ENEL plans for storage introduction in Italian distribution network

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Accumulo e rinnovabili: i sistemi e le tecnologie verso la smart grid
Rimini 09/11/2012

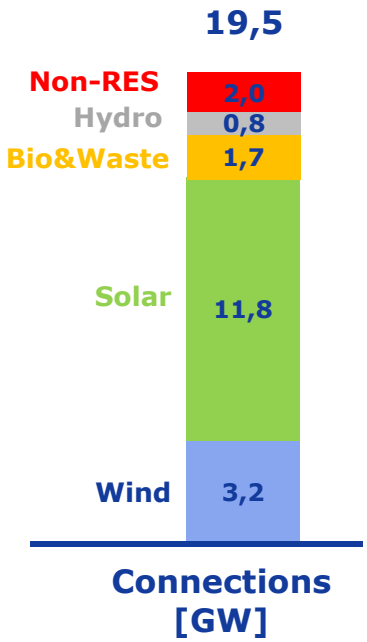
Storage introduction in Enel distribution network

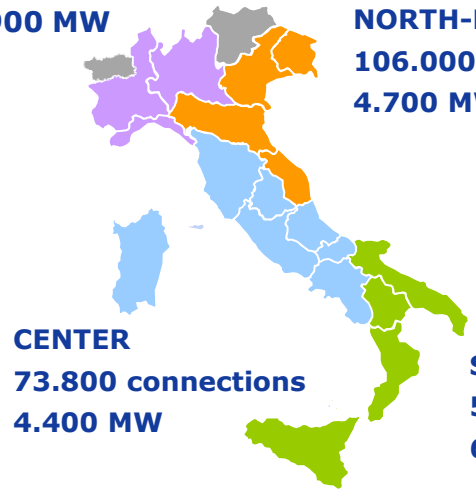
Agenda

- **Impact of Renewable Energy Source (RES) on Enel distribution network in Italy and Smart Grid**
- **Electrical Storage Systems (ESS) in Enel Distribuzione**
- **Conclusions**

Distributed Generation: An Exponential Growth

Connections to Enel Distribuzione grid



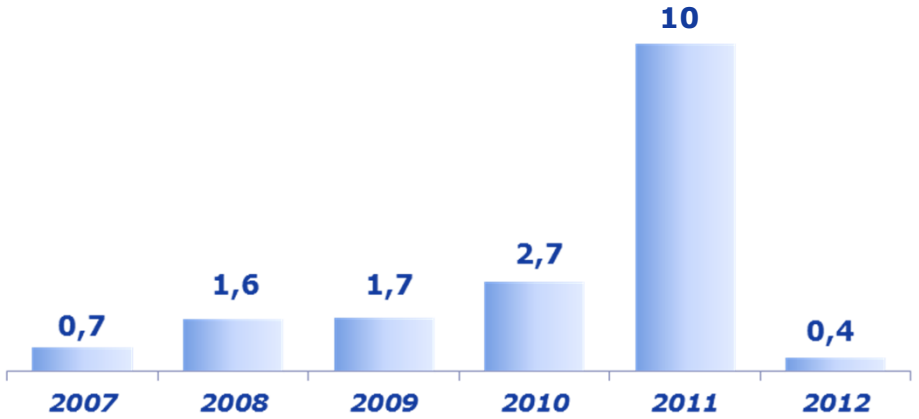


ENEL DISTRIBUZIONE

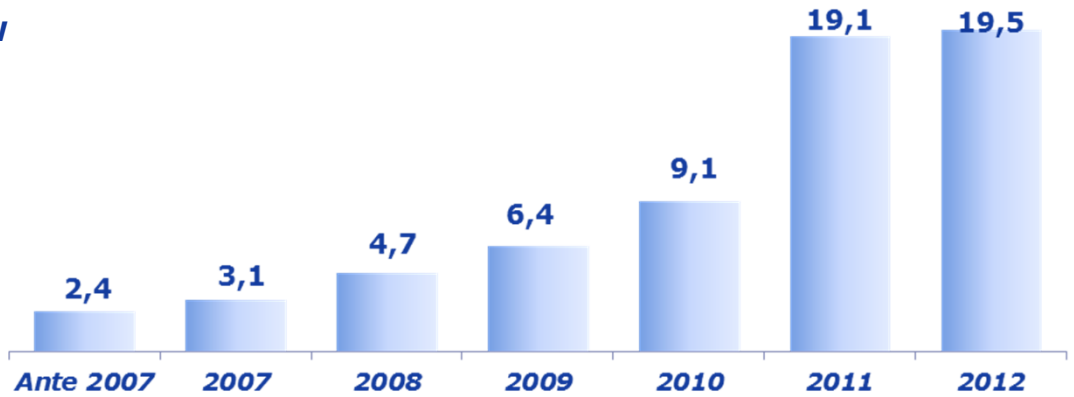
311.500 connections

19.500 MW

Connections – yearly data (GW)



