CENTRO STUDI DI ECONOMIA E TECNICA DELL'ENERGIA "GIORGIO LEVI CASES"

Levi Cases

UNIVERSITÀ DEGLI STUDI DI PADOVA

INCITE: Optimal management methodology for distribution network control in presence of energy communities as flexibility providers

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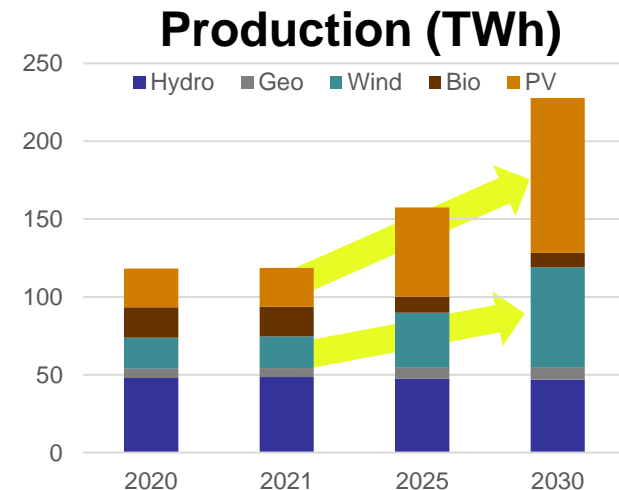**CENTRO STUDI DI ECONOMIA E TECNICA DELL'ENERGIA "GIORGIO LEVI CASES"**

Le ricerche del Levi Cases – 22 settembre 2023 - Corte Benedettina di Legnaro

Project drivers

- **Electricity sector** is the key for reaching the challenging climate goals for **2030** and further
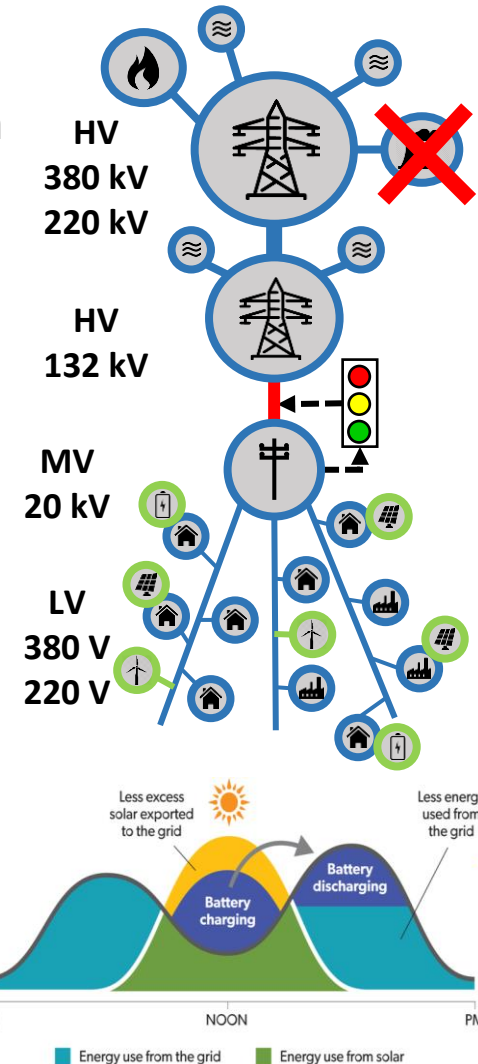
- Italian NECP goals for 2030 (PNIEC – 2023):
    - RES-E share: 36% → 65%   **+81%**
    - WIND capacity: 11.3 → 28.1 GW   **+149%**
    - WIND production: 20.3 → 64.1 TWh   **+216%**
    - PV capacity: 22.6 → 79.9 GW   **+254%**
    - PV production: 25.0 → 99.1 TWh   **+296%**

Production (TWh)

Hydro ■ Geo ■ Wind ■ Bio ■ PV

(bar chart showing production in TWh for years 2020, 2021, 2025, 2030 with y-axis from 0 to 250)

- Larger electrification of the final energy uses is expected both for building heating and transport (6.6 M Evs in 2030 vs. 0.2 M in 2023)

