SmartNet

Smart TSO-DSO interaction schemes, market architectures and ICT Solutions for the integration of ancillary services from demand side management and distributed generation

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Results for the three project pilots

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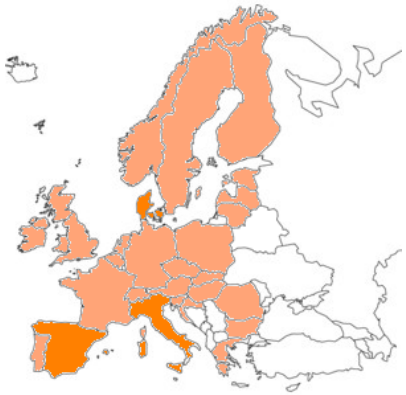
Aims and goals of WP5

Realisation of three complementary pilots to evaluate the performance of different TSO-DSO interactions under different market structures.

Coordination with laboratory simulations to bridge the gap between present real-world implementation and the opportunities envisaged for the future.



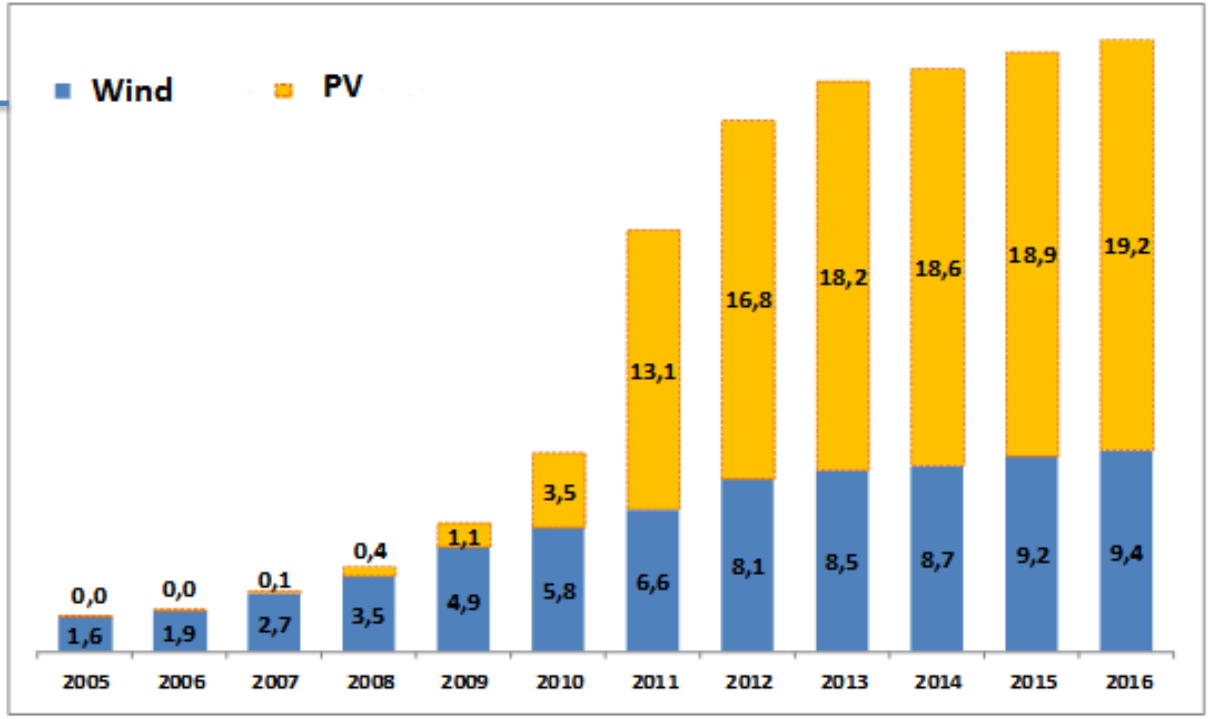
Identify & remove barriers to facilitate the way to the pan-European market for ancillary services.