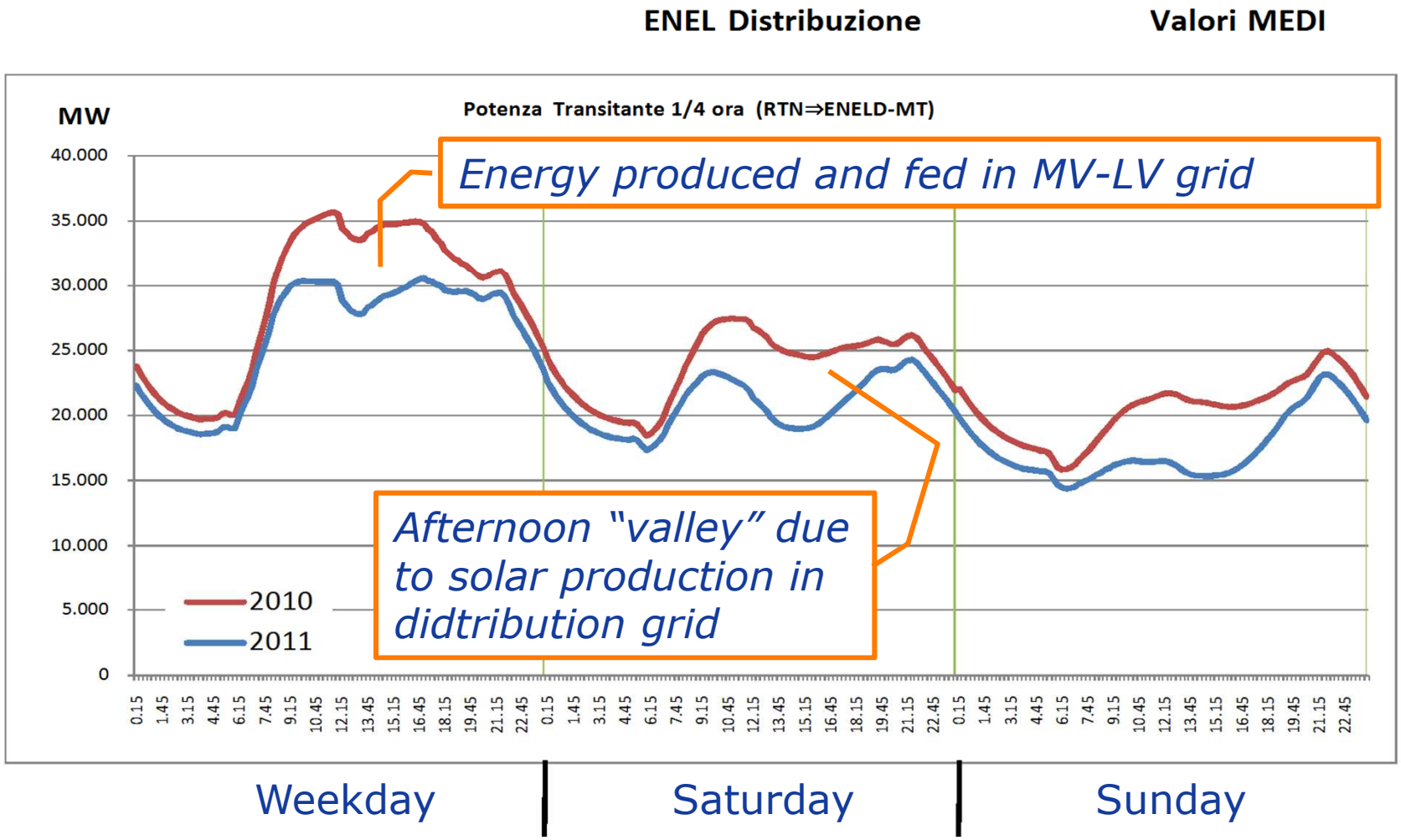
Connections – cumulative data (GW)



Data up to Apr. 2012

Energy flow from trasmission grid

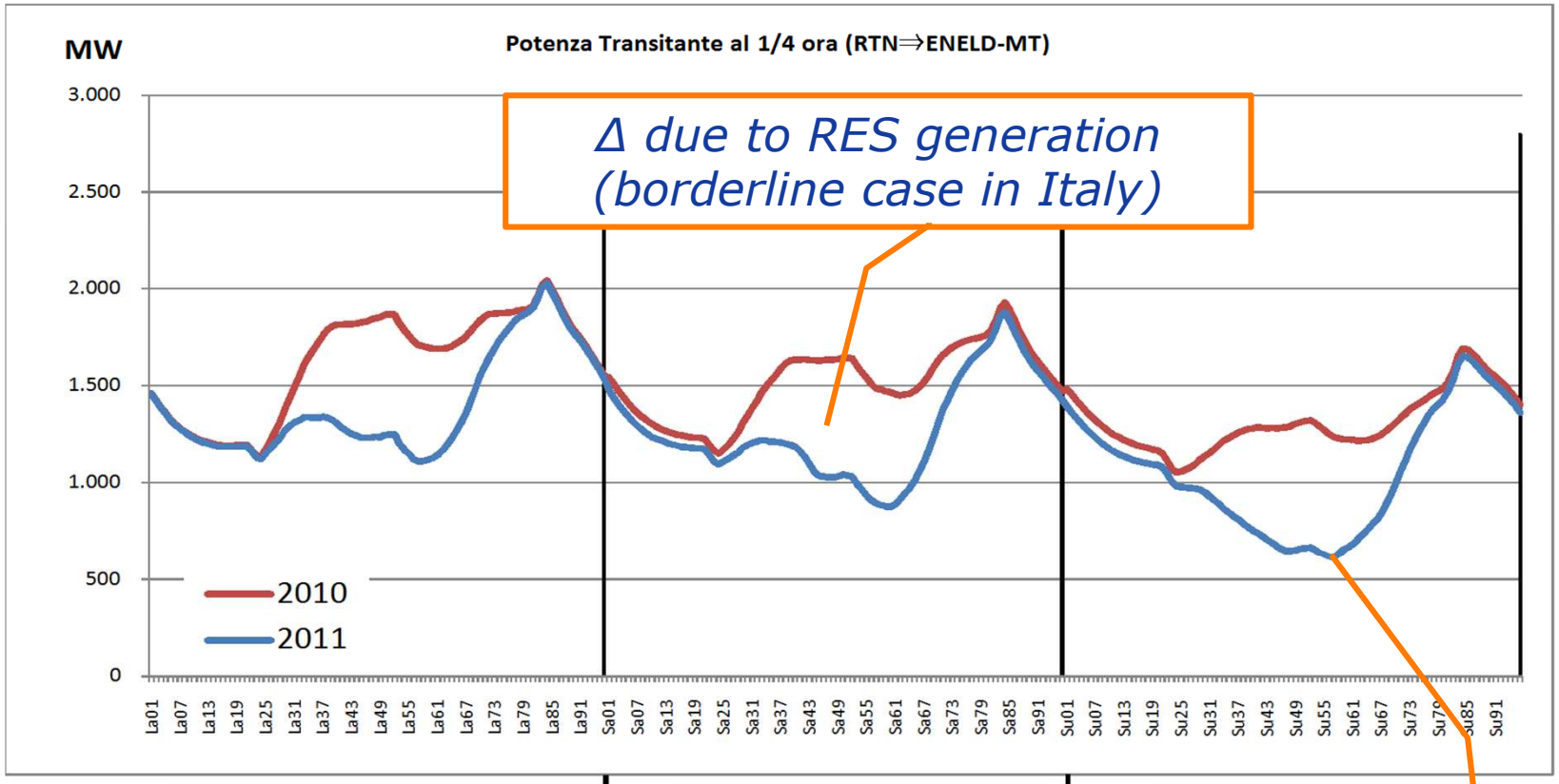
Average load curves comparison – July '10 vs. July '11



