



HYBRIS

Enhanced Hybrid Storage Systems

Messina pilot introduction

..where social justice meets scientific research..

Workshop on energy storage and its crucial role in the energy transition with focus on hybrid solutions

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Santi Smedile, Salvatore Politi (SAE)



□ 1st HYBRIS Workshop

□ Horcynus Orca Foundation, 23rd June 2022



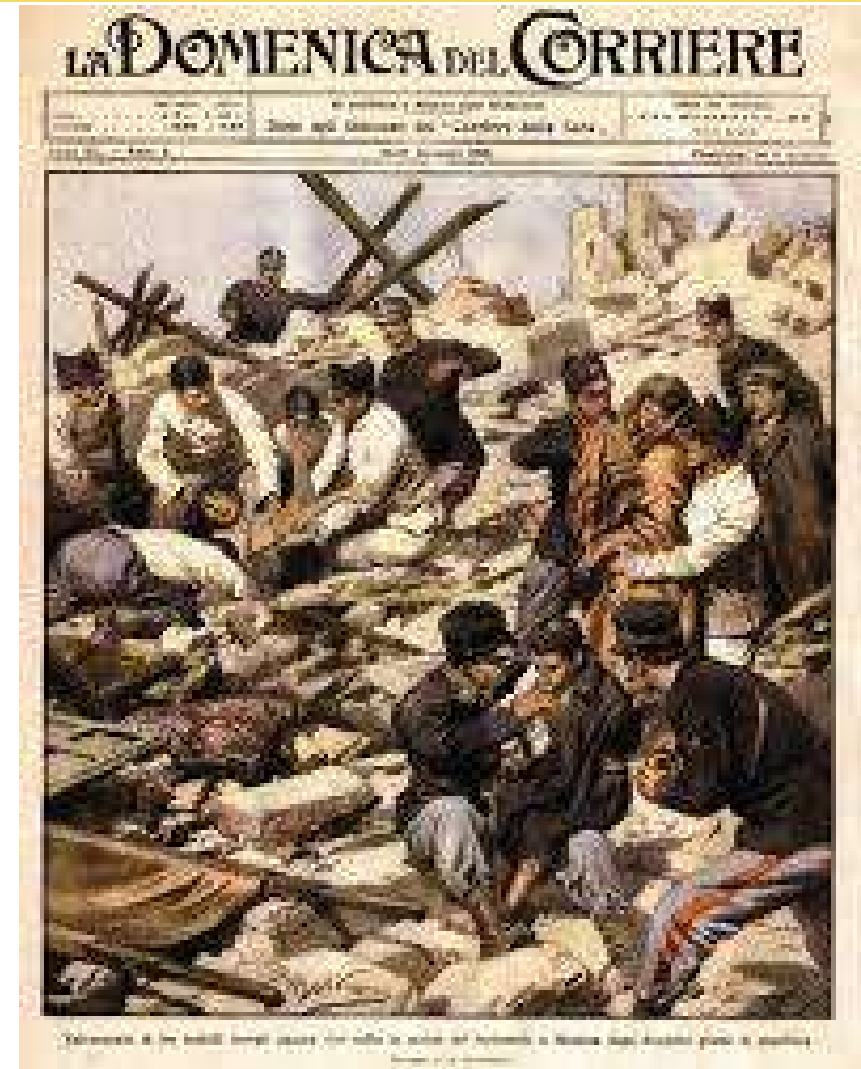
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Messina pilot introduction

To really understand the Messina Pilot importance a short story needs to be told

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This story starts in 1908...when Messina was completely destroyed by the most disruptive earthquake of the twentieth century...about 100.000 dead!



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The remaining people, without home, was housed in temporary accommodation. So entire neighbourhoods, composed by temporary houses ordered in regular rows, were formed.



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During the whole twentieth century, a combination of social degradation, the worst policy and mafia contamination, transformed these neighborhoods in a sort of favelas, slums, where the life of people in these shakes was really difficult...

Fondo Saccà is one of these...