Centralised TSO control in high-DER area

Italian context: Energy situation

Large increasing of RES in the last 10 years

New issues in terms of power management of the electrical grid



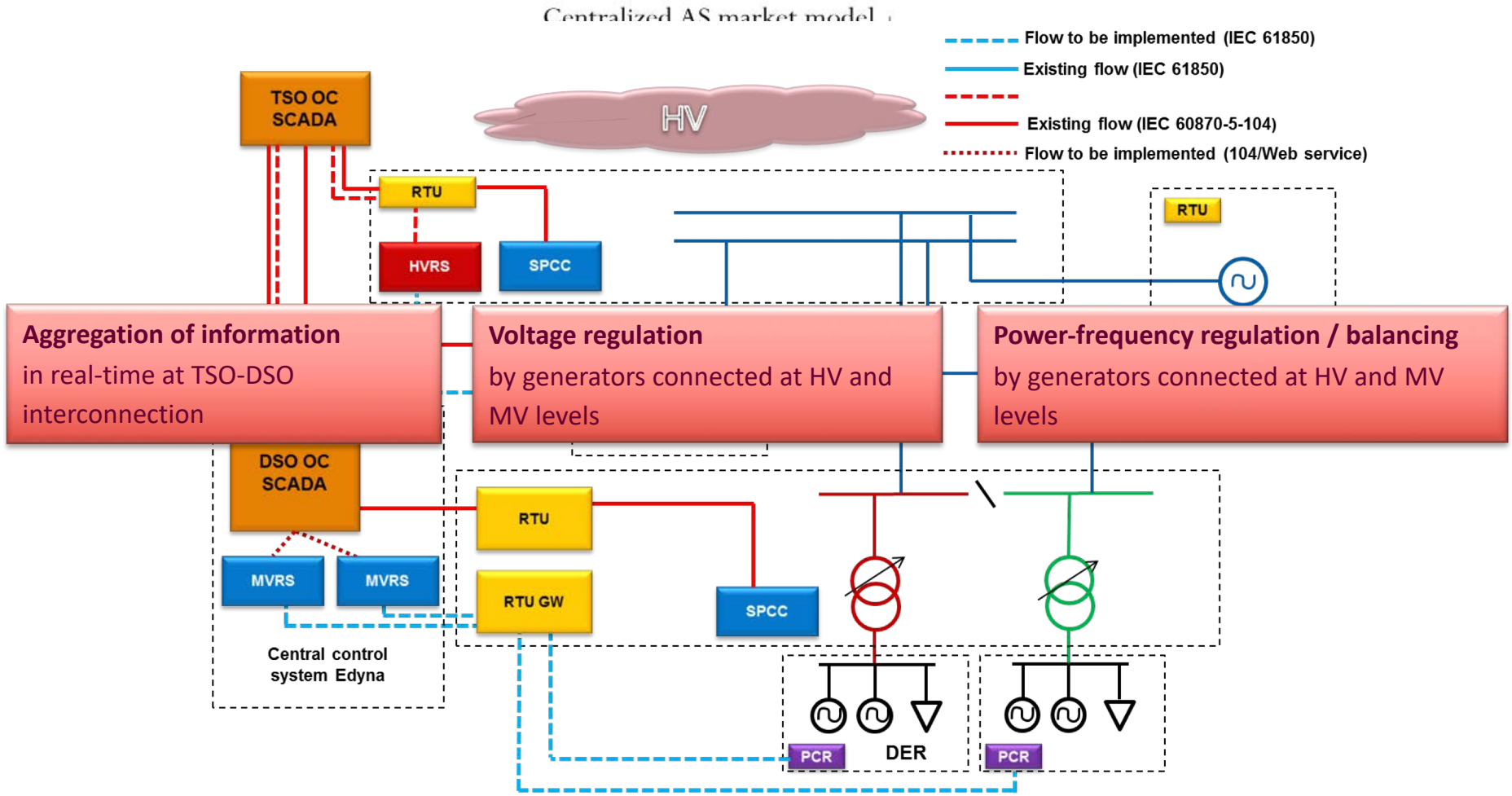
Active power rise from MV up to HV grid

Difficulty to predict RES production

Italian NRA is opening the market to DG and DR through *aggregators* and requiring the DSO to improve *observability* for the TSO