Energy flow from trasmission grid

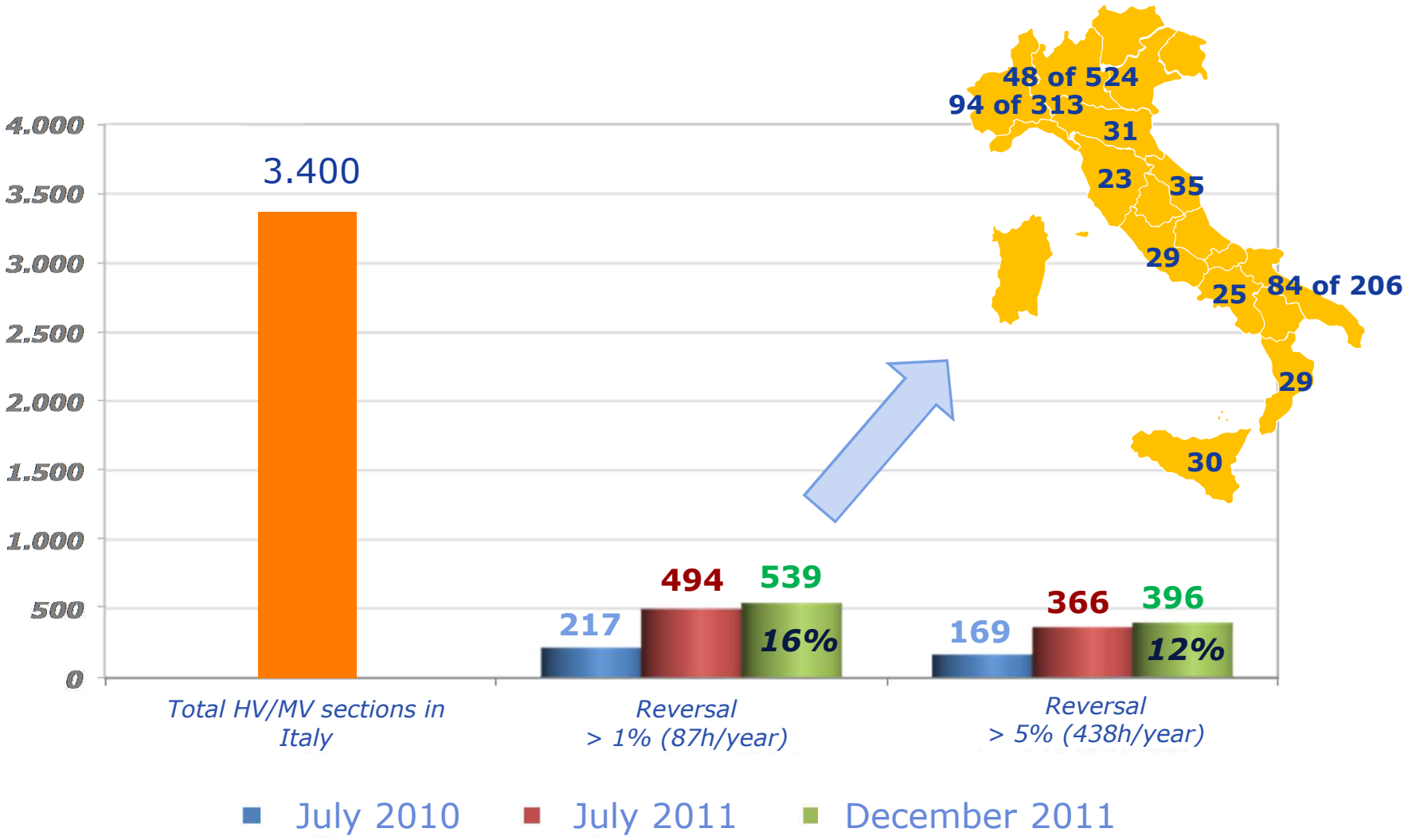
Focus on Puglia region

PUGLIA **Valori MEDI**



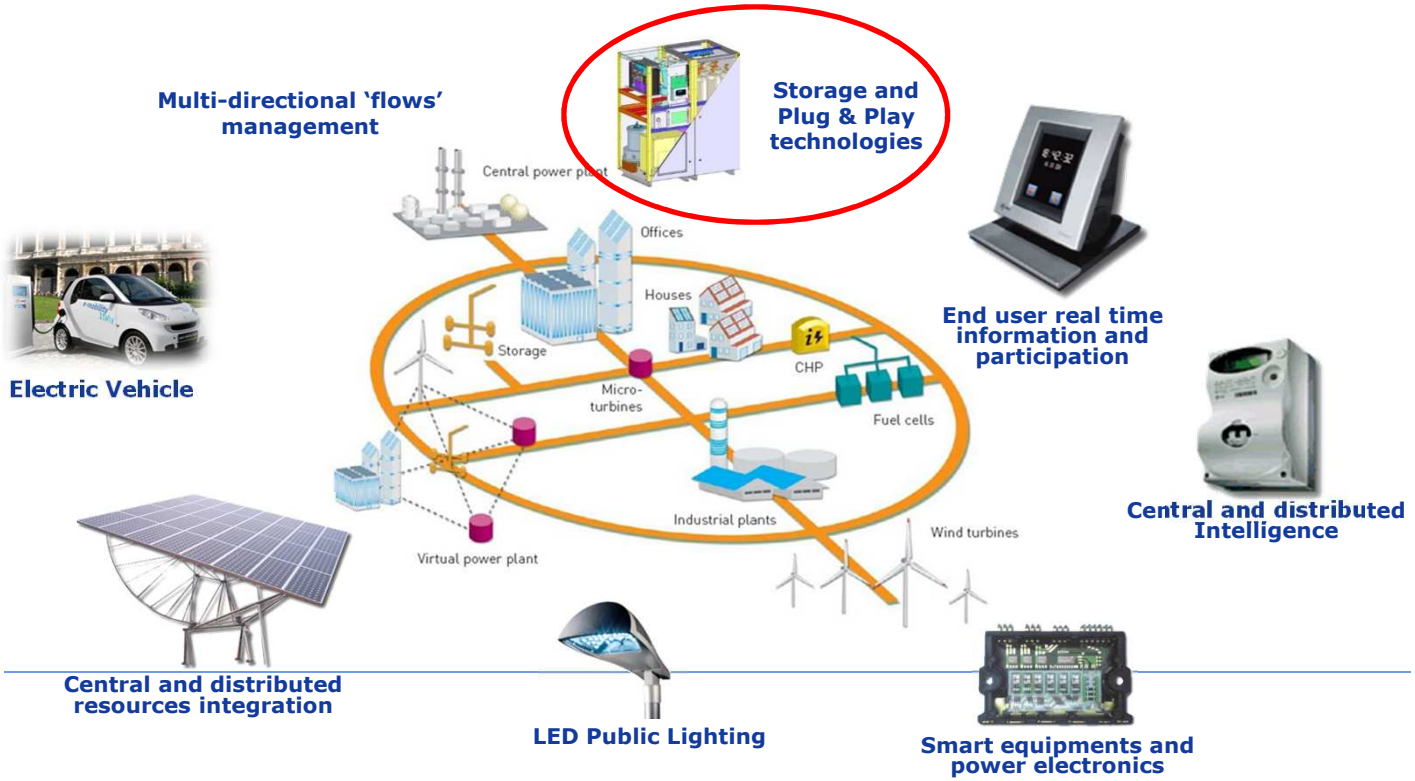
Energy flow from trasmission grid

HV-MV transformers with energy flow reversal



Enel Distribuzione Architecture for Smart Grid

What ought to be better incentivized?



Smart Sensors	Storage
Smart Protections	Security
Smart Meters	Advanced Computing
Power components	Communications
Control Systems	GIS

- ✓ MV RES generators dispatching
- ✓ Voltage control on MV grid
- ✓ Demand management
- ✓ "Intelligent" fault detection

