATION

COMPLIANCE WITH
GRID CODE

FREQUENCY /
VOLTAGE REGULATION



GENERATION
PRIORITIZATION

SHADING
COMPENSATION

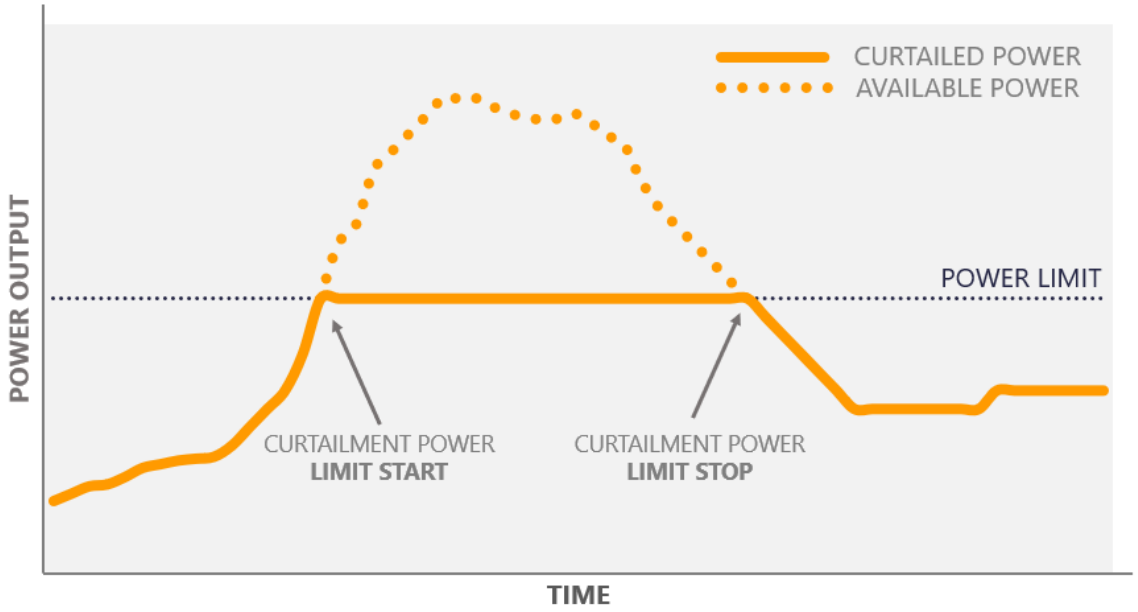
PEAK
SHAVING

REIVAX

COMPLIANCE WITH GENERATION RULES

Control Modes at the Connection Point:

- **P** **Active Power:** Fixed or frequency-dependente
- **Q** **Reactive Power:** Fixed or voltage-dependent
- **PF** **Power Factor:** Fixed or active power-dependent
- **V** **Voltage:** Fixed or static



PPC | PV
POWER PLANT CONTROLLER
PHOTOVOLTAIC

COMPLIANCE WITH GENERATION RULES

Control Modes at the Connection Point:

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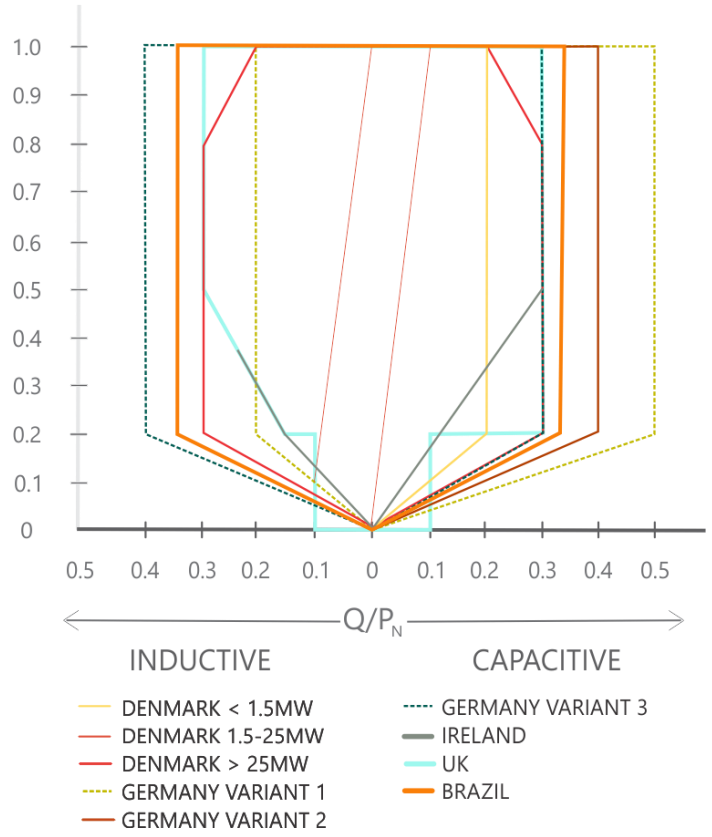

REIVAX

PPC | PV
POWER PLANT CONTROLLER PHOTOVOLTAIC

COMPLIANCE WITH GENERATION RULES

Control Modes at the Connection Point:

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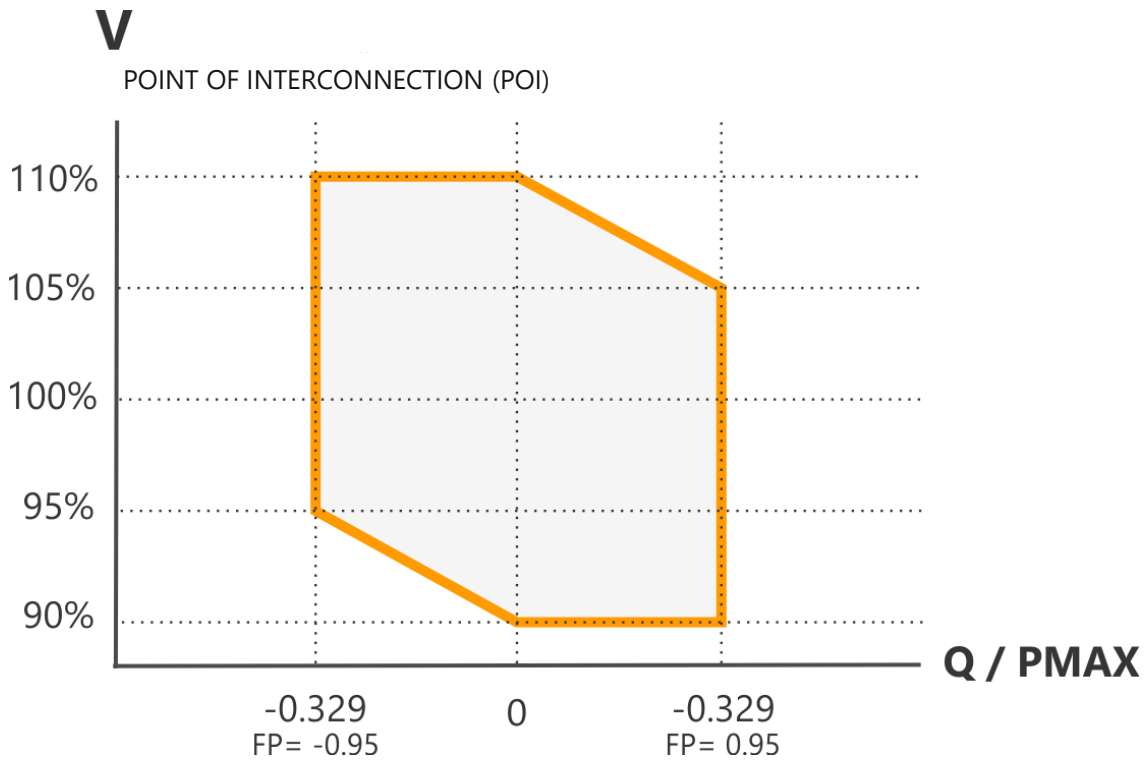


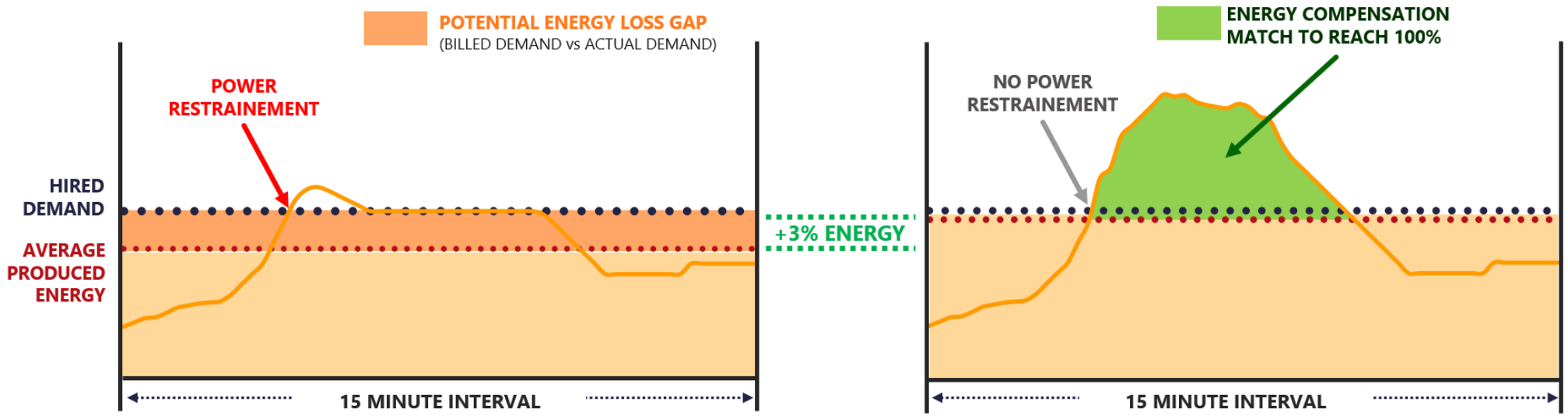
REIVAX

PPC | PV
POWER PLANT CONTROLLER
PHOTOVOLTAIC

OPTIMIZATION OF ENERGY GENERATION

GENERATION DEMAND CONTROL

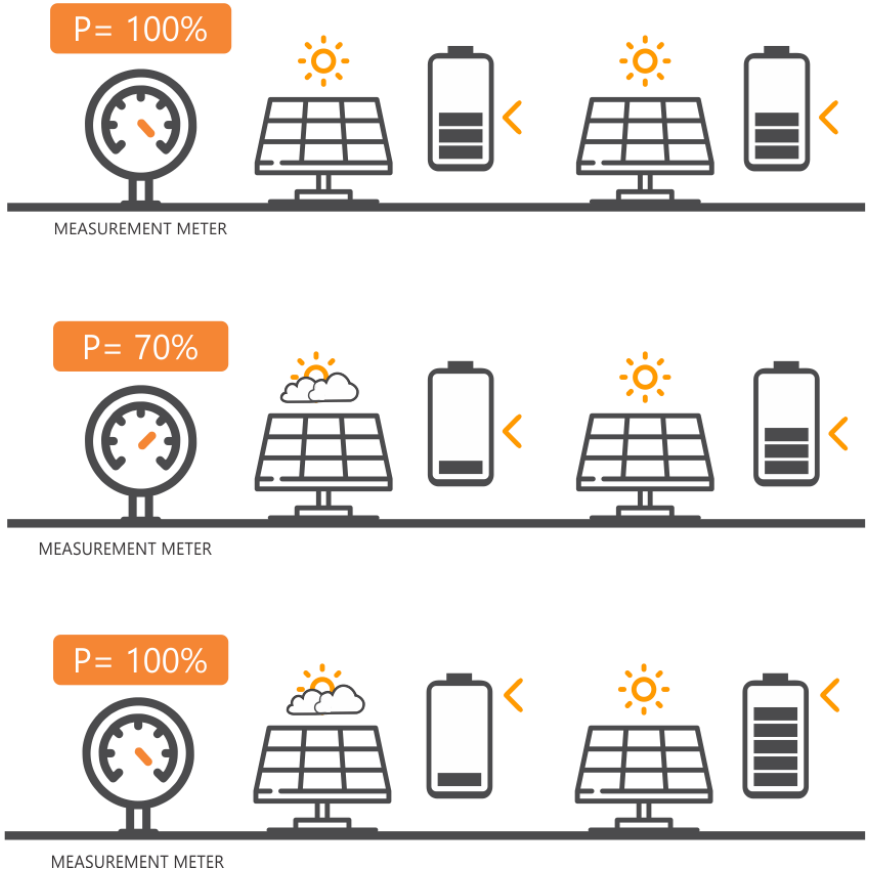
Maximization of the utilization of contracted demand,
increasing generation while there is excess demand to be used
(billed demand).