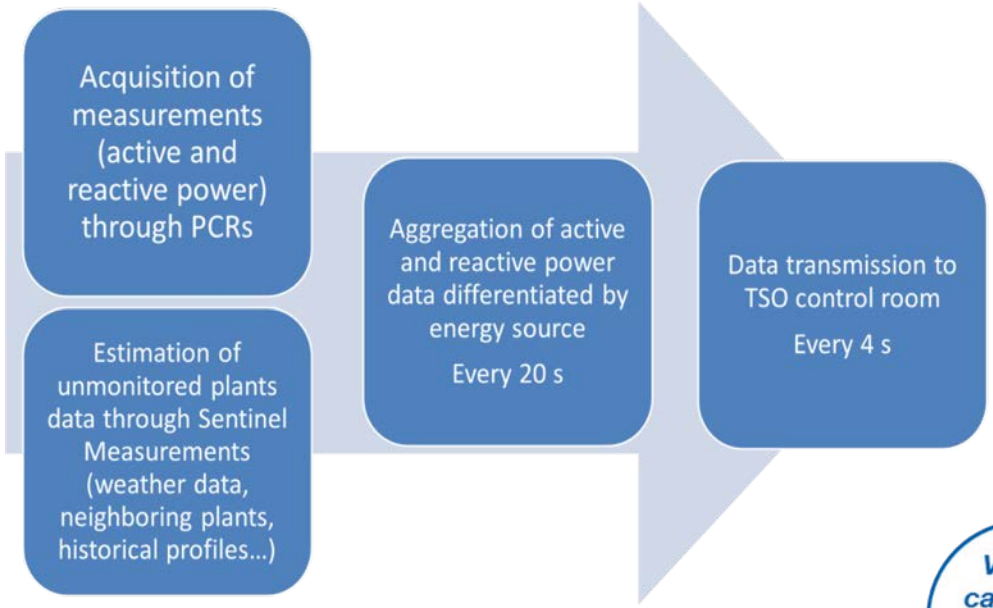
Needs to improve the infrastructure for monitoring and control of MV and LV levels

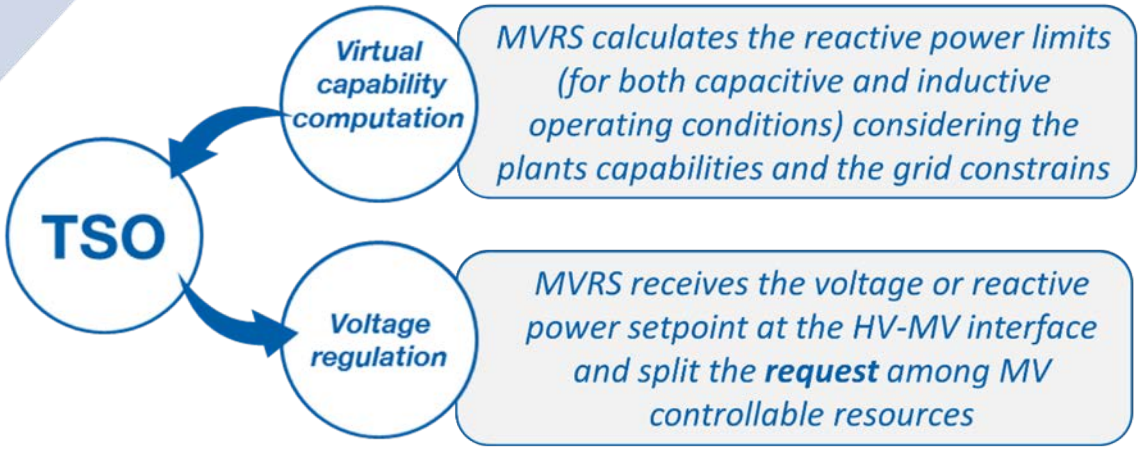
Pilot A: Centralised TSO control in high-DER area