Messina pilot introduction

The Capacity project

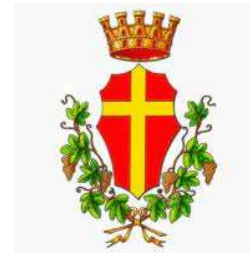


Fondazione
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di Messina



Messina pilot introduction

The Capacity project



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The pillars:

- ❑ Experience a pilot process of social and urban regeneration in the area freed from the Fondo Saccà slum
- ❑ Generate virtuous connections between the scientific and technological research system and community welfare;
- ❑ Experimenting in pilot condominiums with materials, construction methods and the most advanced technologies, including prototype types, which have the requisites of architecture and sustainable engineering;
- ❑ Experimenting in the same area with wage-assisted self-construction practices for the implementation of housing interventions that allow urban renewal processes to be intertwined with policies to fight poverty and support income;
- ❑ Transforming the areas into commons (Parks, educational spaces, social gardens, etc.)
- ❑ Promote concrete community empowerment processes, the development of youth and social entrepreneurship, thanks to a development agency and a dedicated ethical finance system;
- ❑ Promote policies and practices of hybridization of socio-economic contexts to favor the evolutionary processes of the population today in hiding. The unloading process is taking place through two mechanisms:
 - ✓ purchase of housing units and assignment of the same according to the ranking by the Municipality of Messina;
 - ✓ establishment of a personal capacity-building capital that represents a one-off contribution to the beneficiaries so that they can independently buy their own house, within a pact of contrast of criminal organizations.

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The Capacity project: construction criteria



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All raw materials are renewable and at the end of their life the panels can be disassembled, all components reused, recycled, used as biomass or compost safely.



- ❑ The units are built on reinforced concrete foundations, using prefabricated laminated wood panels and pressed straw.
- ❑ The panels are self-supporting and constitute the vertical structure of the buildings: they consist of a laminated wood frame that carries out the static function.
- ❑ The straw bales are coming from the waste of the local agricultural industry without any treatment. The lime coating layer makes the straw practically aseptic.
- ❑ Walls are equipped with temperature and humidity sensors to monitor the main thermal parameters.

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The Capacity project



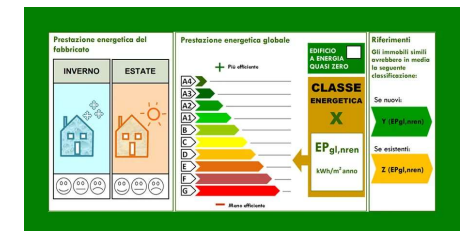
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- ❑ The horizontal structure supporting the flat floor, in correspondence with the photovoltaic panels, tilts to accommodate and architecturally integrate the PV system.
- ❑ The inclination of part of the floor, arises therefore from technological needs of ventilation of the interior spaces and orientation for the optimization of the energy production of the photovoltaic system.
- ❑ This type of system allows for the construction of buildings with good thermal performance and rapidity realization.

- Building envelope with high thermal inertia
- Solar energy contribution defined by the orientation of some openings
- Natural ventilation system
- Rainwater and greywater recovered and reused
- The chosen plant technologies: solar thermal and PV

Energy
performance
index in class A4



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Capacity Project

Messina
Fondo Saccà



CNR4Capacity Project

Photovoltaics and Solar Thermal panels
Energy efficiency criteria in the buildings

SHARING ENERGY COMMUNITY

Power
Network
DSO

Energy Service
Company
Solidarity ESCO



Control System: Measurements, algorithms, tariffs, Renewables Forecast, Energy Storage Management, off-grid/on-grid functions



Energy Storage

H2020
G.A. 963652

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CNR4Capacity Project



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Consiglio Nazionale
delle Ricerche



Main targets

- Reduction of the energy poverty
- Creation of a sharing energy community
- Storage management and integration
- A real “Living Lab”, where people leaves and where it is possible to experiment and monitor social and technological innovations
- Novel tariffs algorithms managed by the Esco (Solidarity and Energy) to reduce social and sanitary unbalances among the users

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Consiglio Nazionale delle Ricerche