OPTIMIZATION OF ENERGY GENERATION

SHADING COMPENSATION

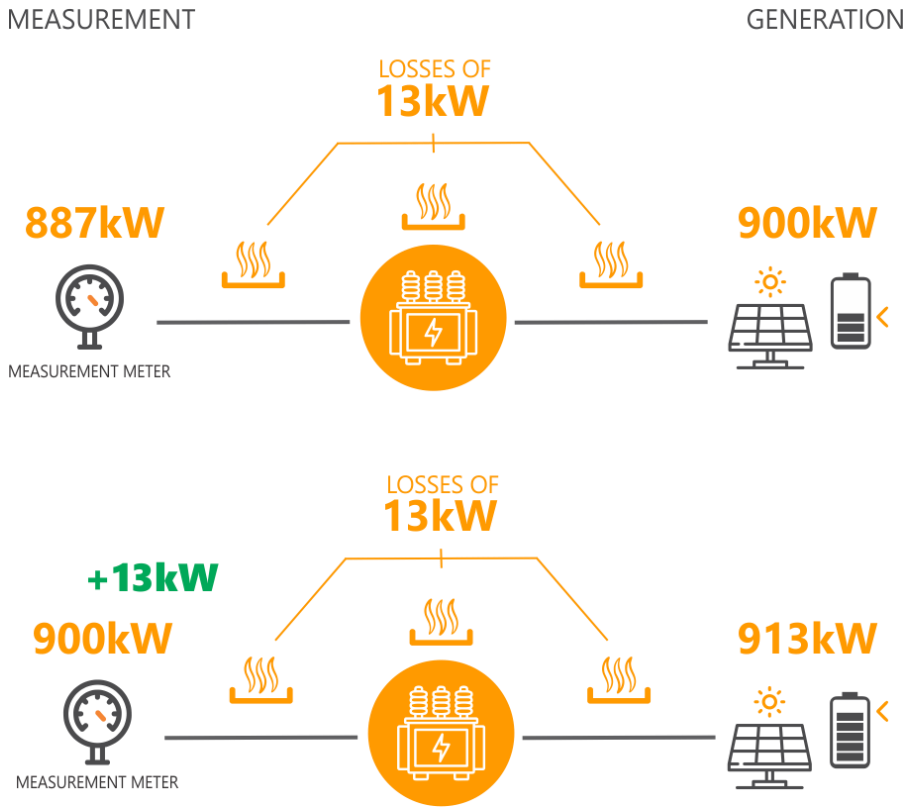
When a module has a generation deficit, the PPC commands an increase in the generation of other modules in the same cluster, thus allowing for the compensation of this deficit and maintaining high generation levels for the cluster.



OPTIMIZATION OF ENERGY GENERATION

COMPENSATION FOR ELECTRIC LOSSES IN THE PLANT AND LOCAL LOADS

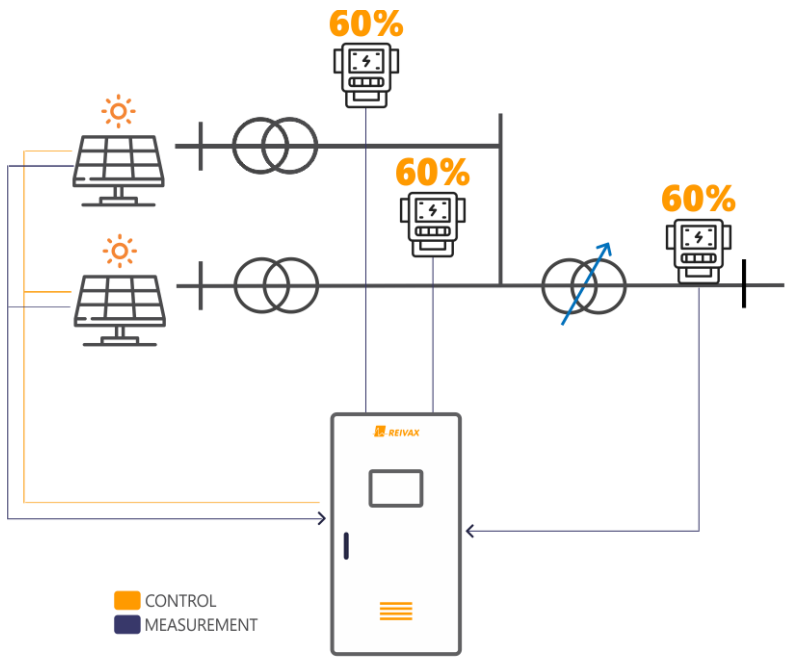
Generation targets compensate for the electric losses present in the plant and local loads, allowing for increased generation at the substation feeder.



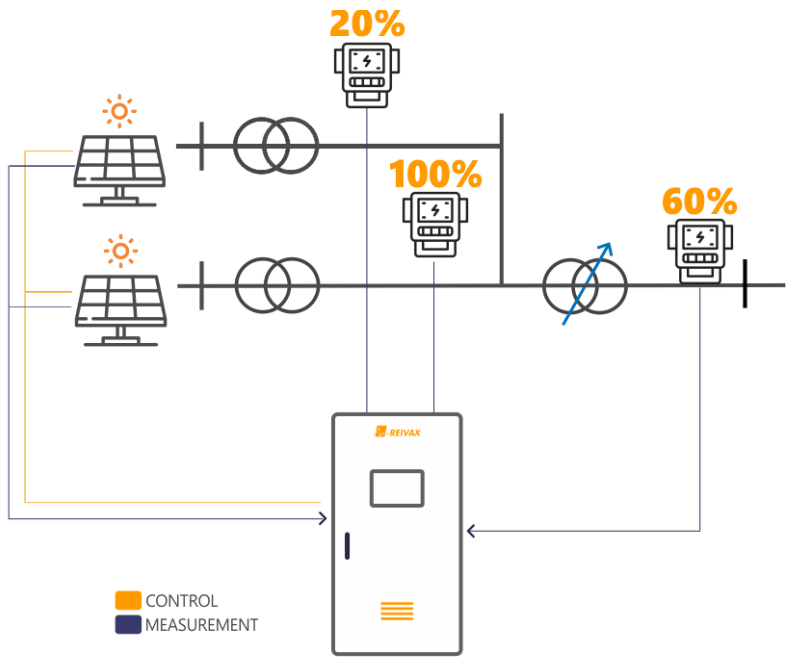
PPC | PV
POWER PLANT CONTROLLER PHOTOVOLTAIC

PRIORITIZATION OF GENERATION BY EACH SOLAR PLANT

During curtailment situations, it is necessary to reduce the plant's power, which can be done either equally or by prioritizing certain power plants. Prioritization is particularly important when the parks have distinct have distinct power purchase agreement, allowing for one contract to be favored over another according to its relevance and contractual needs.



WITHOUT GENERATION PRIORITIZATION



WITH GENERATION PRIORITIZATION

REIVAX

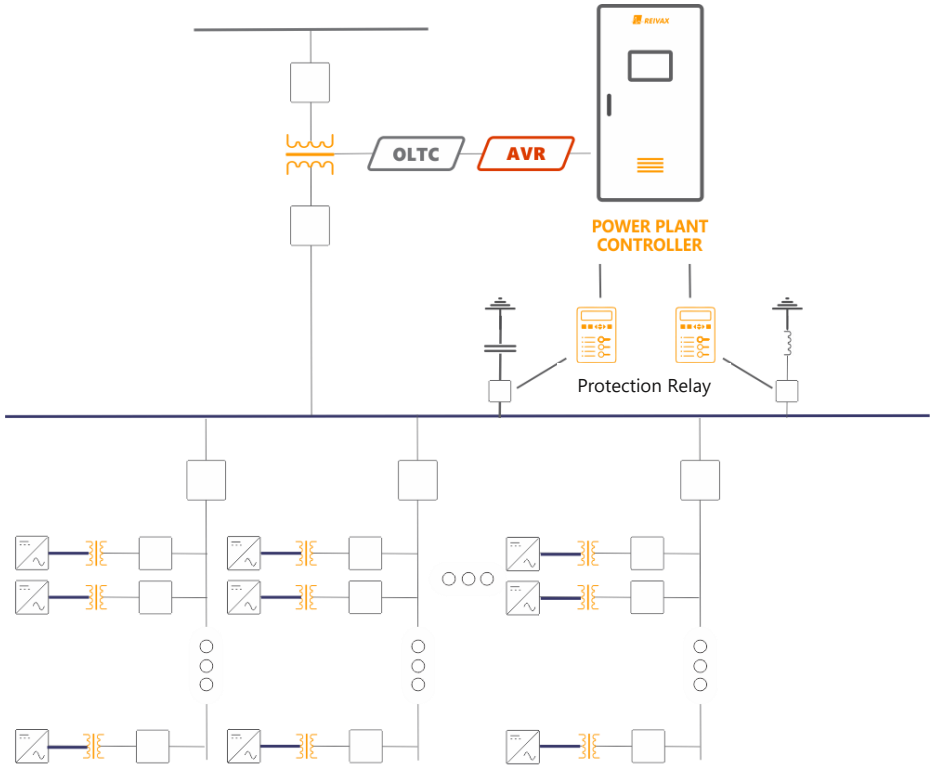
JOINT AND COORDINATED CONTROL OF THE OTHER PLANT ASSETS

CAPACITORS/INDUCTORS AND TRANSFORMER TAPS:

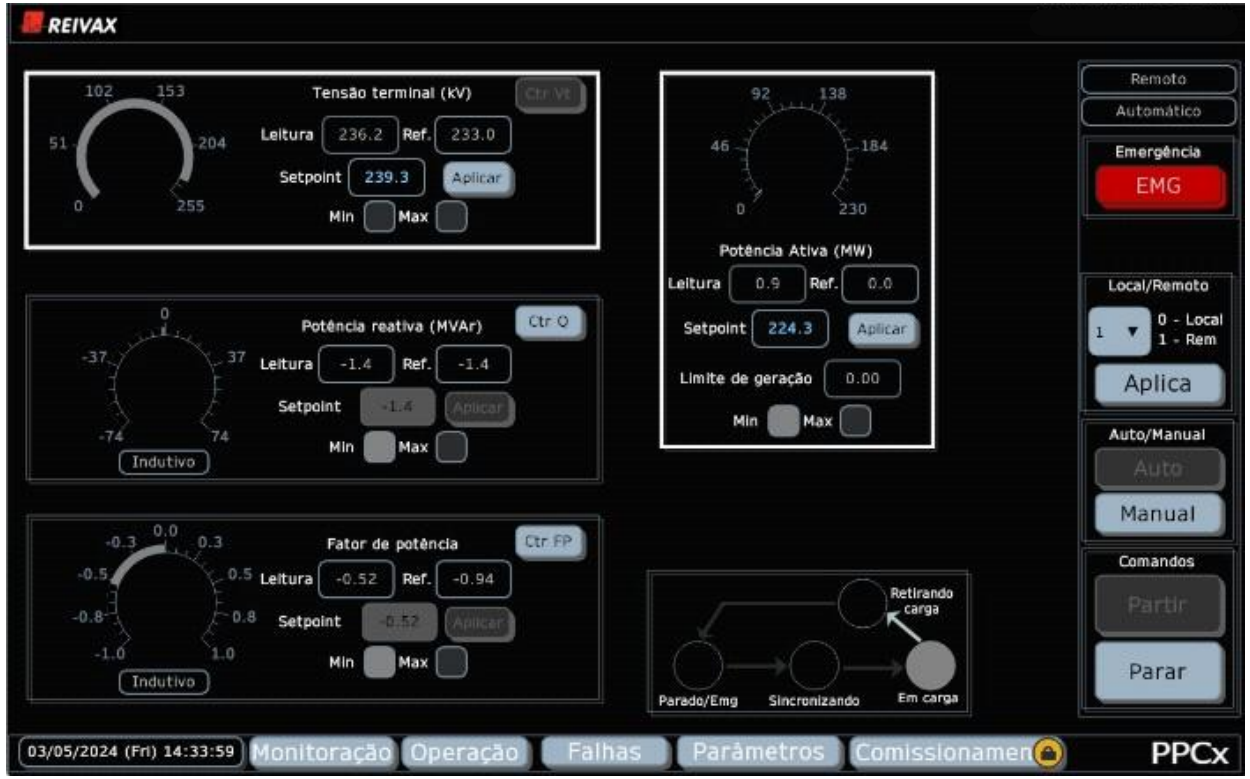
Automated connection/disconnection of capacitor/inductor banks and automated switching of the tap changer position on the generator step-up transformer.

DYNAMIC OVERMAGNETIC FLOW LIMITERS (ANSI 24) AND MAXIMUM POWER LIMITERS (ANSI 32):

To prevent unfavorable conditions in the transformers. Additionally, there are dynamic undervoltage and overvoltage limiters (ANSI 27/59) for medium voltage lines and generator outputs, aiming to comply with the operating limits of auxiliary loads.



IHM & SCADA



EASE OF USE AND SIMPLIFICATION FOR OPERATION AND MAINTENANCE

HMI and SCADA in compliance with ISA-101 (Human Machine Interfaces for Process Automation Systems), facilitating operation and maintenance.

SCADA is a tool for both local and remote use, while HMI focuses on local operation.

PPC | PV
POWER PLANT CONTROLLER
PHOTOVOLTAIC

TECHNICAL
FEATURES

COMMUNICATION INTERFACE

Ethernet

Single-mode or multimode fiber optic

Rs485

PROTOCOL

INDUSTRIAL
Modbus TCP, Modbus RTU, IEC 60870-5-101, IEC 60870-5-104, IEC 61850, DNP3, OPC DA, OPC UA,
Profibus DP, Ethernet IP

NETWORK
VLAN (IEEE 802.1Q), QoS (IEEE802.1D), RSTP (IEEE 802.1w) e MRP;

CONTROL PANEL

POWER SUPPLY
125 V DC / 100-240 V AC (optional)

UPS
24 V DC, 5 A, 7.2 Ah (optional)

IP RATING
IP54 (sheltered)

REIVAX

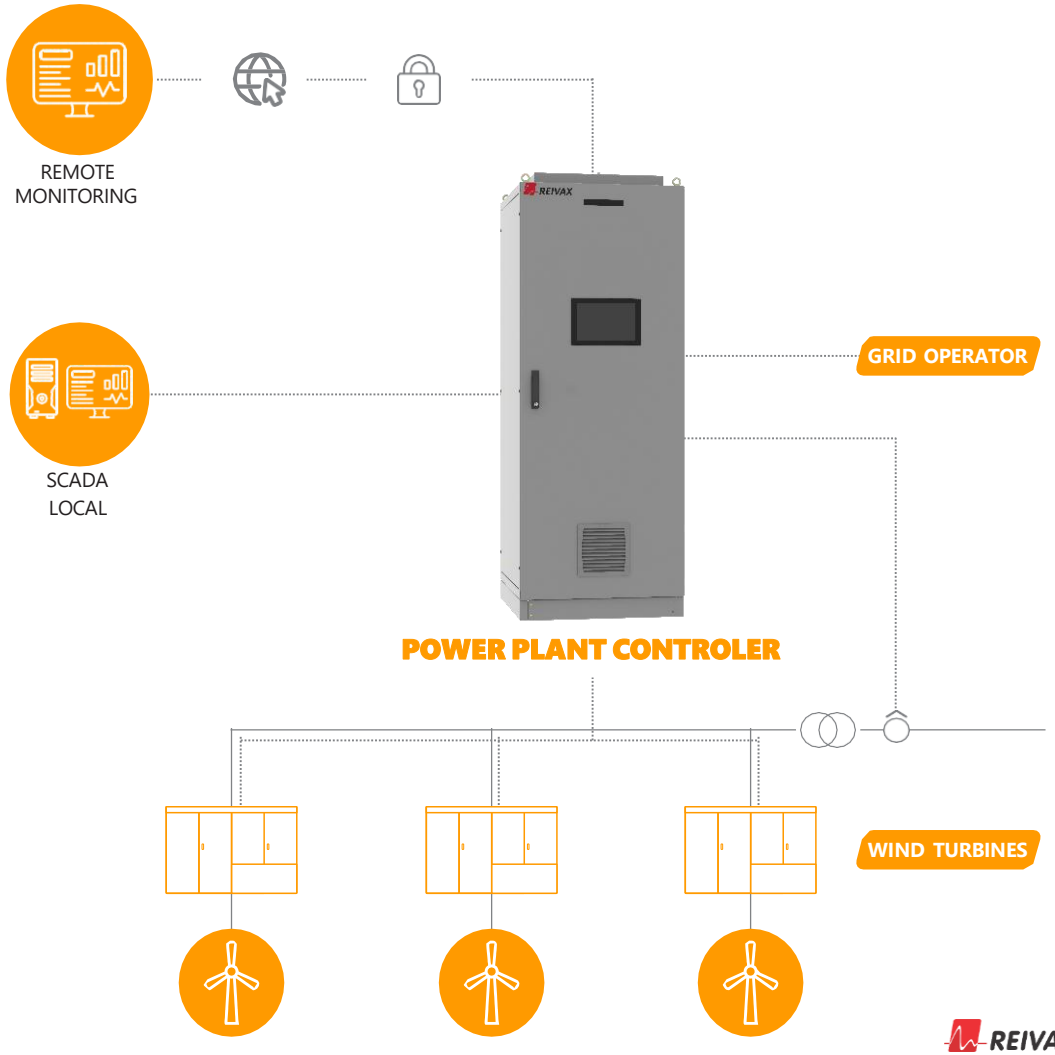
PPC WIND

POWER PLANT CONTROLLER WIND

PPC | W

POWER PLANT CONTROLLER
WIND

The **Wind Power Plant Controller - PPC | W** coordinates wind turbines or other wind PPCs, organizing the joint operation of the equipment, enabling the plant to achieve its objectives regarding the connection point with the electrical system, in compliance with the Grid Code.

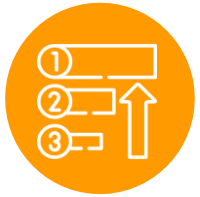


REIVAX

APLICATION

COMPLIANCE WITH
GRID CODE

FREQUENCY /
VOLTAGE REGULATION



GENERATION
PRIORITIZATION

GENERATION
OPTIMIZATION

PEAK
SHAVING

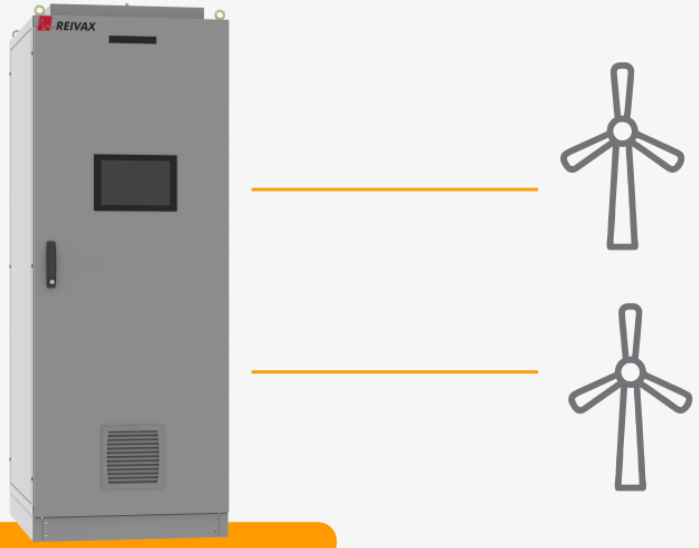
REIVAX

PPC | W
POWER PLANT CONTROLLER
WIND

TOPOLOGY

PRIMARY PPC

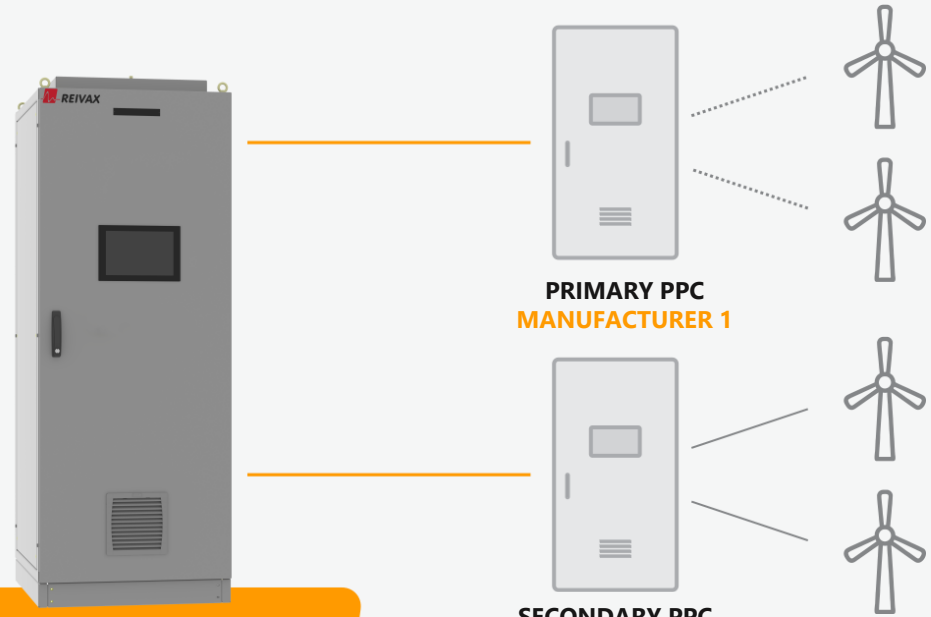
Used in wind plants that do not have other PPCs, being connected directly to the wind turbine generator.