Pilot A: Centralised TSO control in high-DER area

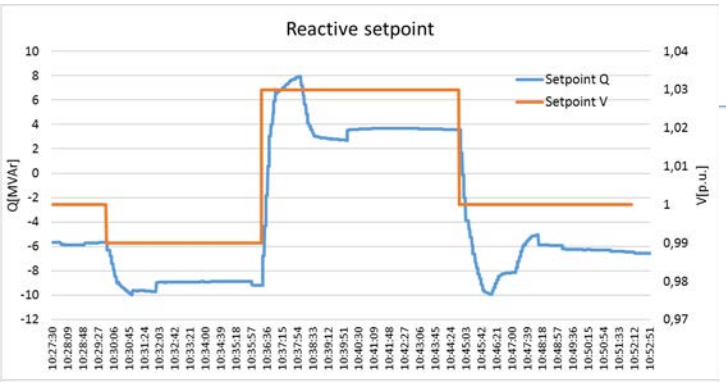
Aggregation of information
in real-time at TSO-DSO interconnection

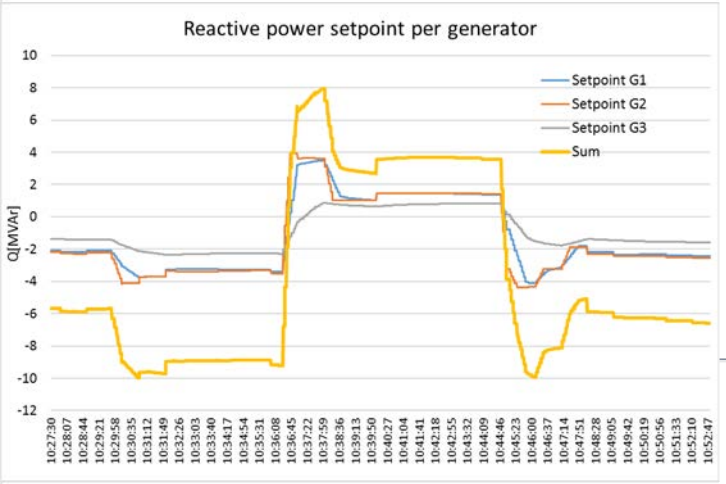


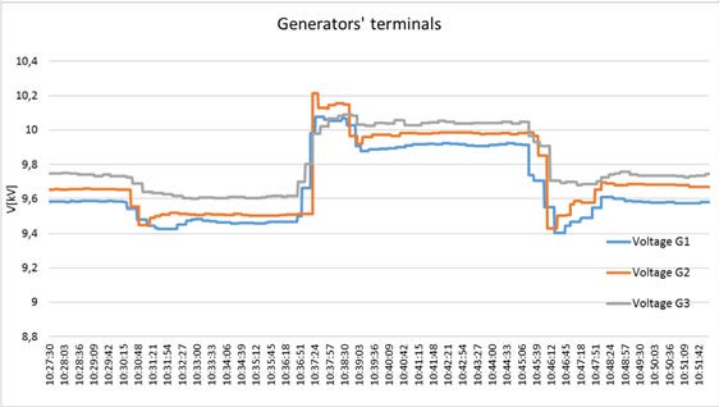


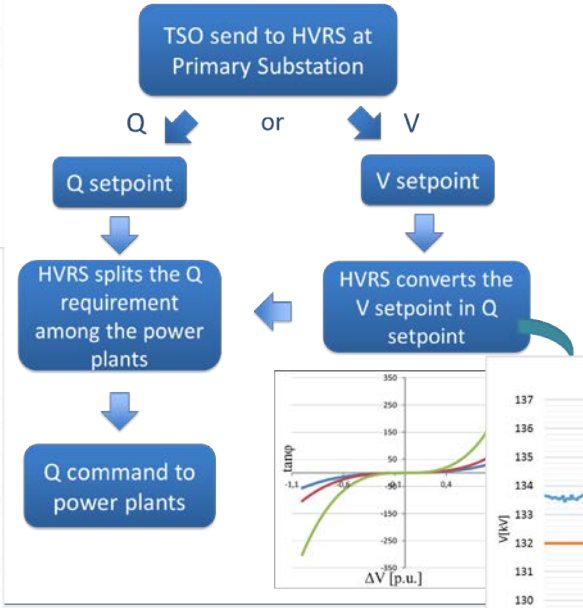
Pilot A: Centralised TSO control in high-DER area