Project drivers

- **More renewable plants = More stress on the power system**
  - HV grid: Terna presented 10y investment plan for >21 B€ (11 B€ on the «hypergrid» to strengthen N-S connection)
  - Higher RES shares lead to lower Thermal PPs share
  - RES production concentrated in few hours and typically misaligned with load profiles

- **Need for enhancing the «hosting capacity»**
  - Smart «local» grids
  - Storage systems (both centralised and decentralised)
  - Management of EV charging stations
  - More control on local electrical consumption (Energy Communities)

- **Reform of the electricity market**
  - Higher resolution of energy markets to allow adjustments by operators
  - Opening of ancillary services market to small scale units (both directly or in aggregated form)

HV
380 kV
220 kV

HV
132 kV

MV
20 kV

LV
380 V
220 V

Less excess solar exported to the grid

Less energy used from the grid

Battery charging

Battery discharging

AM   NOON   PM

■ Energy use from the grid   ■ Energy use from solar

Research background

- Study of "value stacking" opportunities in flexible power plants dealing with new electricity market frameworks

    - Optimal management of hybrid PV-P2G and PV-BESS plants in multi-period perspective

    - Exploitation of novel continuous trading platforms for intraday and balancing service

- Evaluation of the impact of distributed resources aggregation under different schemes

- Study of optimal distribution grid management in presence of distributed storage facilities including EV charging stations
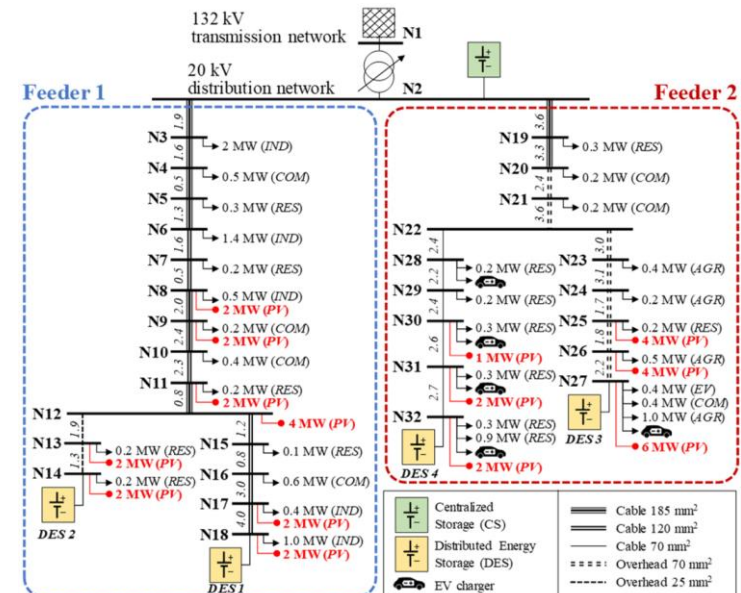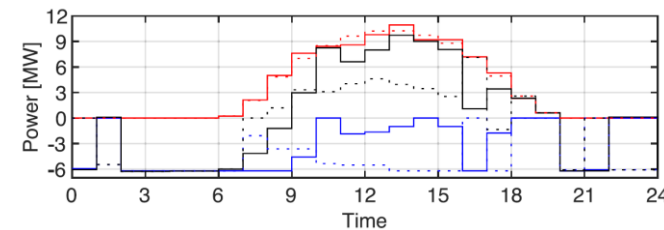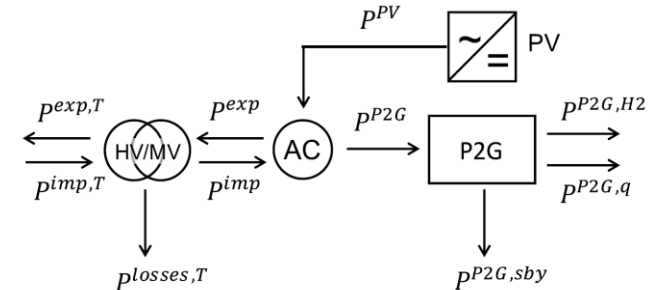
INCITE – research framework

- Integrated management of agglomerations of end users at local level (with strict limits in terms of power) is allowed

- DSOs are proposing projects to create local ancillary service markets to involve users in the distribution network management

- Energy communities can create an active entity (concentrated or distributed) for multiple purposes:

  - Maximisation of self-consumption (considering both storage devices or multi-vector energy usage)

  - More profitable interaction with the DSO for service provision (e.g. voltage control, peak shaving)
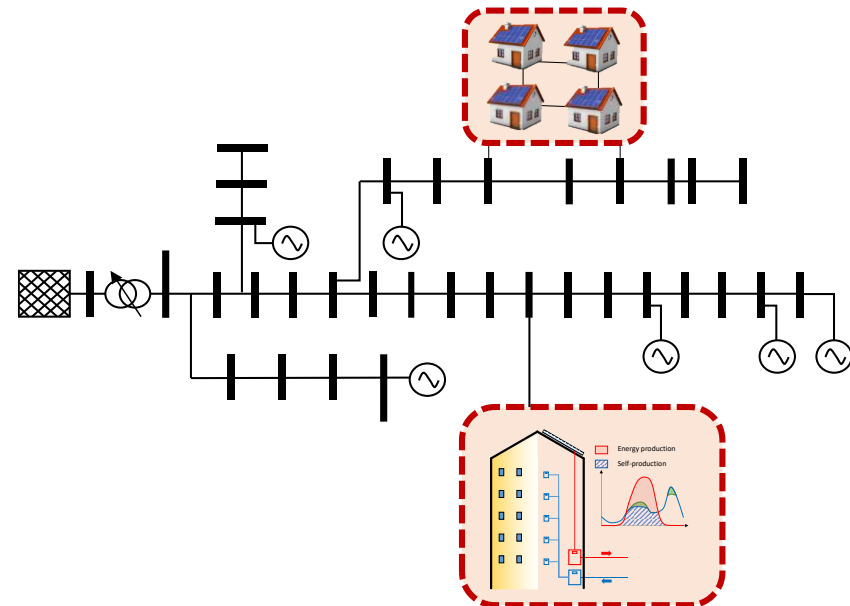
INCITE – expected outcomes

- The project will develop a simulation tool for the analysis of Ecs integration in electricity distribution networks

- The scope of this tool is the quantification of potential benefits from both the user and DSO, by assuming scenarios about:

  - Energy community layout and governance (e.g. allocation of the economical benefits among participants)

  - Possible rules in novel flexibility markets: standardization of ancillary services and of trading rules

  - Schemes for TSO-DSO coordination in exchanging ancillary services

- The research results will provide a scientific approach for the evaluation of novel local market schemes and their impact renewables integration in distribution networks
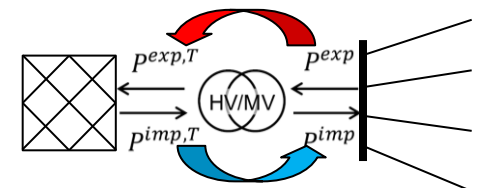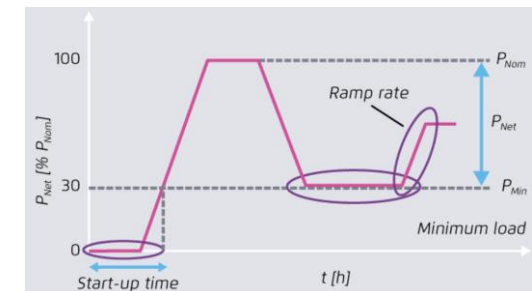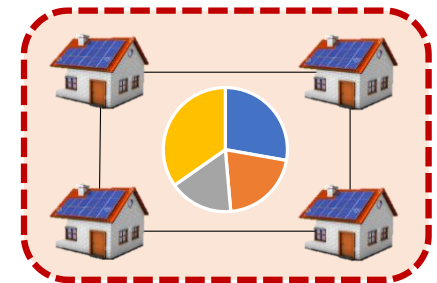
INCITE – interdisciplinary approach

- The project team includes UniPD personnel with different expertise:

    - Power systems regulation and control: M. Coppo (PI), F. Bignucolo (ING-IND/33)

    - Governance models and regulation: A. Lorenzoni (SECS-P/06)

    - Investment evaluation and statistical analysis: M. Bertolini (SECS-S/03)

- Furthermore, collaborations are expected in:

    - Optimal control design: R. Carli (ING-INF/04)

    - Converter and micro-grid layout: T. Caldognetto, D. Biadene (ING-INF/01)