PRIMARY PPC
REIVAX

SECONDARY PPC

Used in wind plant that already have other PPCs, connecting to them and unifying the plant's control.



SECONDARY PPC
REIVAX

COMPLIANCE WITH GENERATION RULES

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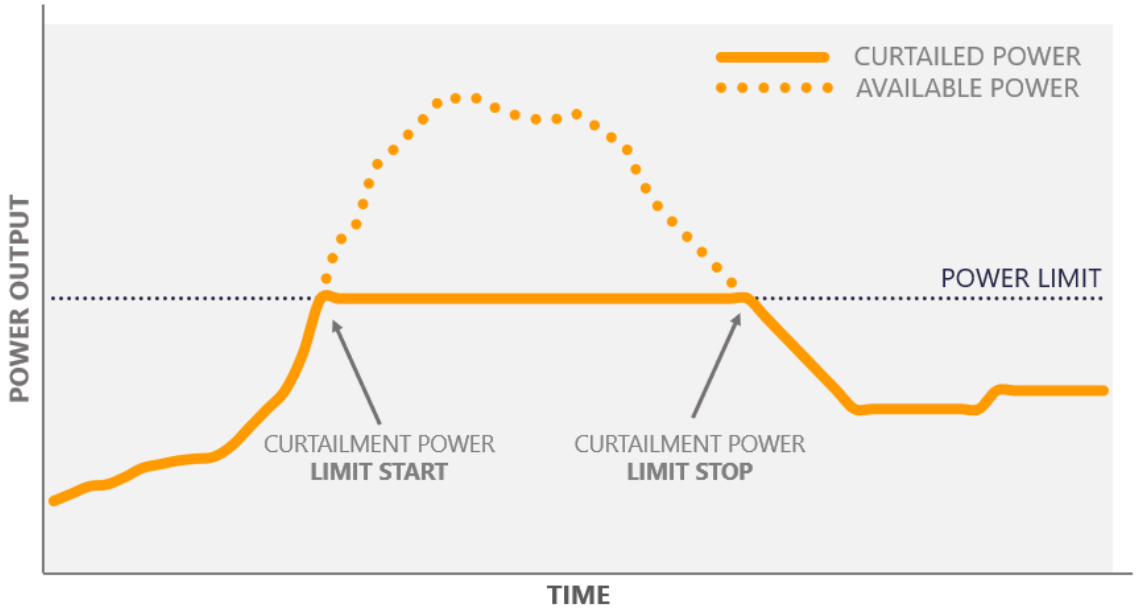

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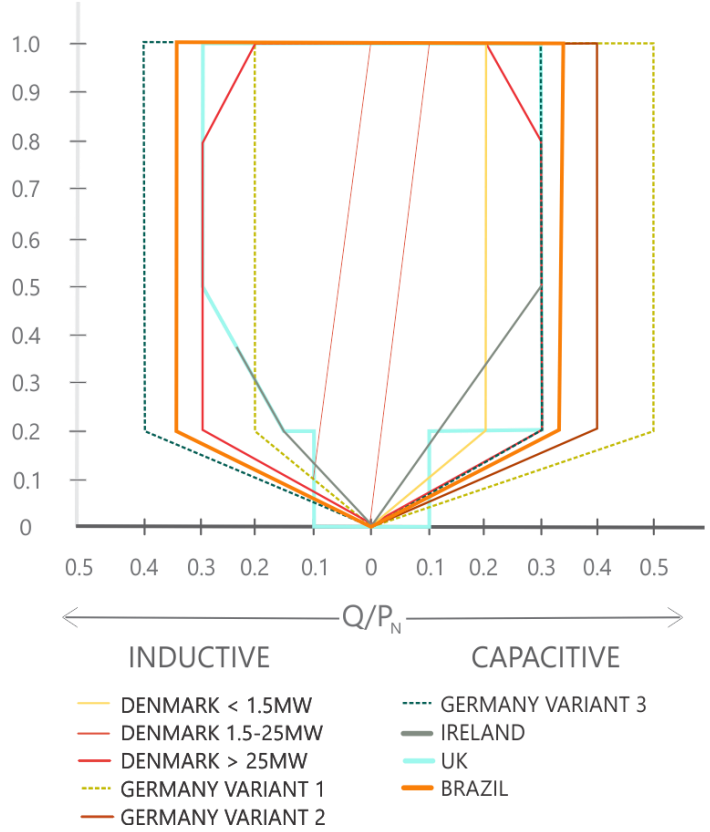

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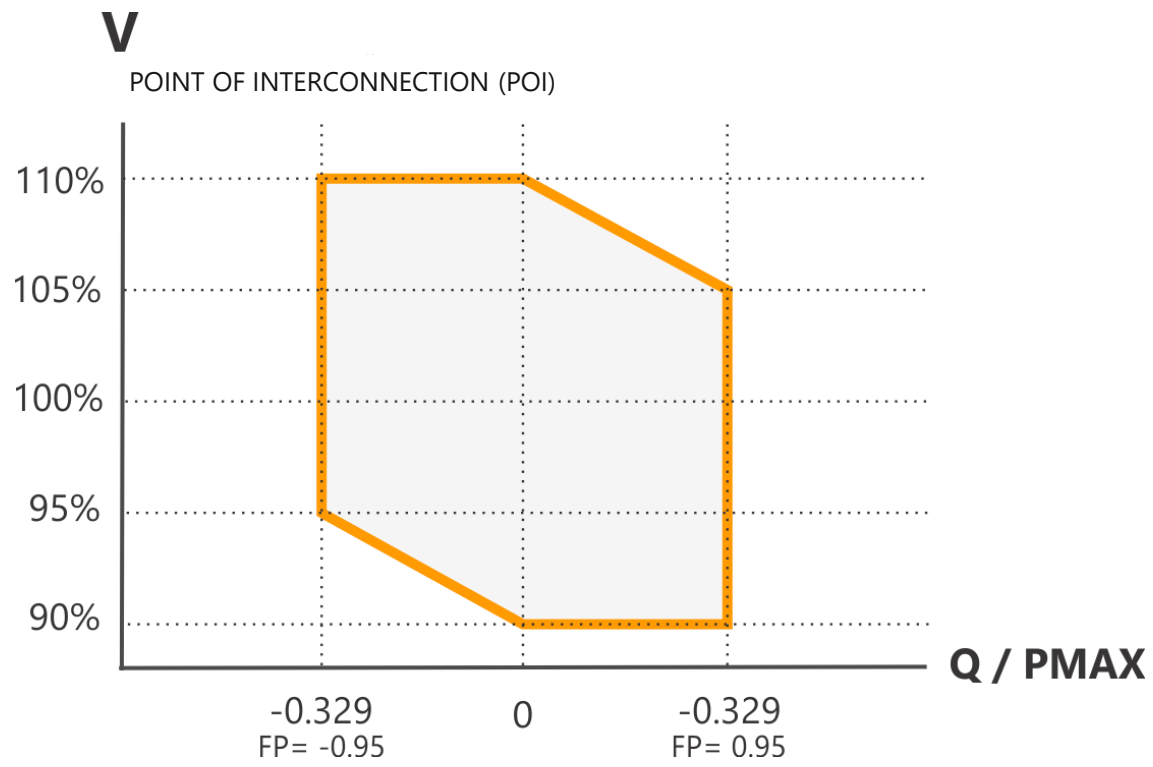

OPTIMIZATION OF ENERGY GENERATION

GENERATION DEMAND CONTROL

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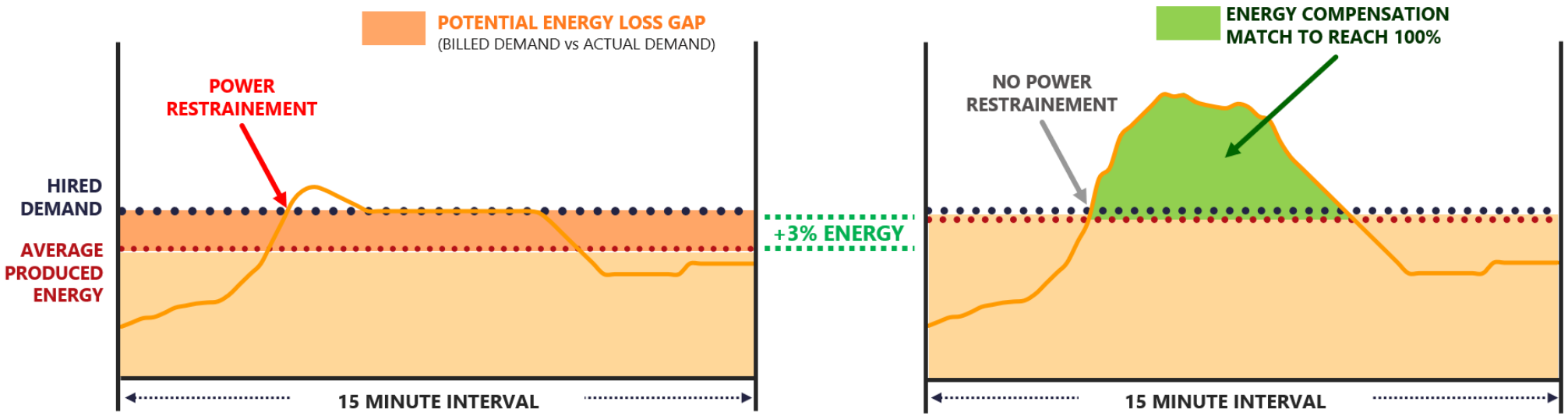
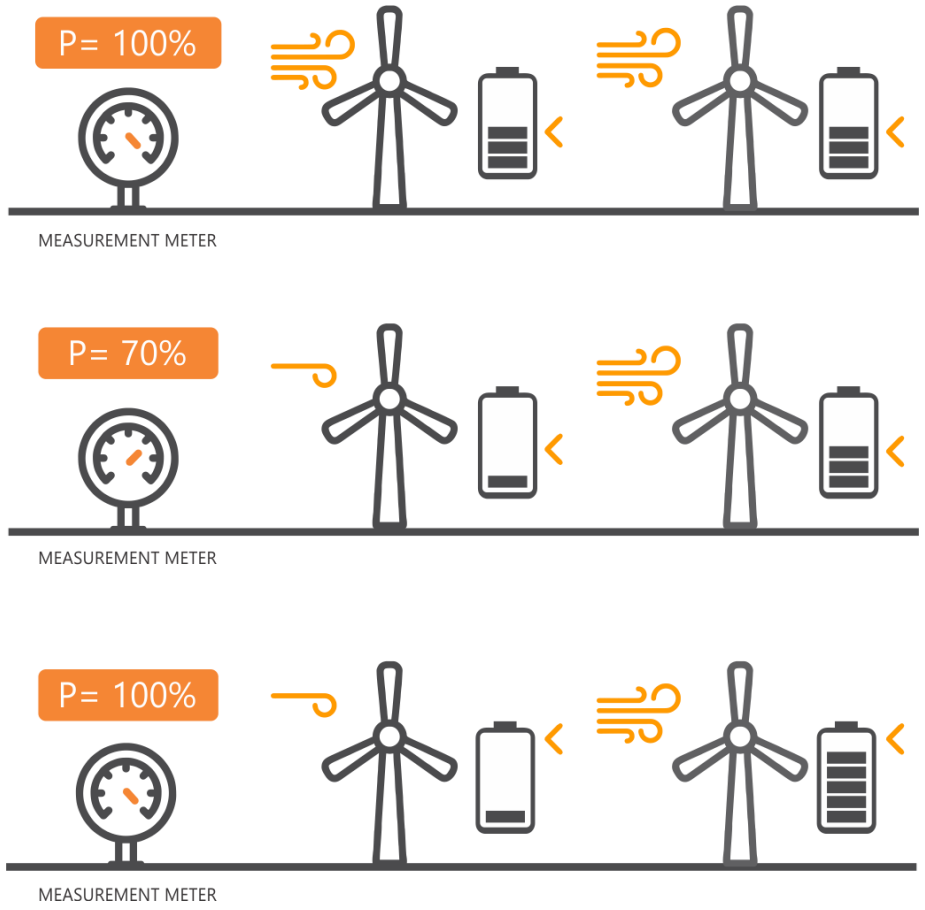