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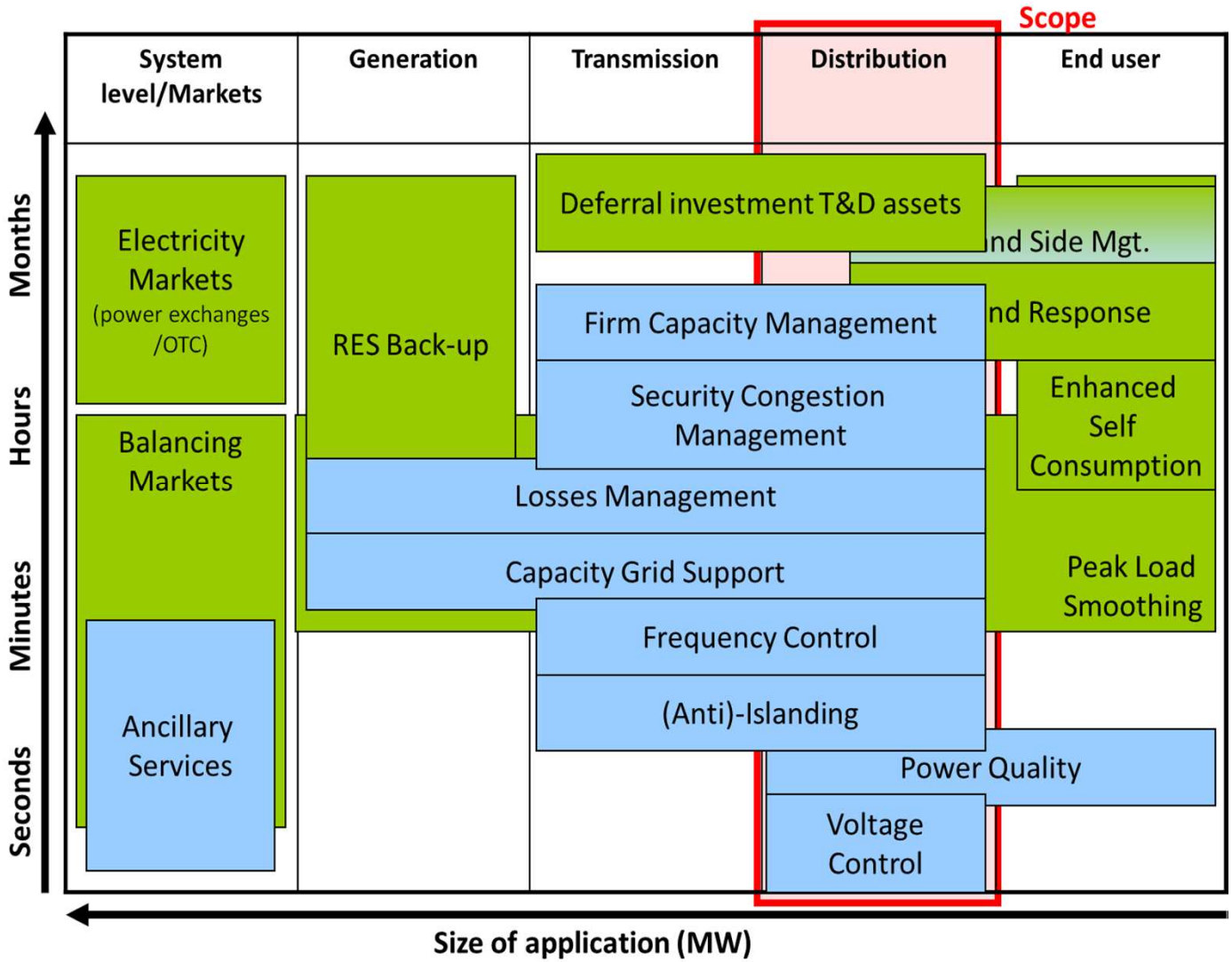
Functions of the ESS