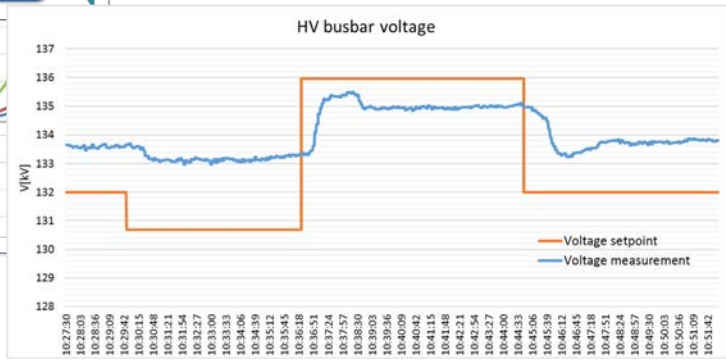
Voltage regulation
by generators connected at HV and MV levels

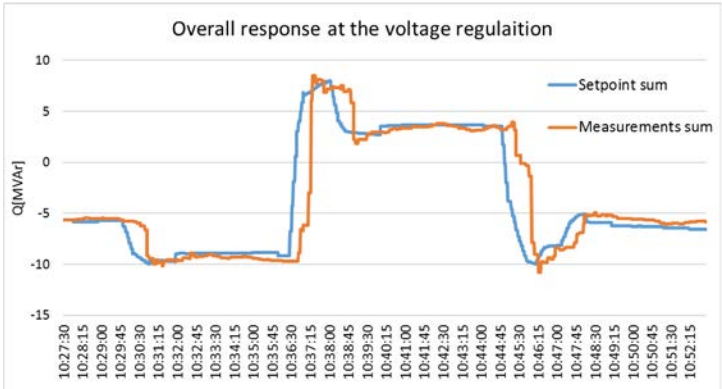






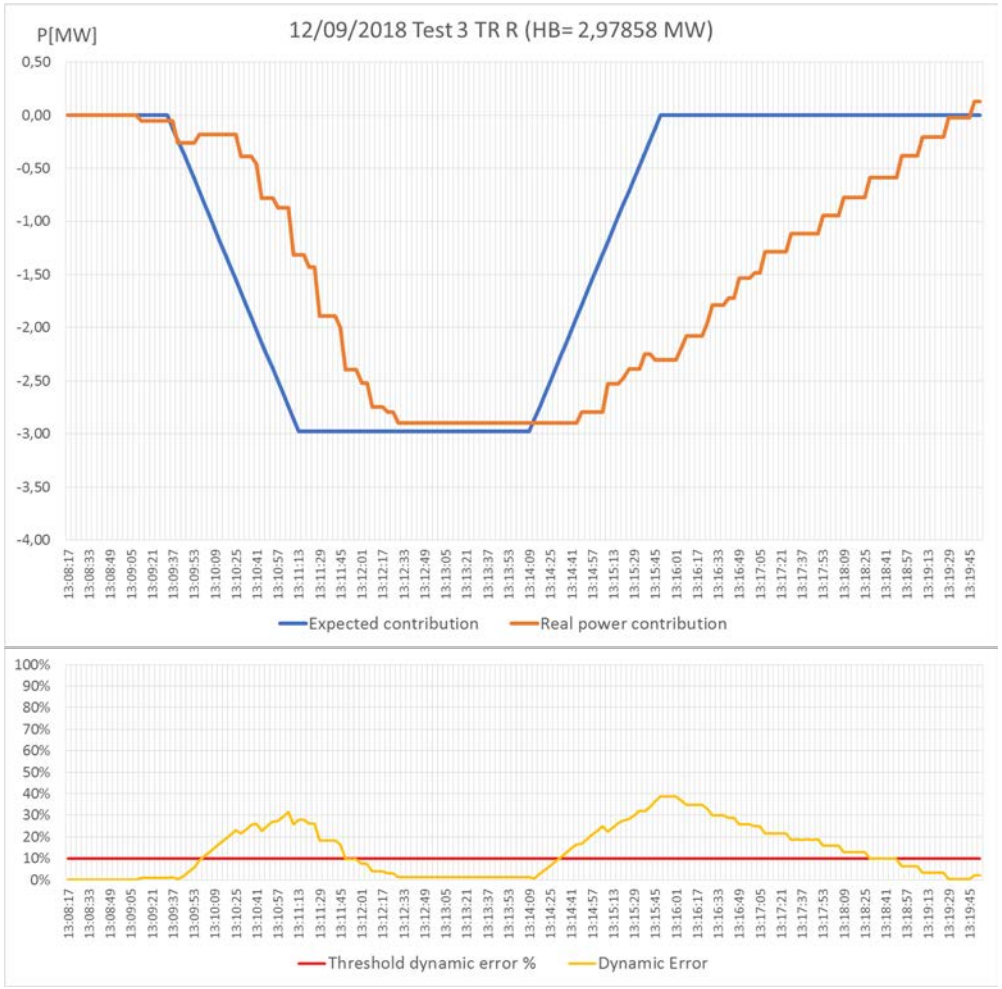






Pilot A: Centralised TSO control in high-DER area

Power-frequency regulation / balancing
by generators connected at HV and MV levels