OPTIMIZATION OF ENERGY GENERATION

COMPENSATION FOR WIND REDUCTION

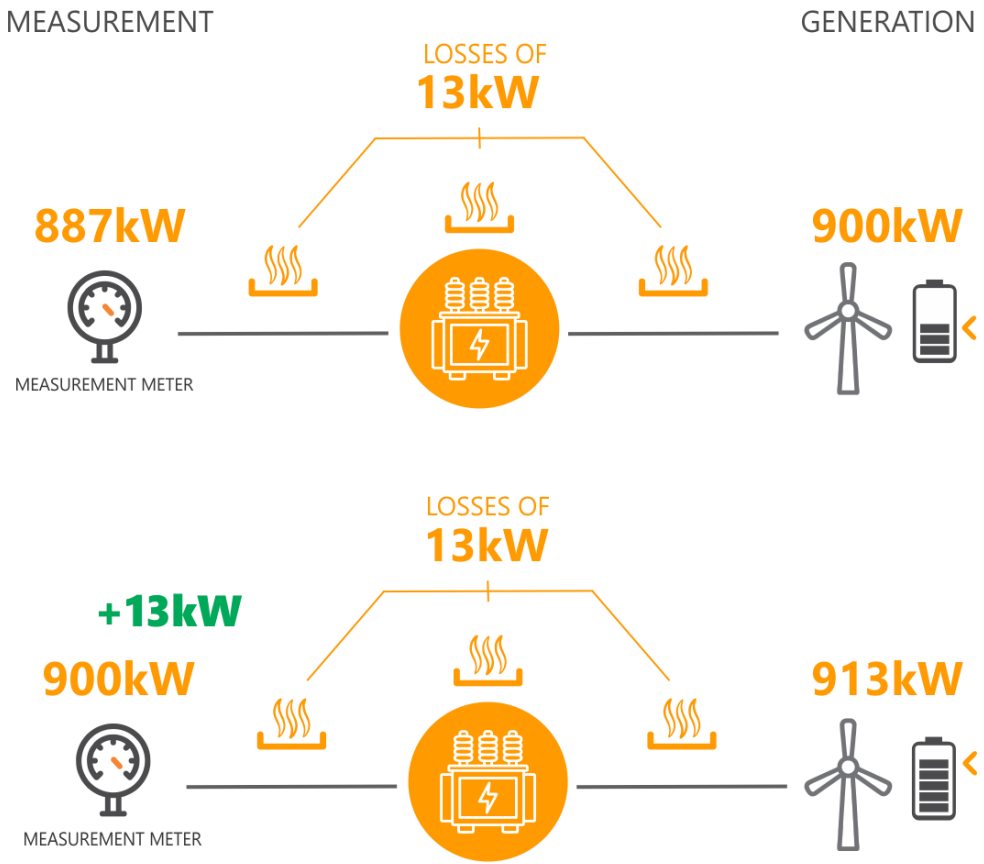
When a wind turbine experiences a generation deficit, the PPC commands an increase in the generation of other turbines in the same cluster, allowing for the compensation of this deficit and maintaining high generation levels for the cluster.



OPTIMIZATION OF ENERGY GENERATION

COMPENSATION FOR ELECTRIC LOSSES IN THE PLANT AND LOCAL LOADS

Generation targets compensate for the electric losses present in the plant and local loads, allowing for increased generation at the connection point.



PRIORITIZATION OF GENERATION BY EACH SOLAR PLANT

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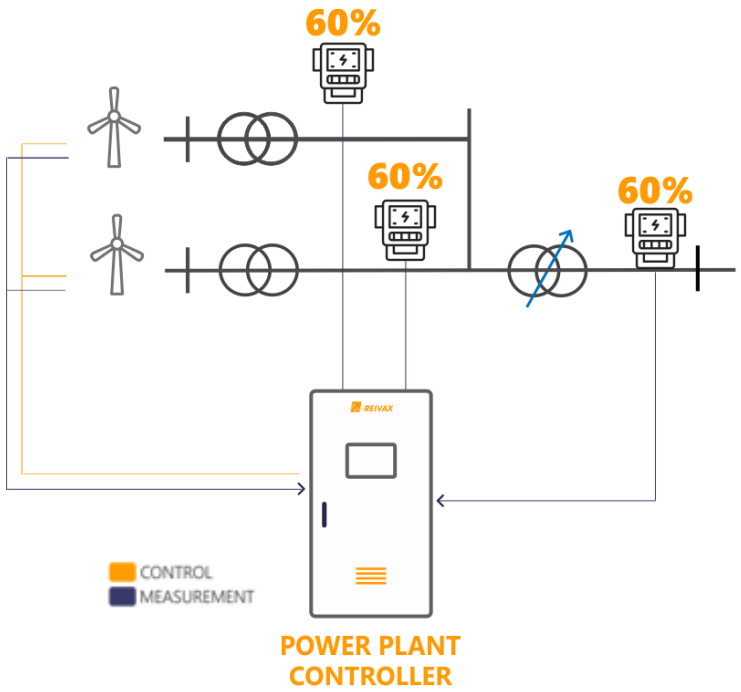
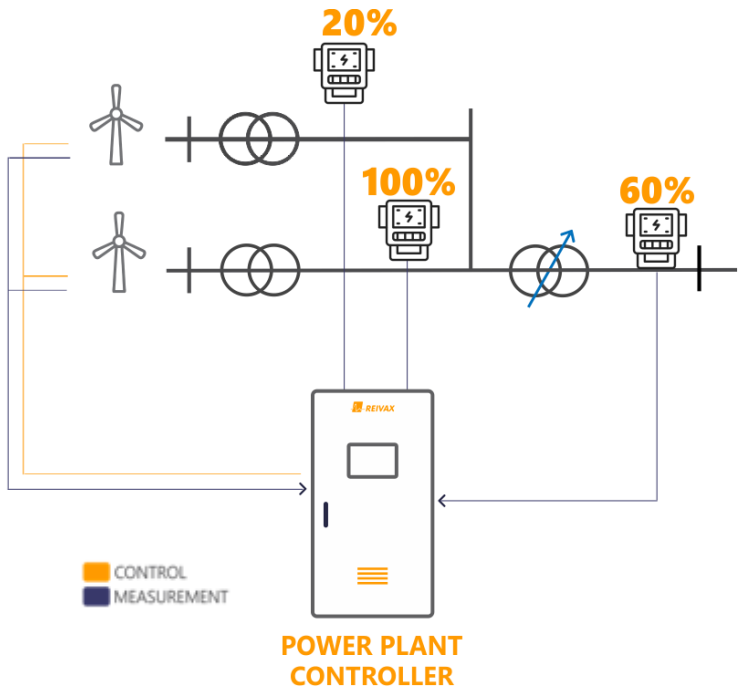


WITHOUT GENERATION PRIORIZATION



WITH GENERATION PRIORIZATION

PPC | W
POWER PLANT CONTROLLER WIND

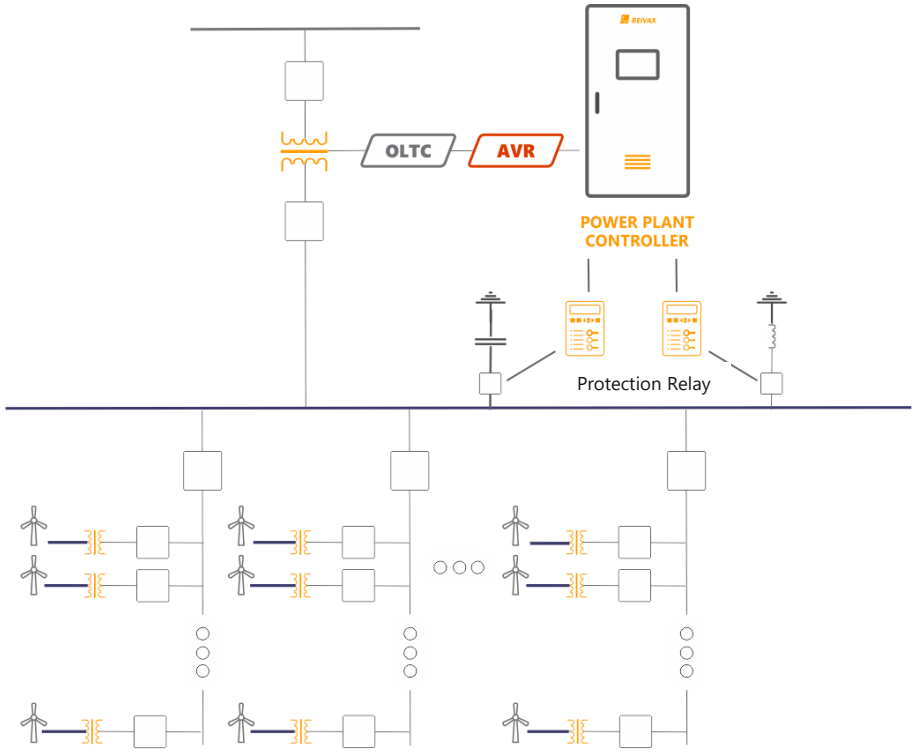
JOINT AND COORDINATED CONTROL OF THE OTHER PLANT ASSETS

CAPACITORS/INDUCTORS AND TRANSFORMER TAPS:

Automated connection/disconnection of capacitor/inductor banks and automated switching of the tap changer position on the step-up transformer.

