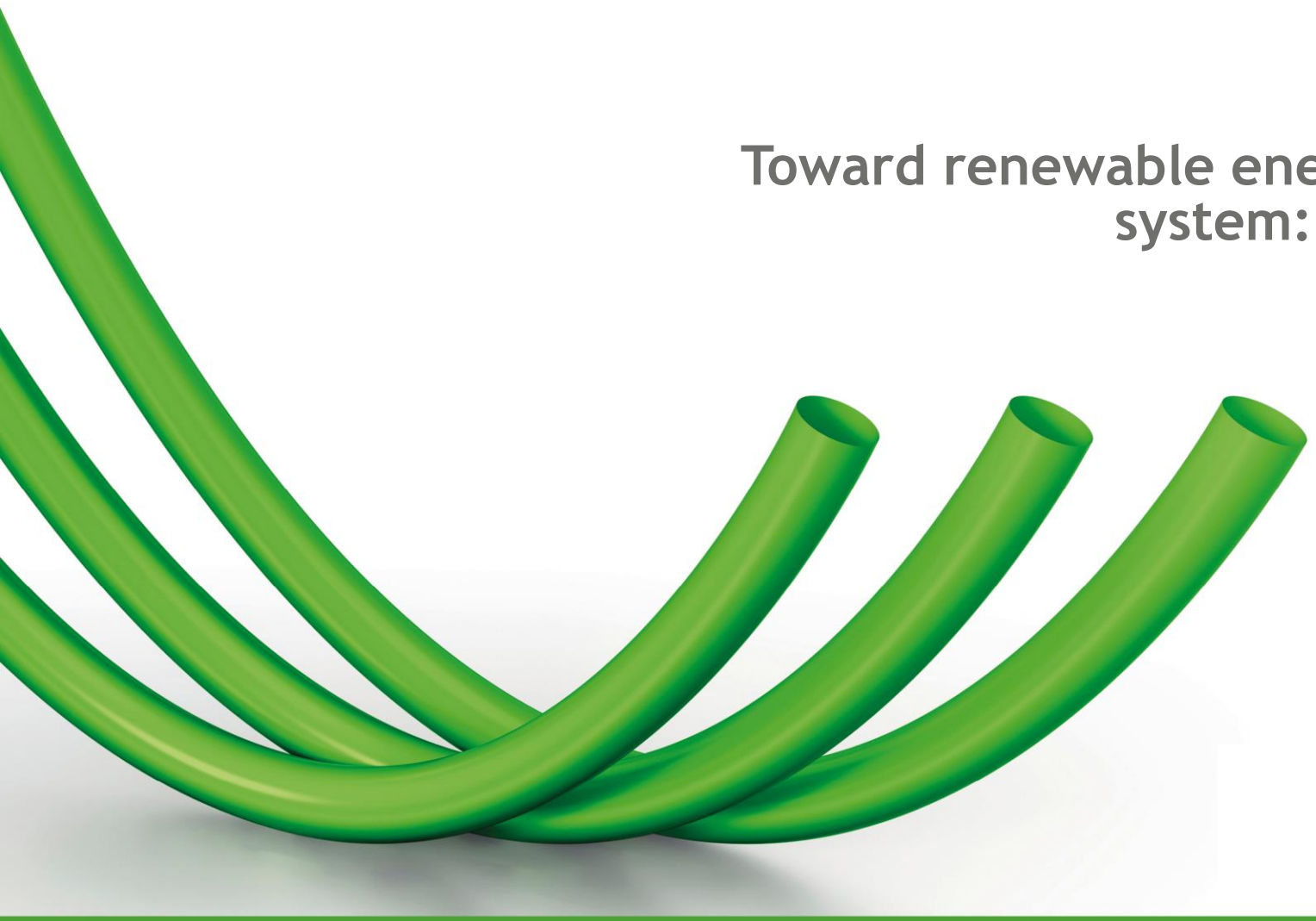
New flexibility resources:
the role of hybrid pumped hydropower
14th May 2021