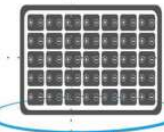
Fondazione di Comunità di Messina



Renewable energy



Energy storage unit

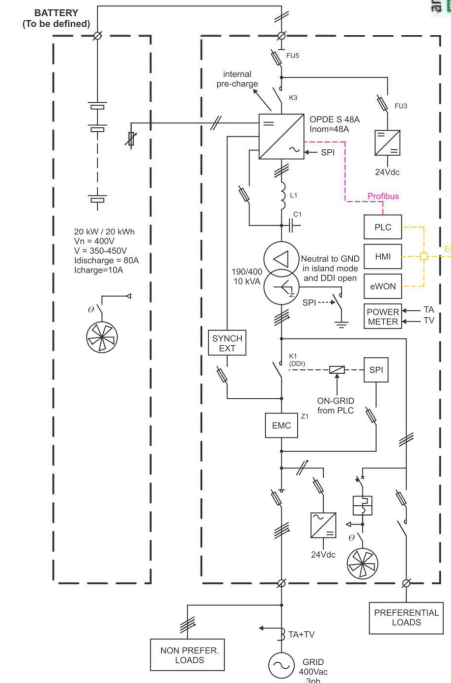


Loads

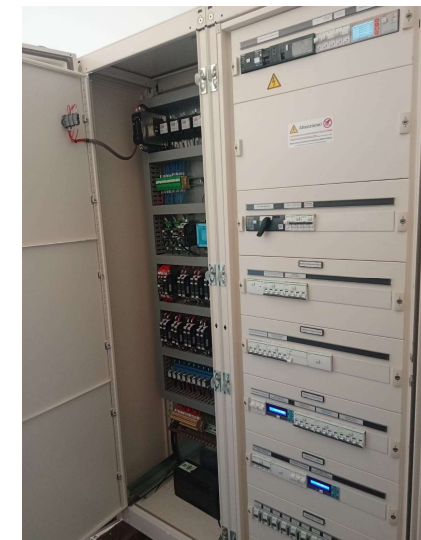
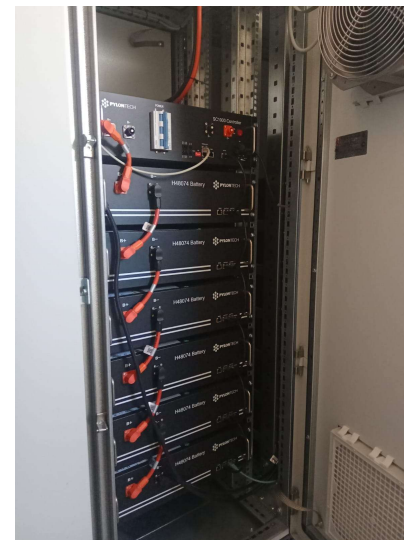
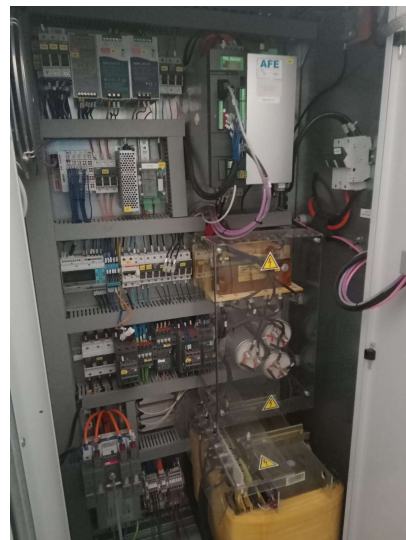


Island Function

- ✓ Bidirectional Inverter
- ✓ Island and grid operation
- ✓ Lithium Iron Phosphate batteries up to 6000 cycles at DoD 80%
- ✓ Algorithms embedded for storage management in coordination with the EMS



Full control of the storage, active and reactive power setpoints->energy services