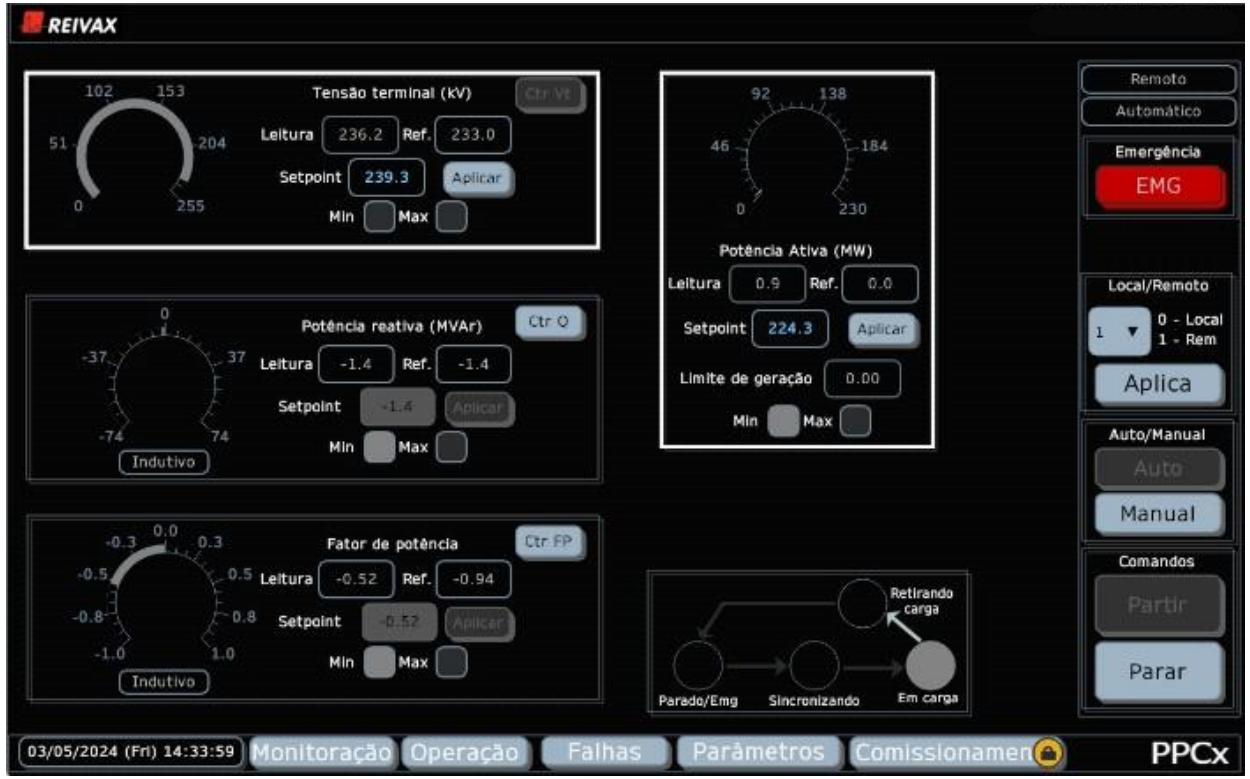
DYNAMIC OVERMAGNETIC FLOW LIMITERS (ANSI 24) AND MAXIMUM POWER LIMITERS (ANSI 32):

To prevent unfavorable conditions in the transformers. Additionally, there are dynamic undervoltage and overvoltage limiters (ANSI 27/59) for medium voltage lines and generator outputs, aiming to comply with the operating limits of auxiliary loads.



REIVAX

IHM & SCADA



EASE OF USE AND SIMPLIFICATION FOR OPERATION AND MAINTENANCE

HMI and SCADA in compliance with ISA-101 (Human Machine Interfaces for Process Automation Systems), facilitating operation and maintenance.

SCADA is a tool for both local and remote use, while HMI focuses on local operation.

PPC | W
POWER PLANT CONTROLLER WIND

TECHNICAL FEATURES

COMMUNICATION INTERFACE

Ethernet

Single-mode or multimode fiber optic

Rs485

PROTOCOL

INDUSTRIAL
Modbus TCP, Modbus RTU, IEC 60870-5-101, IEC 60870-5-104, IEC 61850, DNP3, OPC DA, OPC UA,
Profibus DP, Ethernet IP

NETWORK
VLAN (IEEE 802.1Q), QoS (IEEE802.1D), RSTP (IEEE 802.1w) e MRP;

CONTROL PANEL

POWER SUPPLY
125 V DC / 100-240 V AC (optional)

UPS
24 V DC, 5 A, 7.2 Ah (optional)

IP RATING
IP54 (sheltered)

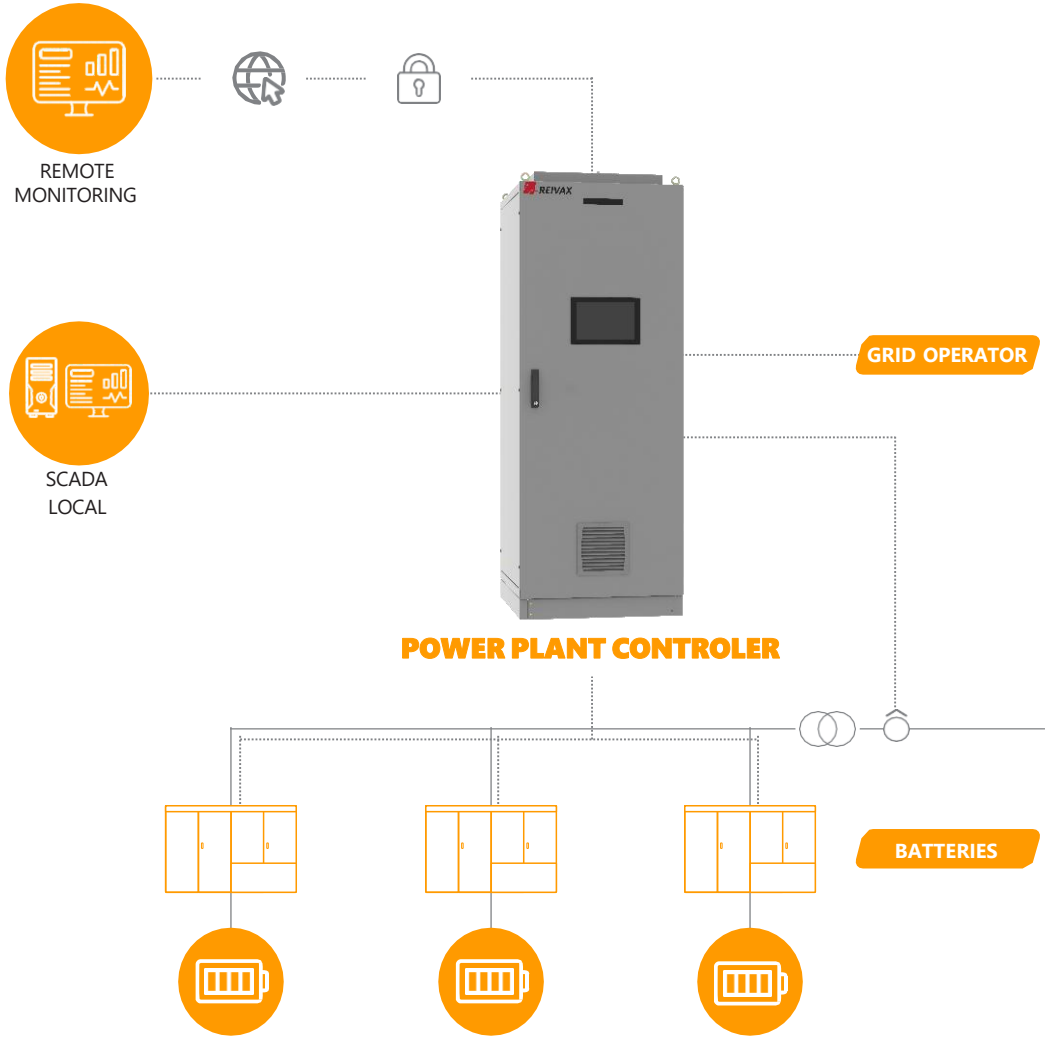
REIVAX


REIVAX
PPC BESS
POWER PLANT CONTROLLER
BESS

PPC | BESS

POWER PLANT CONTROLLER
BESS

The **Battery Energy Storage System Power Plant Controller** (**BESS | PPC BESS**) coordinates the storage and discharge of the battery set, aiming to achieve the plant's objectives regarding the connection point to the electrical system.



REIVAX

APLICATION

BLACK
START

FREQUENCY /
VOLTAGE REGULATION

TRANSMISSION
RELIEF

PEAK
SHAVING

PRICE
ARBITRAGE

SERVICE
LIFE

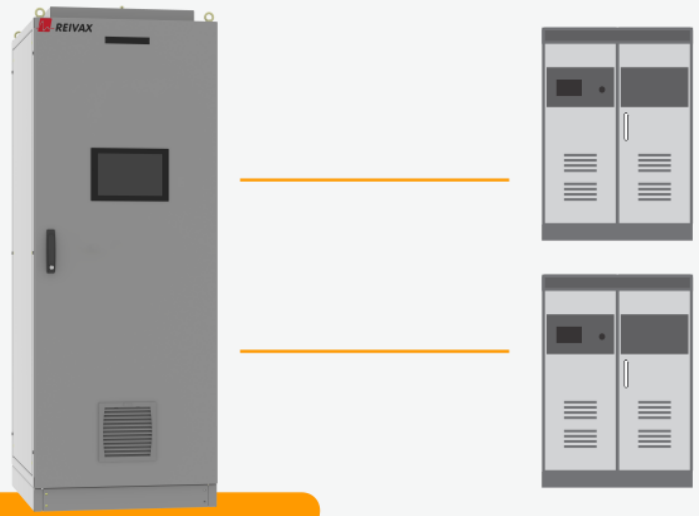
REIVAX

TOPOLOGY

PPC | BESS
POWER PLANT CONTROLLER
BESS

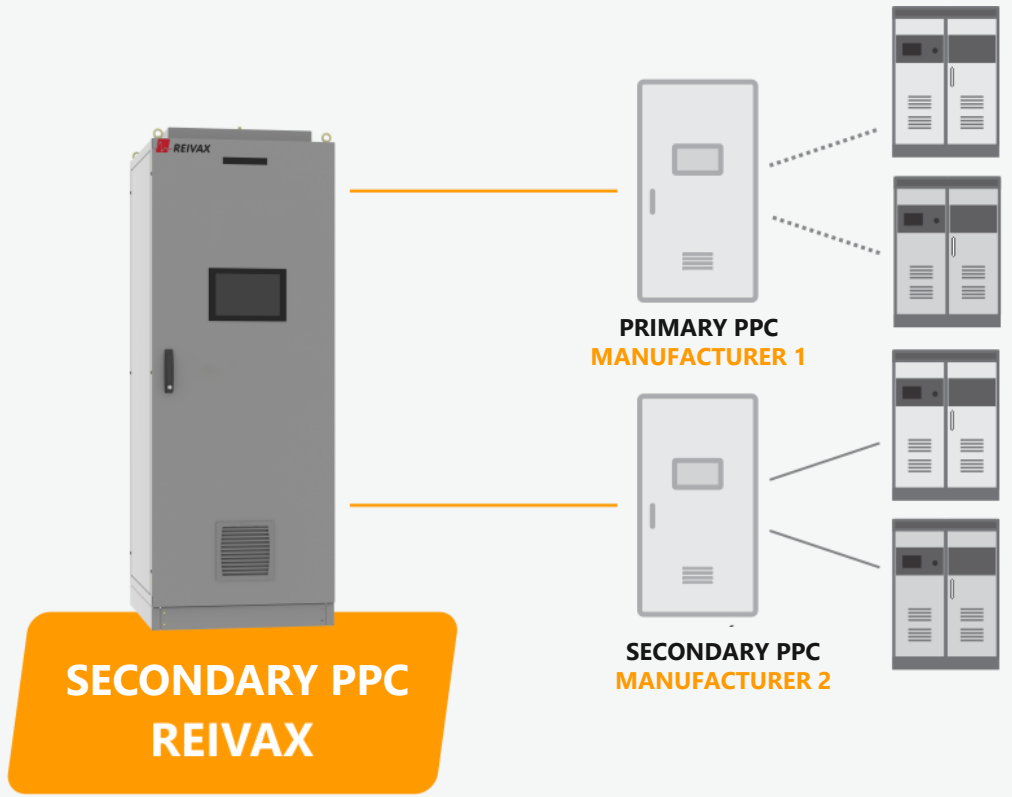
PRIMARY PPC

Used in plants that do not have other PPCs, being connected directly to the PCS.