EERA European Energy Research Alliance
Energy Storage

DIPARTIMENTO DI INGEGNERIA INDUSTRIALE

RSE Ricerca Sistema Energetico



14 May 2021

Toward renewable energy integration into the power system: the Italian research initiatives

Chiara Gandolfi

- Project 2.2 - Architecture, operating and regulatory system models for electric grid to allow the integration of renewable and not programmable energy, storage system, energy community and aggregators
  - Structure
  - Aim and scope
- Distribution Grid
  - Main actors for flexibility
  - Aggregators and microgrids
- Generation and load forecasting
- Institutional support and Standardization activities
- Project’s partners
- Project’s Benefits

WP 1 – New grid model architecture and control, automation and protection logics

WP 2 - Flexibility resourses

WP 3 - Distributed resources aggregation

WP 4 - Load and generation forecasting

WP 5 - Technical standardizazion and institution support activities

- The project's aim is to develop **methodologies**, **studies**, software **tools**, **prototypes** and **demonstrators** to optimize electrical transmission and distribution grids.

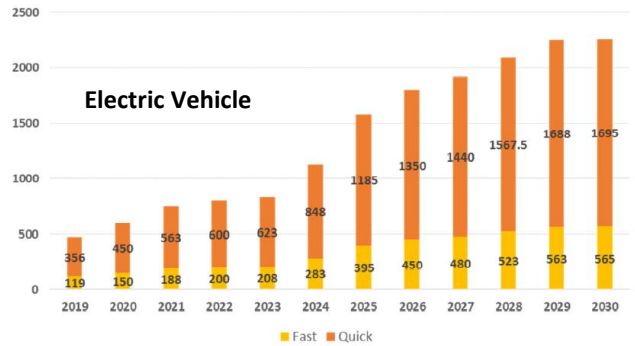
Considering **new architecture**, system **management** models, **regulation** models to favour the renewable and non-programmable generation integration, the self-production, the storage and the aggregators taking into account the electric penetration.

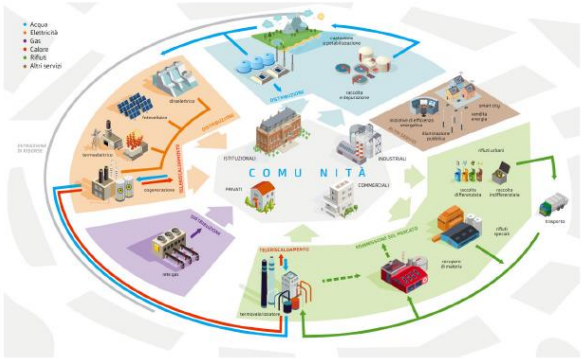
The project:

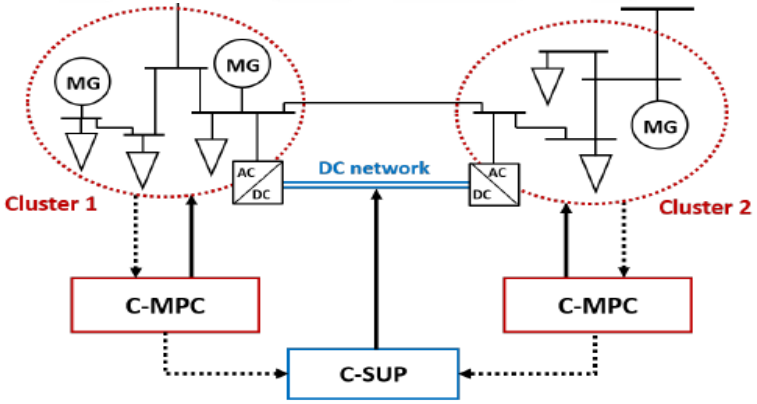
- addresses the planned issues by ensuring a **system approach**
- **supports** institutions and technical standardization at national and international level
- Accelerate the development, testing and availability of the technologies needed for the **energy transition**.