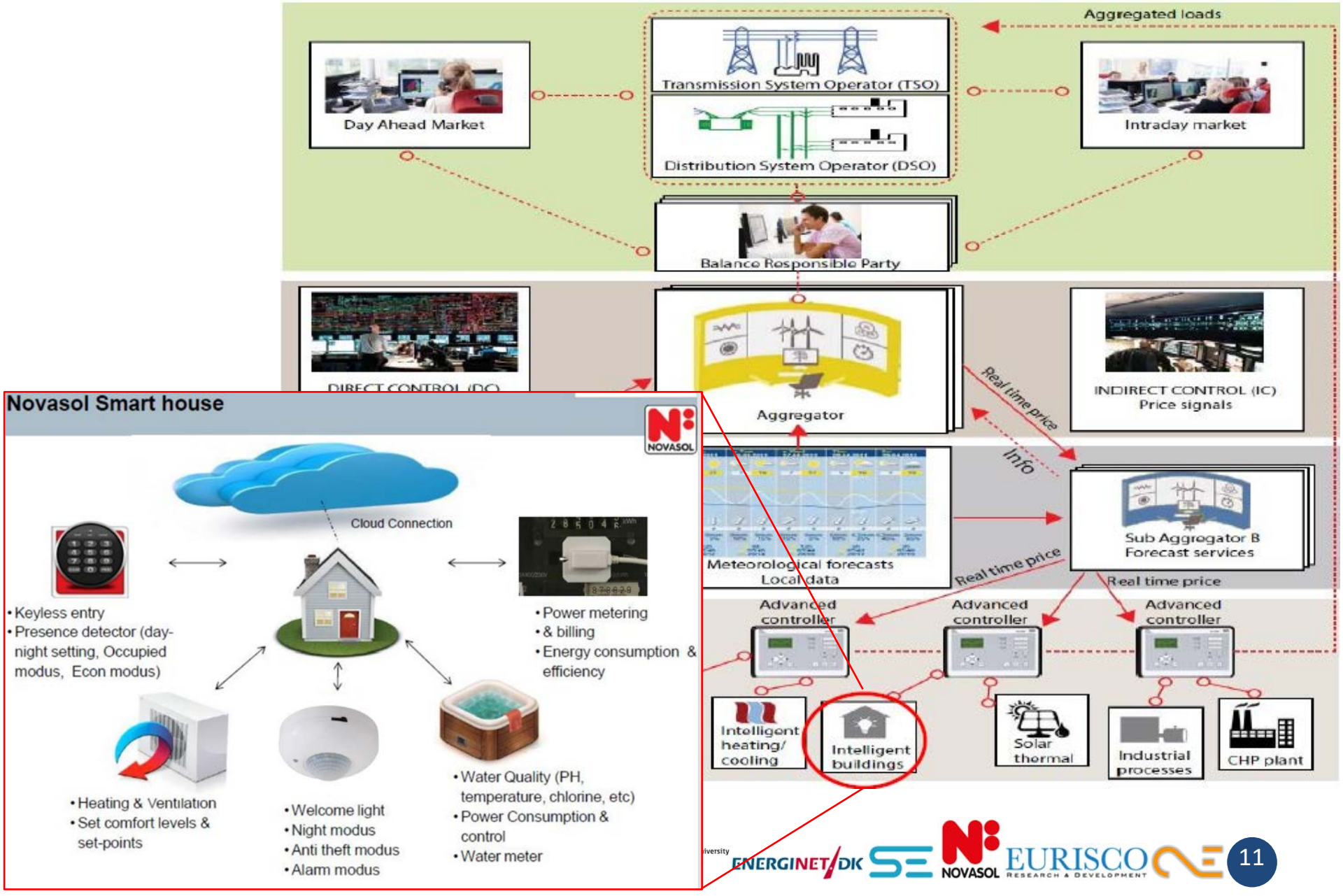


Pilot A: Centralised TSO control in high-DER area

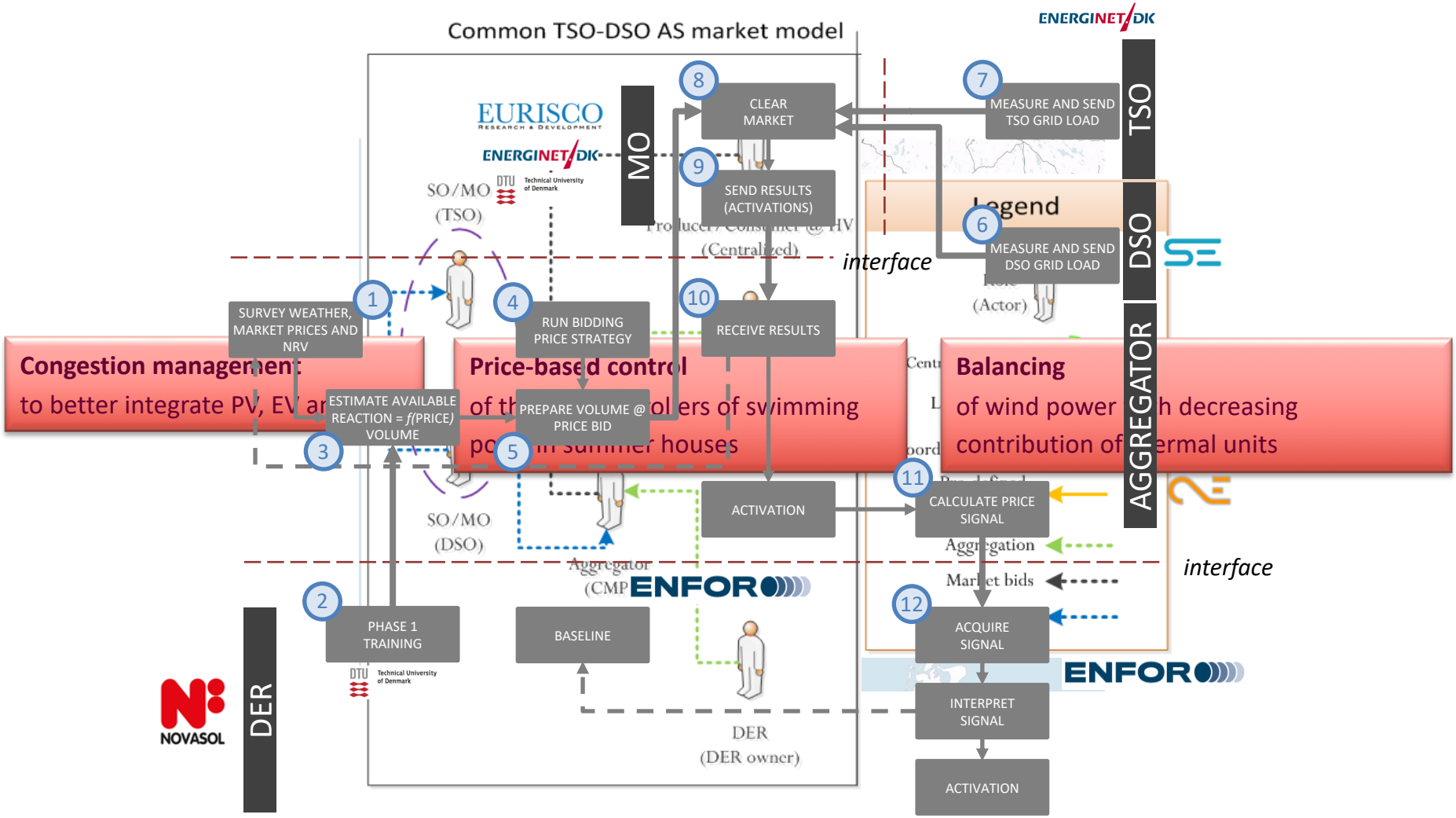
- Observability function: OK
- Voltage regulation:
  - HVRS: OK (lower impact than big power plants and small delays)
  - MVRS:
    - OK for distribution
    - Very low impact at transmission
    - Good to avoid reactive power loops which waste resources
- Frequency regulation:
  - RES were able to provide downward balancing
  - But they could not follow aFRR control signal (they may for mFRR)