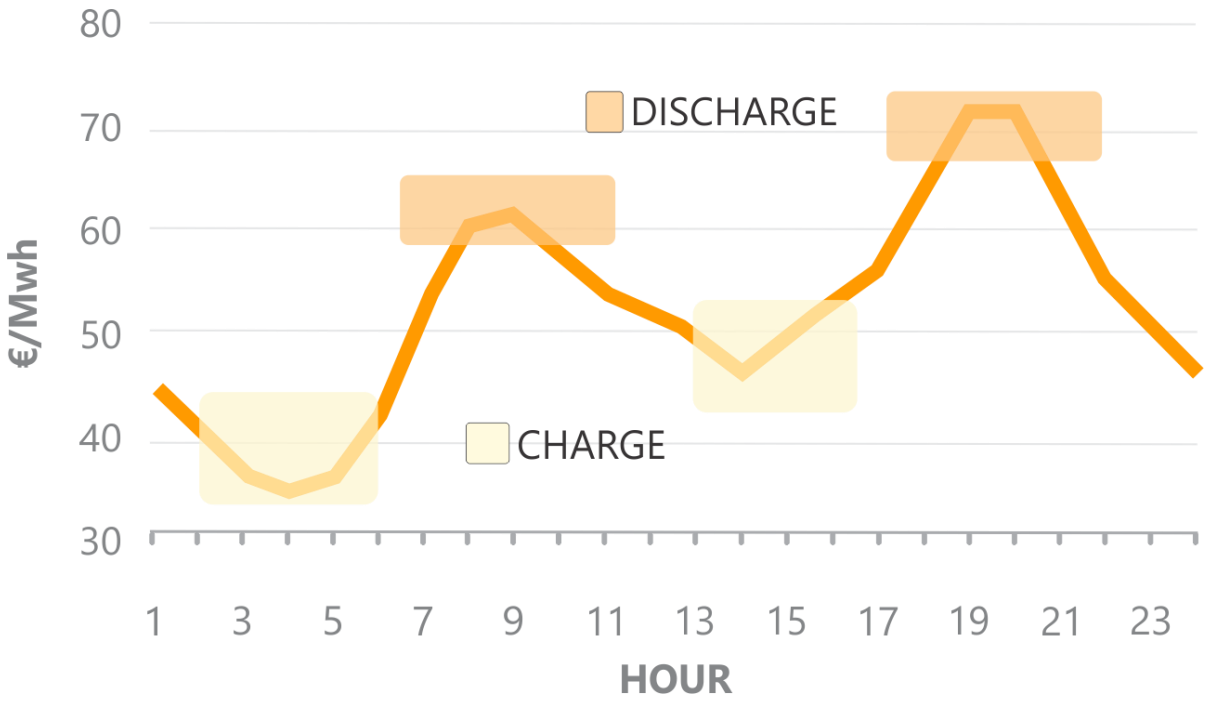
SECONDARY PPC

Used in plants that already have other PPCs, connecting to them and unifying the plant's control.



PPC | BESS
POWER PLANT CONTROLLER BESS

PRICE ARBITRAGE



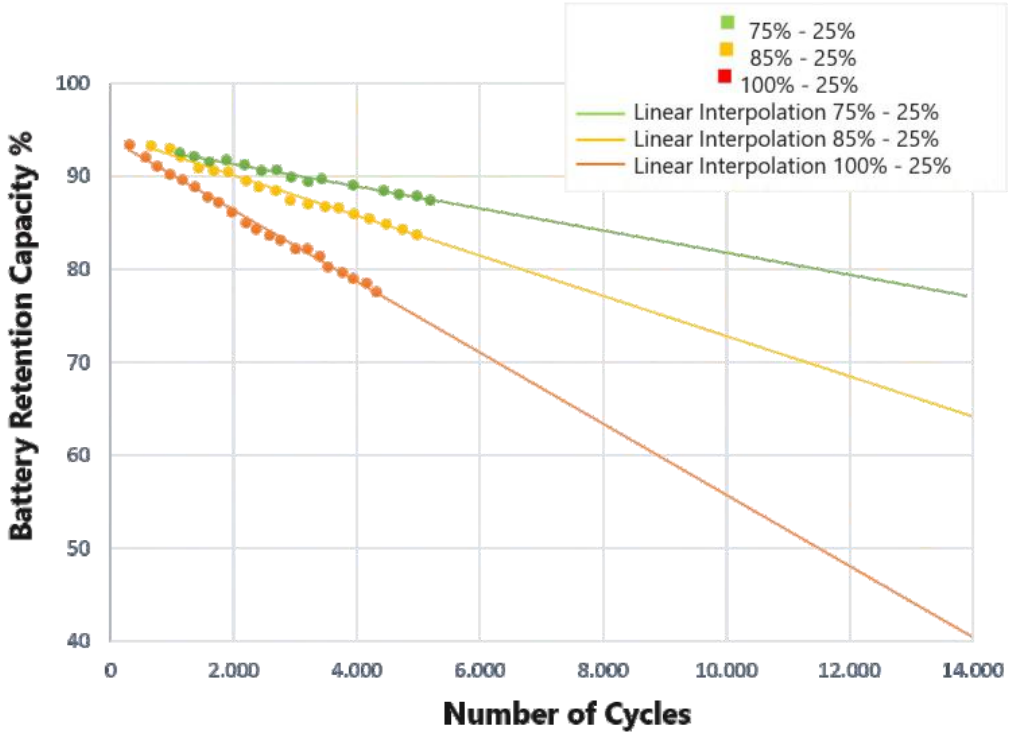
PROFIT MAXIMIZATION:
In markets with real-time pricing or time-of-use tariffs, the BESS PPC optimizes the storage and discharge of energy.

In this way, the plant injects energy into the grid at times of higher value, taking advantage of the most favorable tariffs.

REIVAX

PPC | BESS
POWER PLANT CONTROLLER
BESS

BATTERY LONGEVITY



Maximization of Battery Lifespan with Intelligent Control

HIGH INVESTMENT, HIGH EFFICIENCY:
Batteries represent a significant cost, making it essential to adopt control strategies that increase their durability.

OPTIMIZED OPERATION MODES:
While some strategies may achieve short-term goals, they can accelerate battery wear over time.

SMART CHOICE FOR THE FUTURE:
It is crucial to carefully select control modes that ensure efficient and sustainable performance for energy generation projects

REIVAX

PPC HYBRID

POWER PLANT CONTROLLER HYBRID

PPC | H

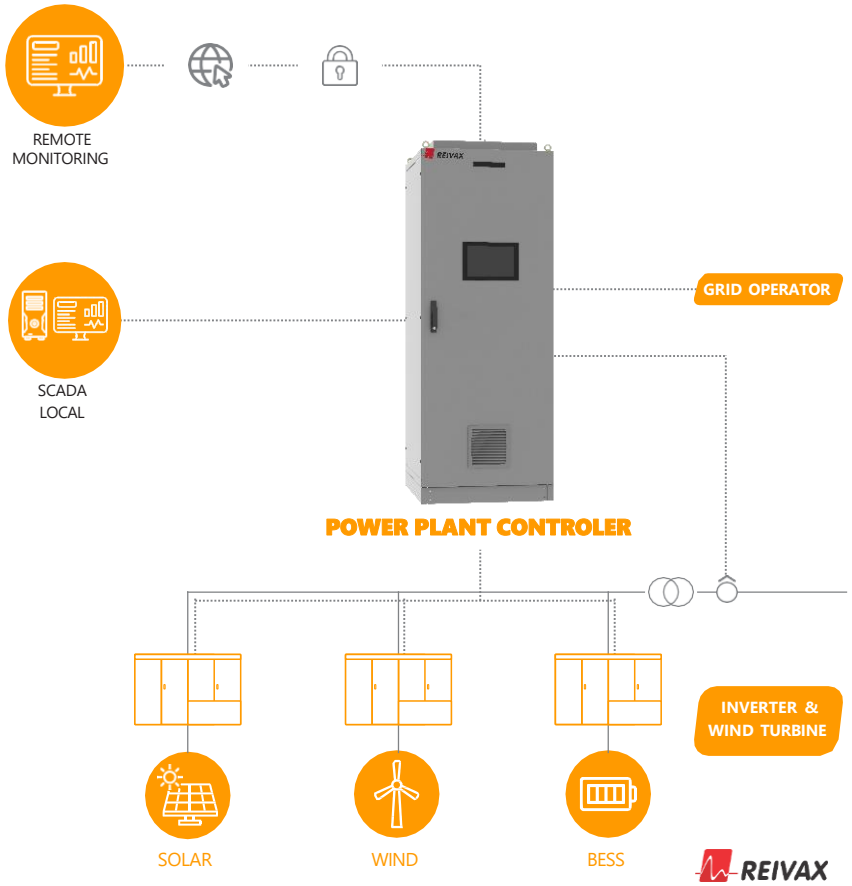
POWER PLANT CONTROLLER
HYBRID

The **Hybrid Power Plant Controller (PPC H)** coordinates different sources of generation and storage to ensure the joint operation of the equipment.

This allows for the achievement of the plant's control objectives and compliance with the access regulations at the grid code. Additionally, it integrates with other assets, performing **control and monitoring** at the **substation for capacitors/inductors and transformers.**

To increase energy production, it is possible to combine different technologies within the same cluster, taking advantage of the highest energy potential depending on the available resources at a given moment.

Furthermore, it is possible to make even existing plants with one technology operational hybrid.The objective of this association is generally to increase the capacity factor of the generating substation and avoid the expansion of the transmission power margin.