Starting from the scenarios foreseen by the last edition of the National Energy Strategy (SEN) and in order to achieve the objectives proposed by the Integrated National Plan for Energy and Climate (PNIEC), the project activities will allow:

- to evaluate **planning alternatives**
- to validate **operation strategies** of the grids during steady state and in case of fault
- to improve the **observability**, **monitoring** and analysis of the **stability** and **Power Quality** level



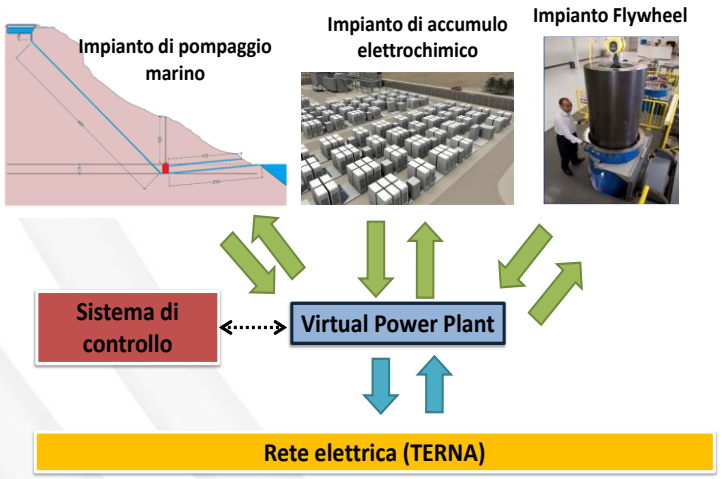




Mixed distribution grid in Alternative Current (AC) and Direct Current (DC), networks organized in microgrids, clusters or aggregates will also be considered.

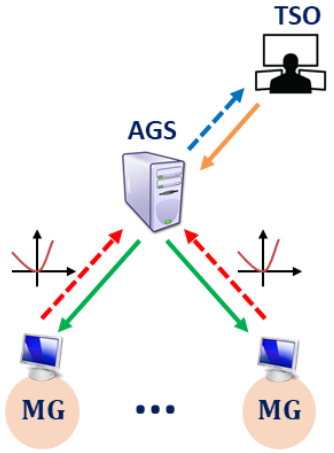
Distributed resources, Non-programmable renewable sources, Combined cycle thermoelectric plants, Hydroelectric pumping systems, Electrochemical storage systems, Active users