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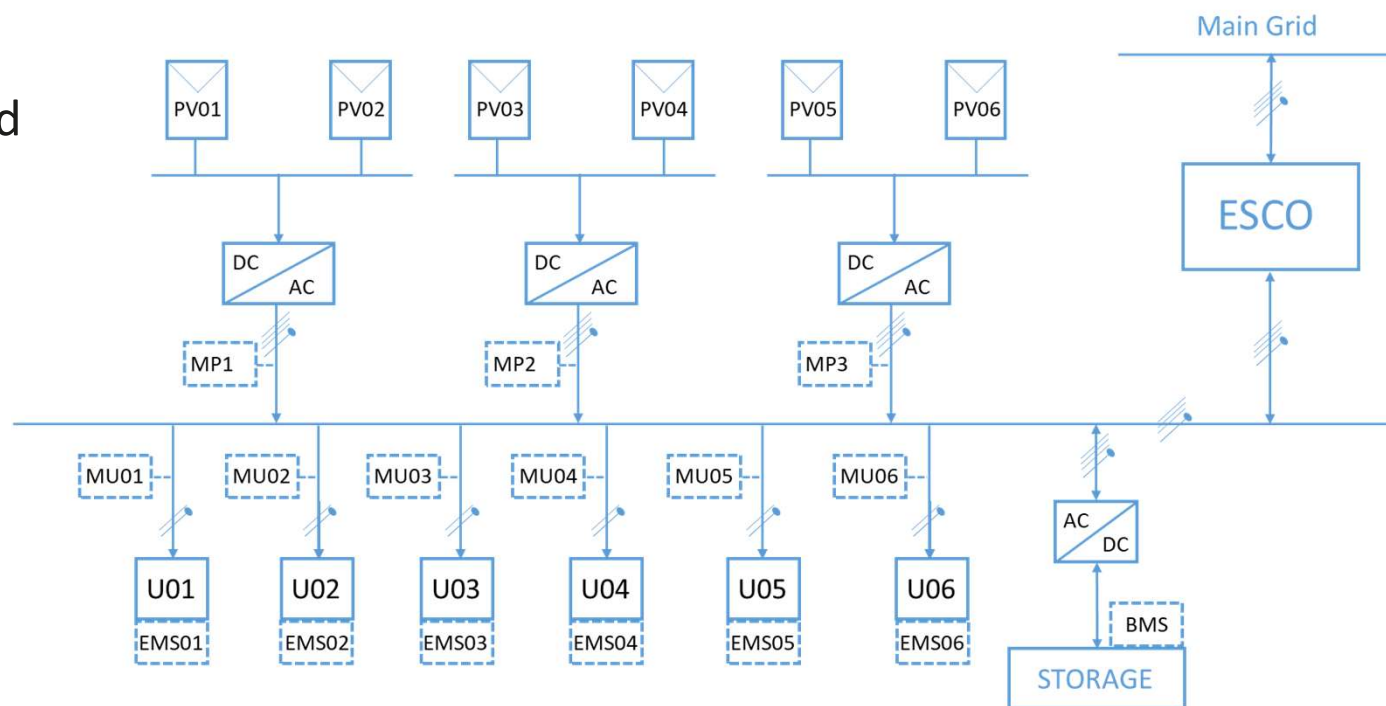


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Simplified electrical layout

- ❑ PV Inverter control to manage island operation and frequency stabilization
- ❑ Load control for each user for demand response purposes
- ❑ Metering of every component, both production, storage and utilization
- ❑ Full control of the storage



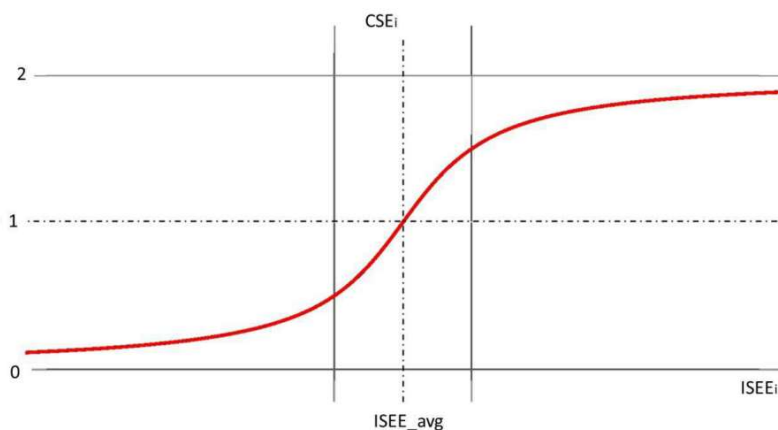
Novel social tariffs algorithms

The initial investment is harmonized over 25 years and the costs relating to consumption are calculated on the basis of some coefficients

Economic Solidarity Coefficient

$$ISEE_{avg} = \frac{\sum_i ISEE_i}{NU}$$

$$CSE_i = 1 + \frac{2}{\pi} * \arctan\left(\frac{ISEE_i - ISEE_{avg}}{ISEE_{avg}}\right)$$