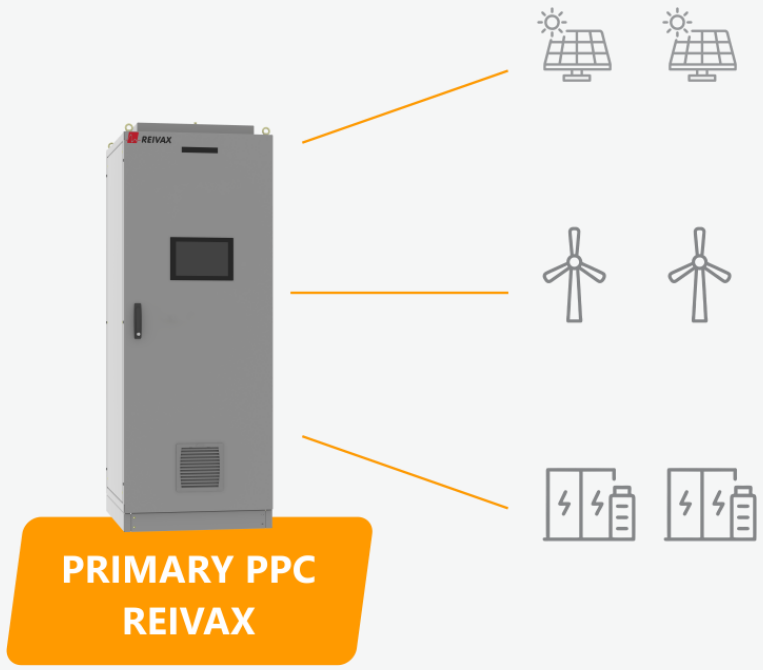


TOPOLOGY

PPC | H
POWER PLANT CONTROLLER
HYBRID

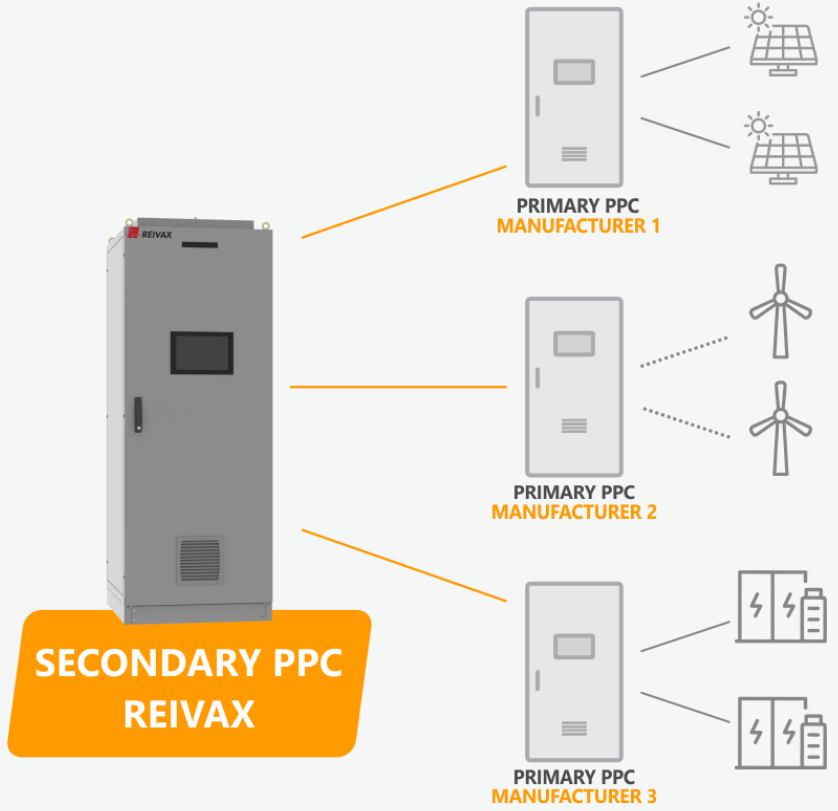
PRIMARY PPC

Used in wind plants that do not have other PPCs, being connected directly to the wind turbine generator.



SECONDARY PPC

Used in wind plant that already have other PPCs, connecting to them and unifying the plant's control.



PPC | H
POWER PLANT CONTROLLER
HYBRID

ENERGY SOURCES

SOLAR

The regularity of its generation is simultaneously its greatest virtue and its greatest limitation. Supplementing generation with batteries is a commonly made association aimed at increasing the number of hours of generation. It is also frequently added to wind generation to enhance the capacity factor of the combined system, without the need to expand the substation's capacity

WIND

This renewable source has the advantage of providing energy for 24 hours; however, it is difficult to predict its generation. Wind plants depend on winds with sufficient speed to produce energy, making the careful selection of tower installation sites necessary. One strategy that has been adopted is the association of wind plants with solar plants, as it is possible to harness good irradiation potential in almost any territory.

HYDRO

To better utilize the reservoir area and increase generation, hydropower plants can *"hybridize"* with floating photovoltaic modules. This association is referred to as a hydrosolar plant.

Solar panels benefit from the availability of installation area already belonging to the plant and from the natural cooling provided by the proximity to the lake water, allowing for increased panel efficiency.

THERMAL

Thermal power plants have the advantage of being less influenced by environmental conditions for their operation; however, they have a long startup time and face difficulties in generating power away from nominal conditions.

Thus, its typical use is as a baseload, ensuring a constant minimum level of generation. Its supplementation with solar photovoltaic generation aims to conserve fuel while still meeting the customer's energy needs.

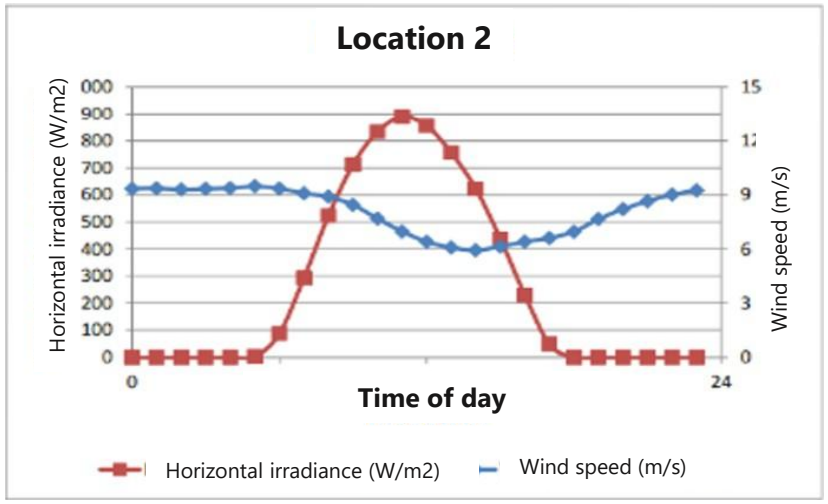
DIESEL

Quick startup, a wide power control range, and 24-hour availability make this source quite versatile. A negative aspect is the emission of pollutant gases due to diesel combustion. The combination with solar power balances fuel economy on one hand and flexibility and generation availability on the other.

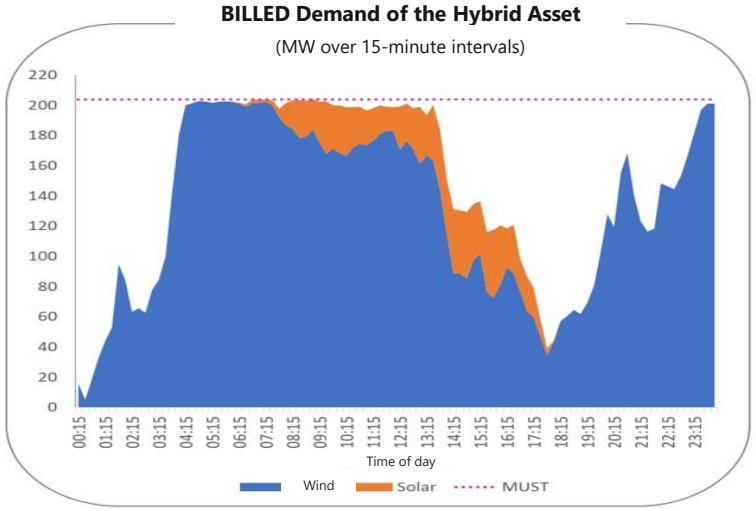
BESS

The availability of storage provides great flexibility for the plant that has it. It can operate during times when the alternative generation source has low efficiency, such as a diesel generator at low power. It can also complement generation during peak demand periods, a situation where it does not justify oversizing the generator for use only in this extreme case.

An example of hybridization potential can be seen in the image alongside, where for a given location we have the generation profile of two distinct sources as a function of the time of day. It is observed that, on average, the peak generation of each source occurs at different times for each type of source, around 12:00 for solar and between 00:00 and 06:00 for wind. Therefore, it is possible to utilize the same substation for the outflow of the combination of these sources.



In another case, we have a plant that originally only had wind generation and was expanded with the installation of a solar plant. An increase in the daily energy generation at the substation can be observed, without altering the contracted demand of the plant. In the case of high simultaneous generation from both sources, the PPC acts to limit the plant's demand to the contracted value.



Operation on 02/24/24

PPC | BESS
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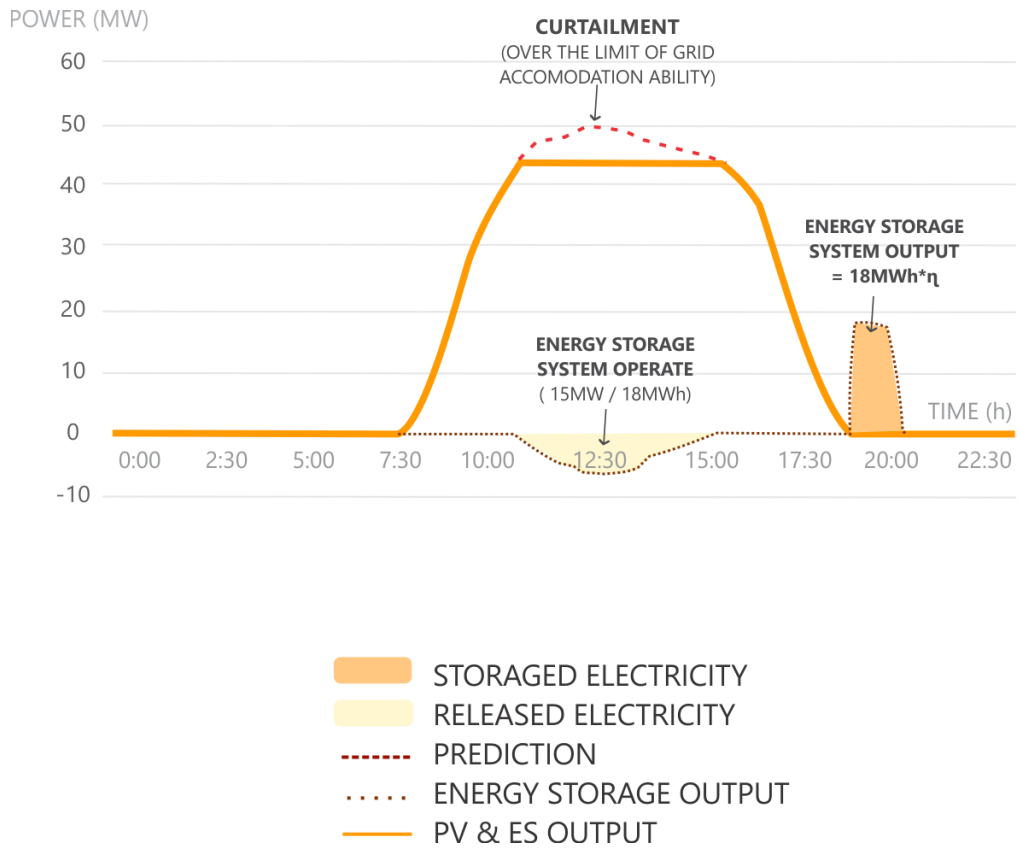
BESS

GENERATION FLOW OVERLOAD RELIEF

In certain locations, the power margin limitation of the grid leads to wasted energy resources.

INTELLIGENT SOLUTION:
The BESS PPC commands the storage of excess energy in batteries, preventing loss.

STRATEGIC USE:
The stored energy is injected into the grid when there is no more overload or during more advantageous times.



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