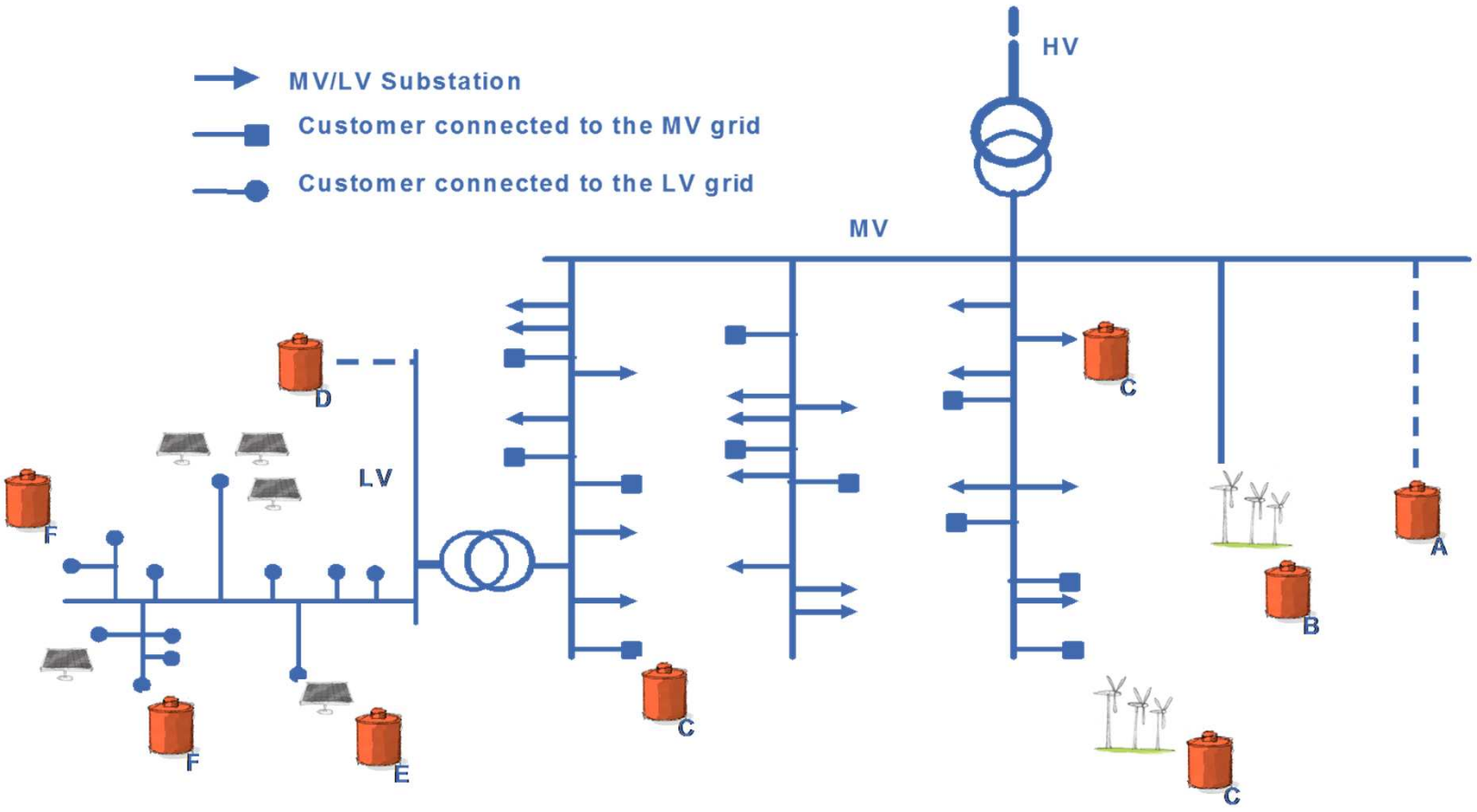
Eurelectric view



Source: "Decentralized Storage: Impact on future distribution grids" A Eurelectric paper

ESS location within the distribution grid

Eurelectric view

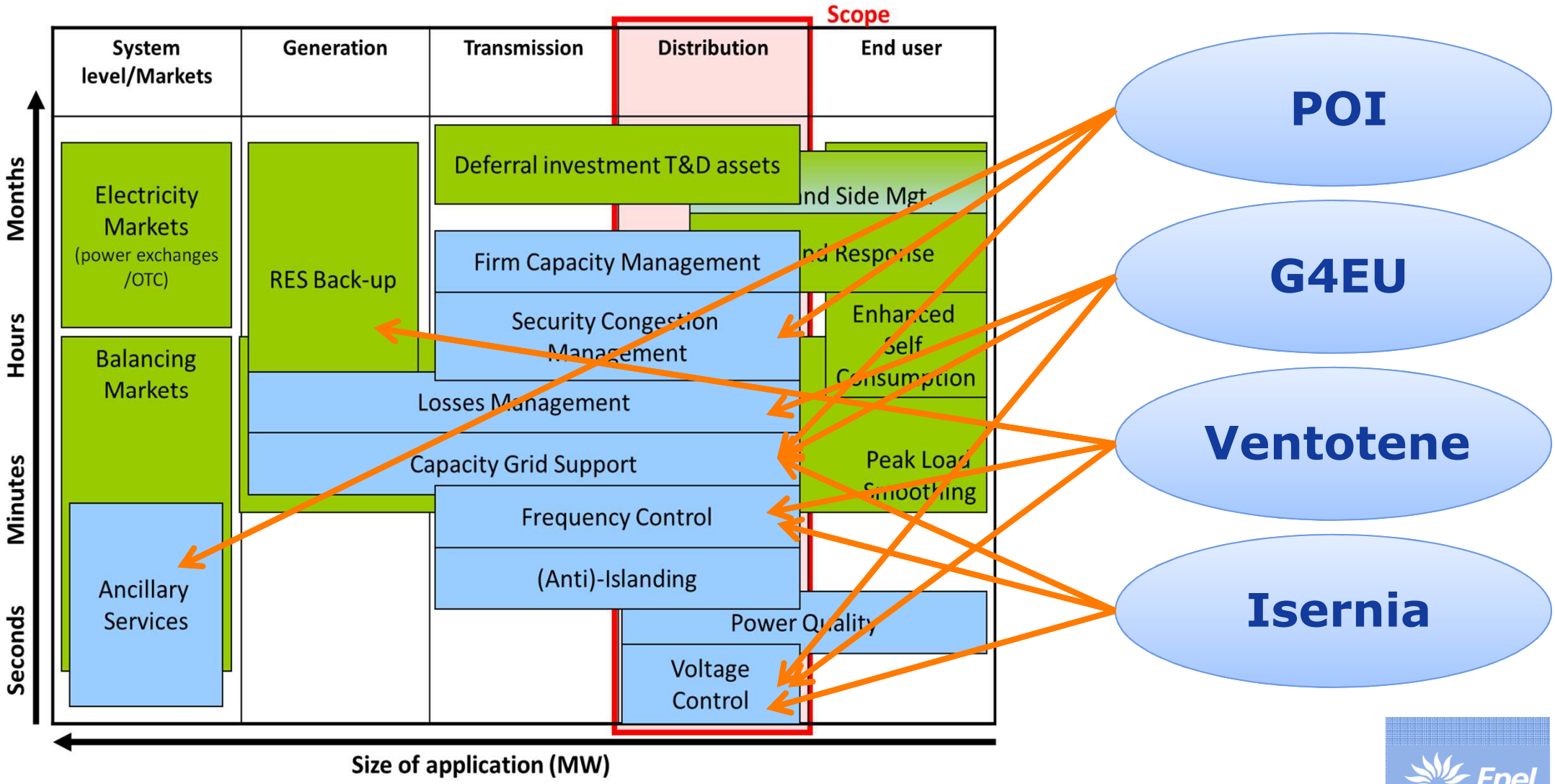


A	At a HV/MV substation
B	At a feeder of RES in the MV grid
C	At any point of an existing MV grid
D	At a MV/LV substation
E	At a *prosumer* facility connected to an LV grid
F	At any point of an existing LV grid

Source: "Decentralized Storage: Impact on future distribution grids" A Eurelectric paper

Functions of the ESS in the distribution grid

The Enel Distribuzione experimentations



The Isernia smart grid project

ESS in the MV/lv substation

Isernia "Smart grid"

Integration of renewables

Storage (1)

Customer Engagement (demand response) (8.000)