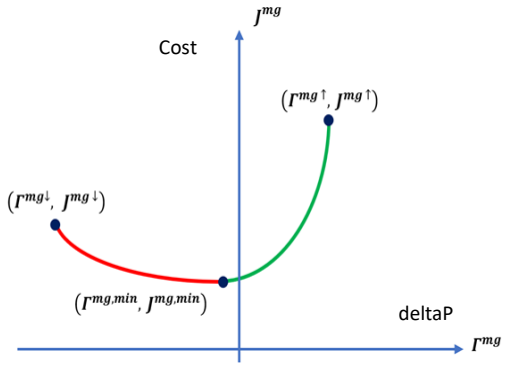
Virtual Power Plant



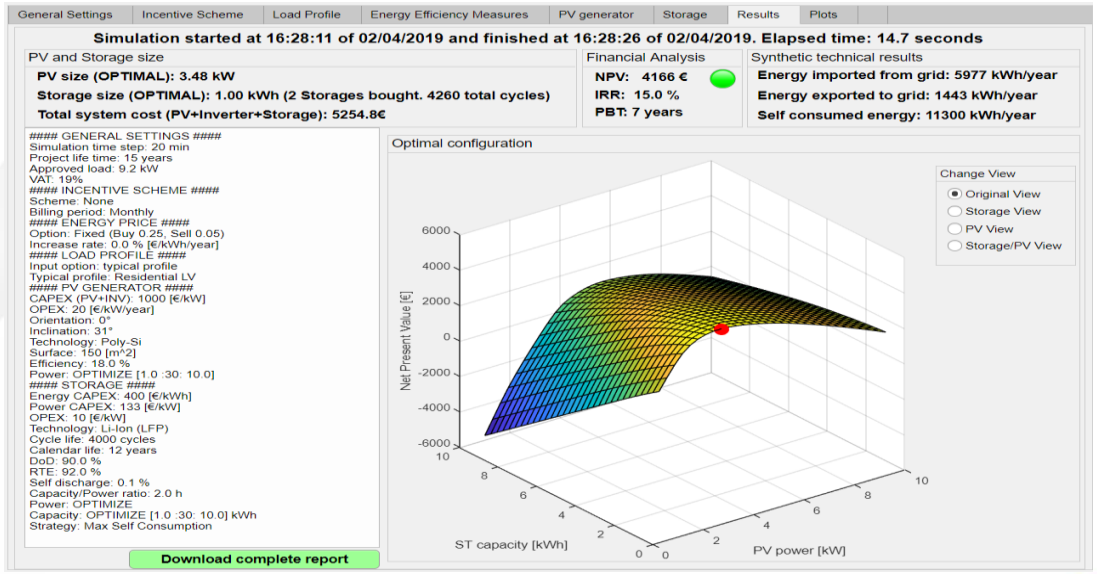
- to develop **network flexibility services**
- to analyze the **adequacy for frequency regulation**
- to participate in the **balancing market and dispatching services** (MSD)

Energy Management Systems (EMS's) for virtual aggregations of DERs/MicroGrids.
A real-time control-optimization algorithm able to follow unforeseen imbalances.

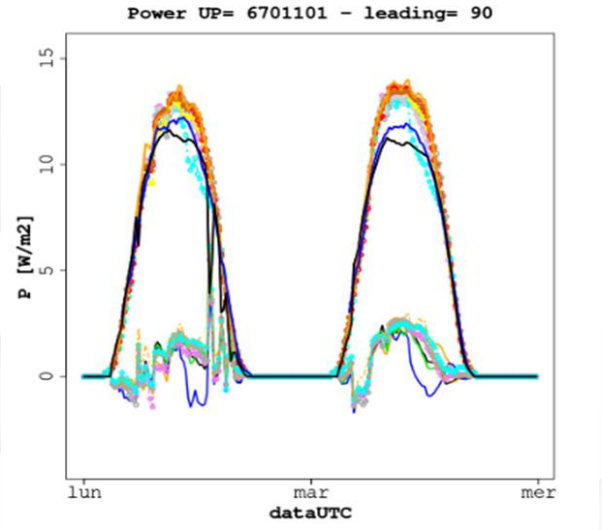




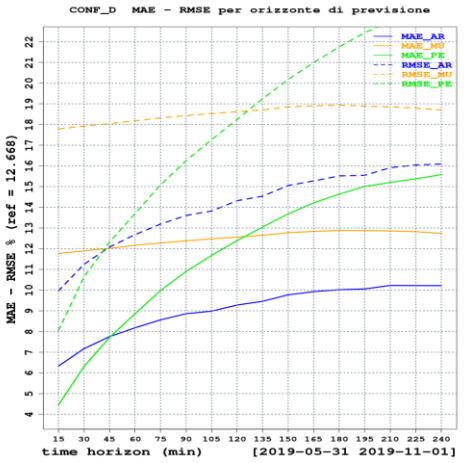
Software DOPA (Dimensionamento Ottimo PV e Accumulo) to compute the **optimal sizing of PV generators and storage systems** so as to **maximize the corresponding return on investment.**