Sanitary Solidarity Discount

$$kWh_i^{eqn} = kWh_i^{eq} - SSS_i$$

Energetic Virtuosity Coefficient

$$CVE_i = \frac{E_m^B + E_m^F}{E_m^A + E_m^B + E_m^F} \Big|_i$$

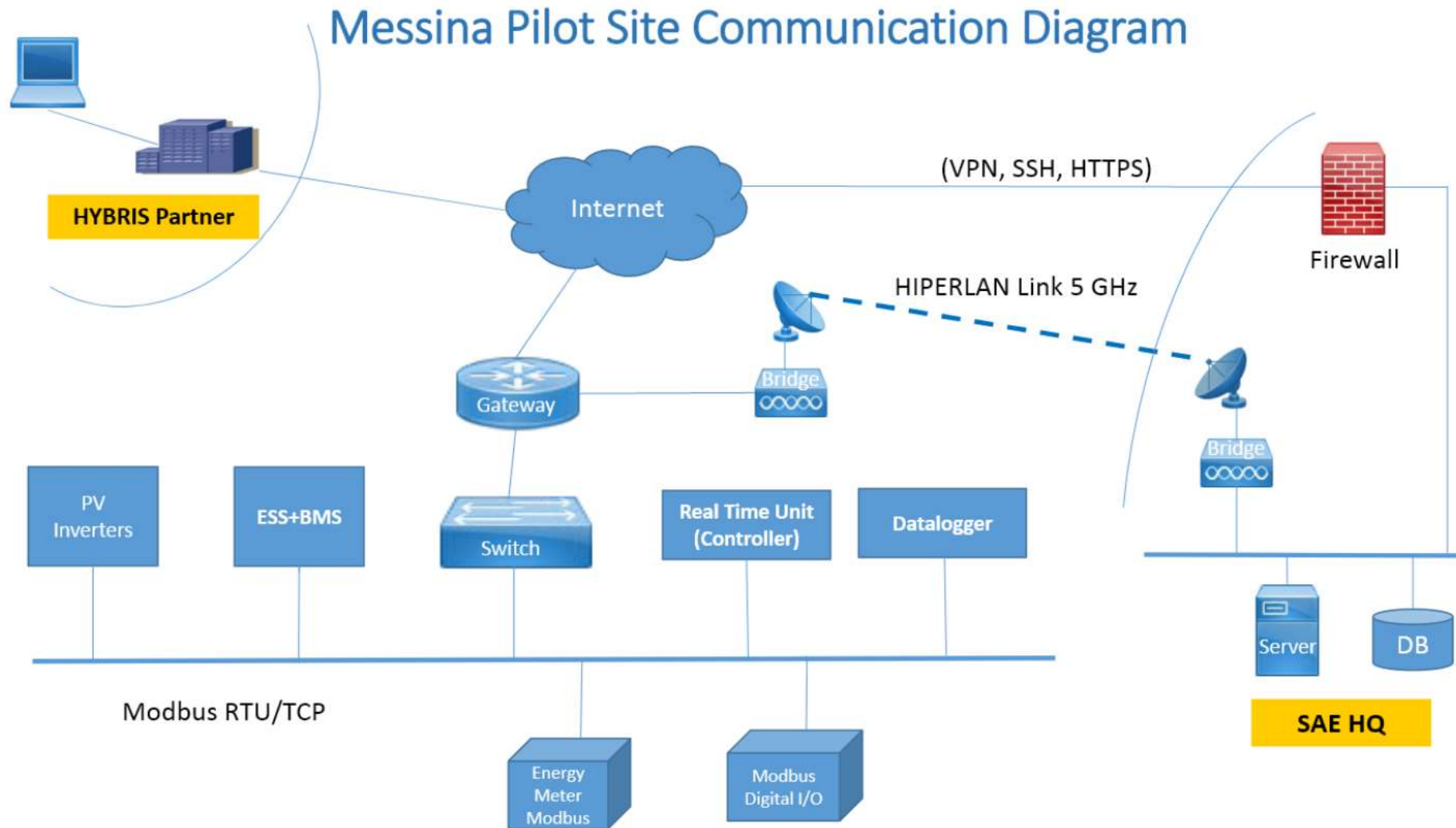
$$C_{premiabile_i} = \frac{CVE_i}{\sum_i CVE_i} * C_{premiabile}$$