Electric Vehicles (5 Charging pole)

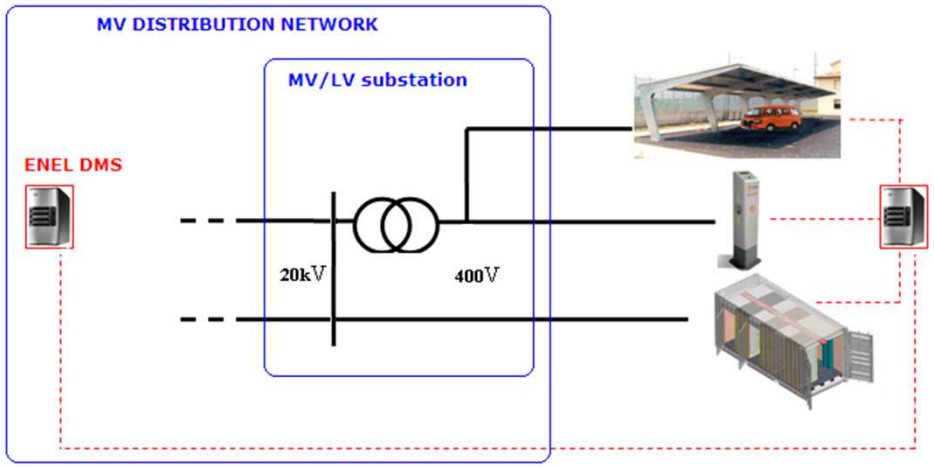
The project born following a call of the Italian Regulator (AEEG).

Inside the selected project, the Isernia project had the highest score in the innovation classification, because propose several promising solutions for a secure and reliable operation of the network and to increase the hosting capacity.

The involved network is a MV busbar of the primary substation of Carpinone with 8000 LV customers, 26 MV customers (9 have renewable plants).

ESS in MV/LV substation

ESS in the Isernia Project



Isernia Project

The local control system will use the ESS to optimize both the active and reactive power exchanges between the node and the feeder; alongside the mitigation of the PV emission and EV recharging impact on the network, a real optimization of both local and global parameters will be taken into account by the integration with the Enel's Distribution Management System.

ESS main characteristics

Battery technology: Li-ion

Max power: 1 MVA

Energy capacity: 500 kWh

Number of cycles: 2000

Efficiency: 85%

Installation area: 90 m²

ESS in MV/LV substation

ESS in the G4EU Project

ESS main characteristics

Battery technology: **Elettrochemical**

Max power: **1 MVA**

Energy capacity: **1 MWh**

Number of cycles: **2000**

Efficiency: **> 80%**

G4EU Project

The Italian Demo Region of the European project G4EU is located in the Italian region Emilia Romagna. Enel, that lead this demo, will install a storage system (1 MVA – 1 MWh) in a MV/LV substation that can be connected to several feeders.

The goal is to study a new centralized/decentralized solution for voltage regulation and hosting capacity rising. In particular, thank to this particular installation, it will be possible to "move" the storage in different feeders depending of the results of an optimization procedure (ESS optimal location).

The goal of the GRID4EU project is to carry on demonstration pilots of Smart Grids solutions on a large scale basis. The project involves 27 partners in 12 EU countries; it is coordinated by ERDF, the main French distribution company, and has its technical management belonging to Enel. The initiative will implement 6 demonstration projects in 6 EU countries (Italy, France, Germany, Sweden, Spain and Czech Republic), to be integrated into a single one.

ESS in a microgrid

ESS in the Ventotene Project

ESS main characteristics

Battery technology: Li-ion

Max power: 1 MVA

Energy capacity: 500 kWh

Number of cycles: 2500

Efficiency: 85%

Ventotene scenario

Load: 0.15 MVA ÷ 1.15 MVA

Not-renewable installed power: 4 Diesel generators for total 2.7 MVA

Renewable installed power and new request: 76 kW today, new request for 74 kW

Min Load = Max renewable generation → NO hosting capacity without ESS

Ventotene Project

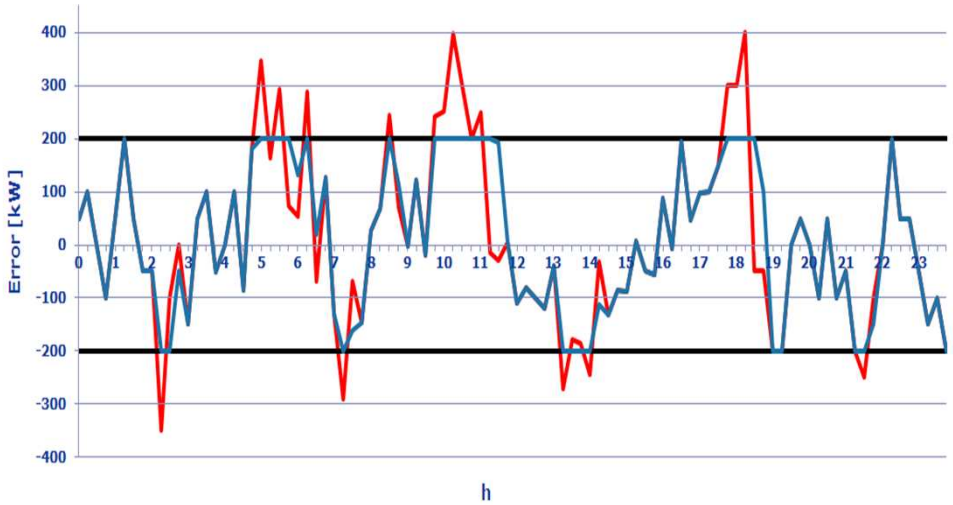
In Ventotene island an ESS will be installed by Enel Produzione for the renewable energy integration and the network stabilization. The network is a MV microgrid not connected to the Italian transmission/distribution system, where the electrical energy is supplied by a diesel generator and several other dispersed generators.