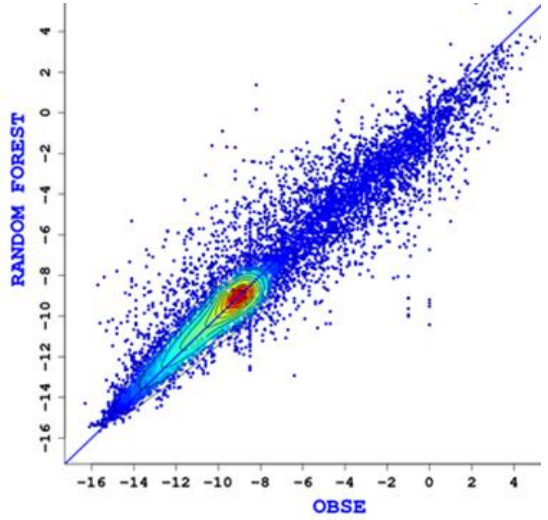
To guarantee the networks operation in these contexts, new **generation and load forecasting techniques** will be developed to define and develop the energy management systems of the networks in the various configurations.



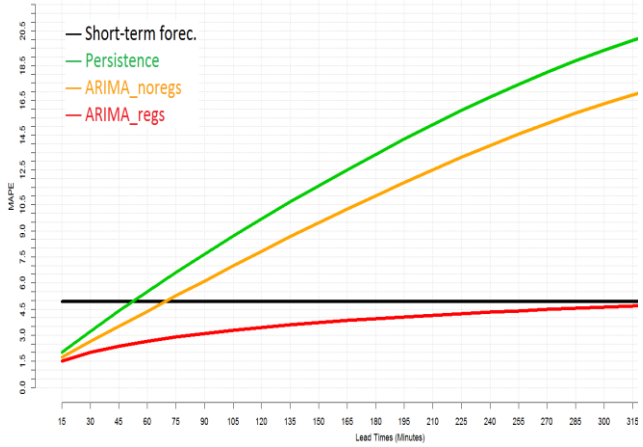
Very short-term generation forecasts for single plant



Absolute errors ARIMAX, multi-model, smart persistence for Pontedera PV plant



Scatter plot short term forecasting of power in primary substation



Error very short term forecasting of loads

The project involves participation in initiatives **to accelerate the innovation** of the national electro-energy system and to provide ideas for **future research**, the definition of **strategic plans and implementation** of R&I at national and international level (EERA, ISGAN, Mission Innovation, CEM) and in technical standardization activities (CEI, CENELEC, IEC).

The project activities will be carried out in collaboration with **national accademias**, national and international **research centers**, **EU projects**, **DSO and TSO** in order to guarantee the results dissemination and application to maximize the benefits for the electricity system and users.

The results of the network studies will make it possible to estimate the **impacts in terms of greater investments** on the distribution networks for the achievement of the PNIEC objectives and to evaluate the **possible contribution from local flexibility services.**

In the field of electrical measurements, the results will allow the **Standardization activities** to implement **new regulatory schemes**, with reference to both energy and **Power Quality** measurements.

The **experimental characterization** of the different solutions developed, tools, controls and demonstrators, will allow to favor the integration of renewable and non-programmable generation, self-production and aggregators.

DSO, TSO and the national manufactures will benefit from the results: **management, flexibility, load forecasting and generation**.

The experimental demonstrators developed will increase **confidence in the management of mixed AC / DC distribution and multi-energy grids**.

The methodology developed for the planning of distribution networks in accordance with the PNIEC scenario and considering different architectures and the results obtained from its application in realistic case studies allow to evaluate, also from an economic point of view, the expected interventions **to enable the decarbonisation of the electricity system**. They will allow the **selection of investments** considering both the energy and service markets.

The users could have better perfomances from the grid in terms of **Power Quality and flexibility.**

Active users will be able to benefit from the **revenues deriving from the flexibility services**.

Thanks to the studies and validation of the logic for the development of the MSD at local level, users will be able to benefit from a **possible reduction in the costs associated with the energy vectors** (for example a possible reduction of dispatching charges).

Thank you!

http://www.rse-web.it/

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