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Communication diagram

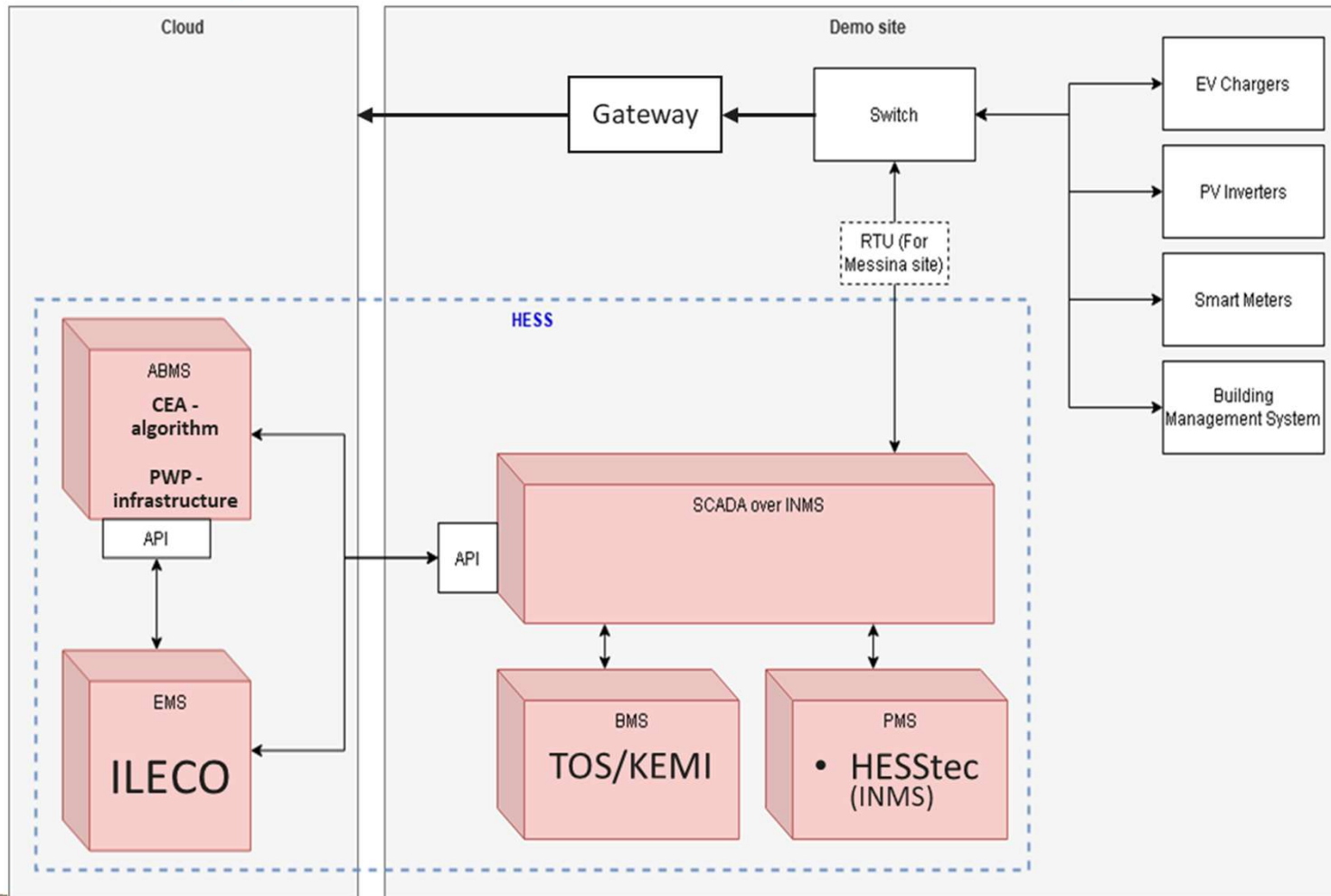


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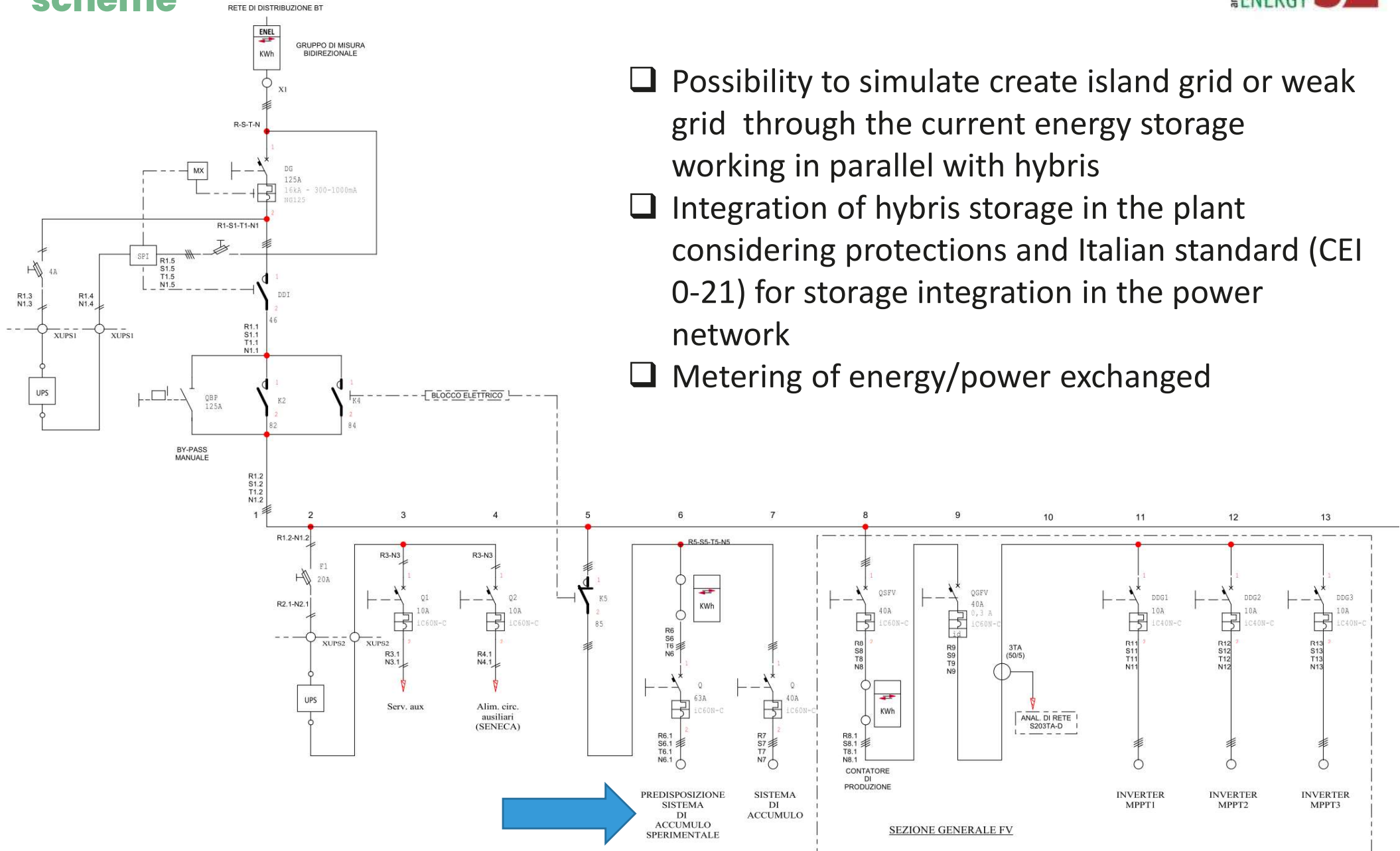
Communication scheme for interfacing demo sites with EMS and HYBRIS battery

conceptual diagram of the communication architecture



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Predisposition of the Hybris storage in the electrical scheme



- Possibility to simulate create island grid or weak grid through the current energy storage working in parallel with hybris
- Integration of hybris storage in the plant considering protections and Italian standard (CEI 0-21) for storage integration in the power network
- Metering of energy/power exchanged

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Predisposition of the Hybris storage on the layout



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THANK YOU FOR YOUR ATTENTION



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