The goal is to increase the hosting capacity of the grid allowing the connection of new renewable sources. Moreover, the installation of the storage system will optimize the load curve of the diesel generator (enabling costs reduction) and stabilize the network.

Enel
L'ENERGIA CHE TI ASCOLTA.

ESS in HV/MV substations

ESS in the POI Project



POI Project

Three ESS will be used to reduce the variability of the power flow in the parts of the network with high penetration of RES, alleviating fast power flow variations in case of wind gusts or passage of clouds. In particular, the ESS will be used to control energy exchange profiles between the HV/MV substations and the National Grid to make them more predictable (1h - 24h ahead).

ESS main characteristics

Battery technology: Li-ion

Max power: 2 MVA

Energy capacity: 1 MWh (2), 2 MWh (1)

Number of cycles: 2000 ÷ 4000

Efficiency: 85%

Max installation area: 200 m^2/MWh

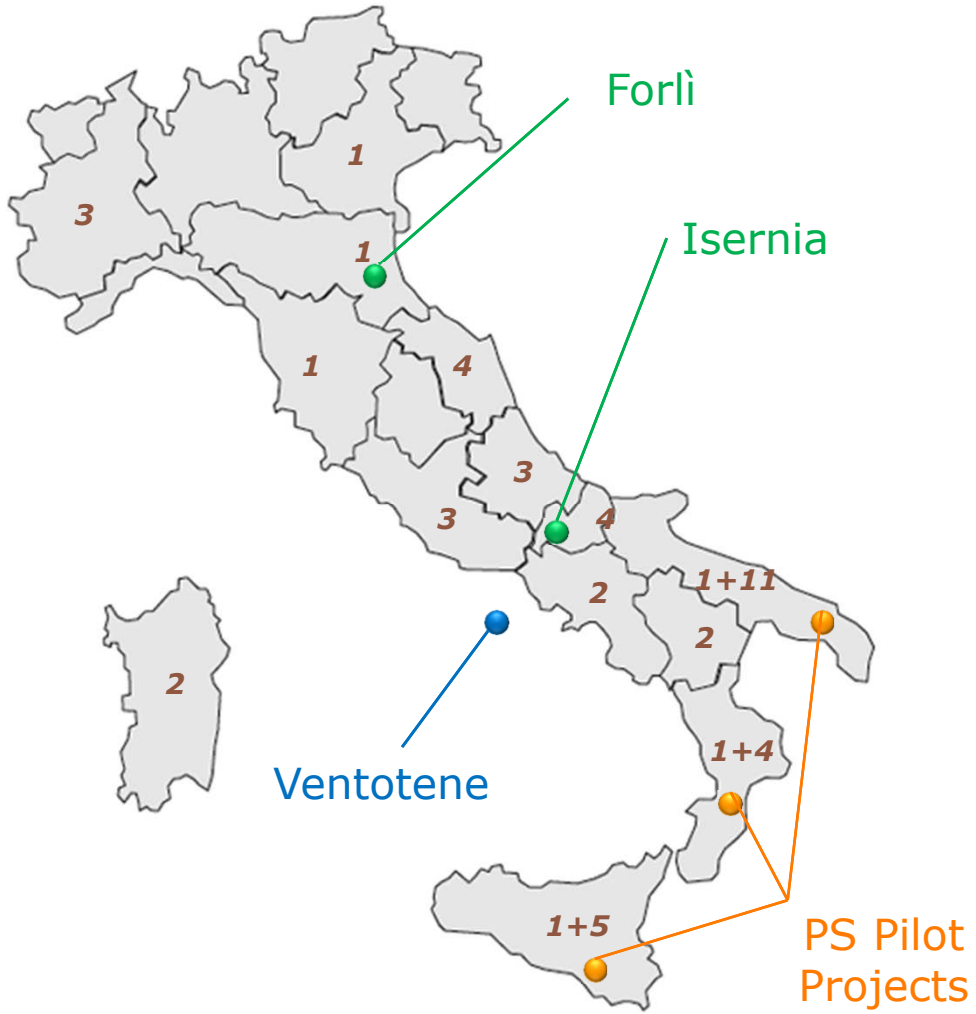
Dirillo

Campi salentina

Chiaravalle

ESS in HV/MV substations

Potential installations



In case of positive pilots Enel Distribuzione identified 46 further installations

- **Preliminary criteria for location:**
  - **Reverse energy flows**
  - **Temporary (limited) Connections**
- **60-80 MW**
- **2013-15**
- **1-2 MVA 1-2 MWh per HV/MV substation**
- **Power applications should be confirmed from pilots**

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Concusions

- The impact of Renewable Energy Source (RES) on Italian distribution network is very high
- The costs for the systems (regulations and reserves) increase and ESS can be a key factor to reduce them but, today, incentives are necessary to develop ESS solutions
- Enel Distribuzione have around 3400 HV/MV transformers in Italy that feed the 85% of the Italian distribution network
- Enel Distribuzione have 6 pilot projects to test the ESS functions for the distribution network
- ESS connected to HV/MV substation can contribute to reduce the costs for power reserve for the electrical system
- In case of positive pilots Enel Distribuzione identified 46 further installations in the next years

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