Common TSO-DSO market with pool flexibility

Smart Energy Operating System (SE-OS)

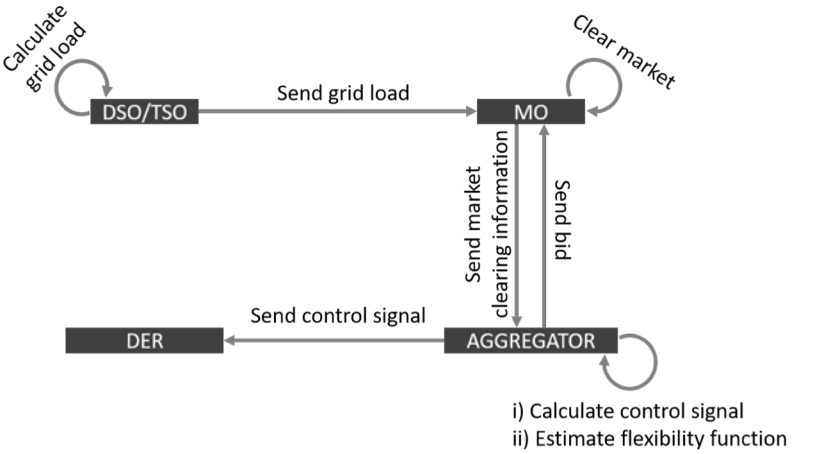


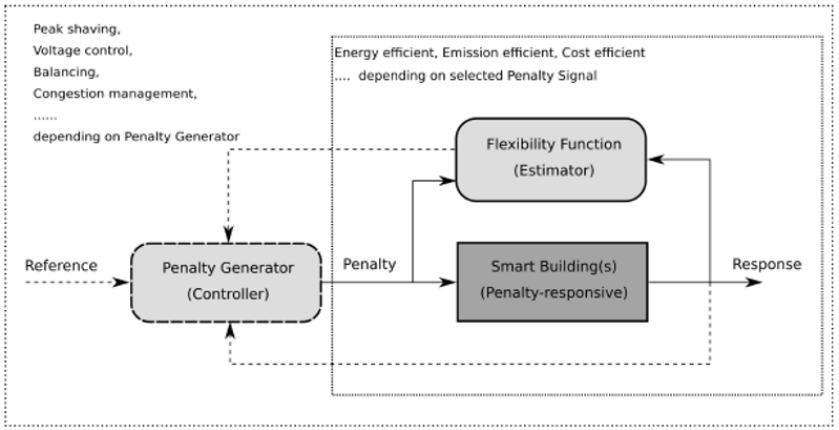
Pilot B: Common TSO-DSO market with pool flexibility

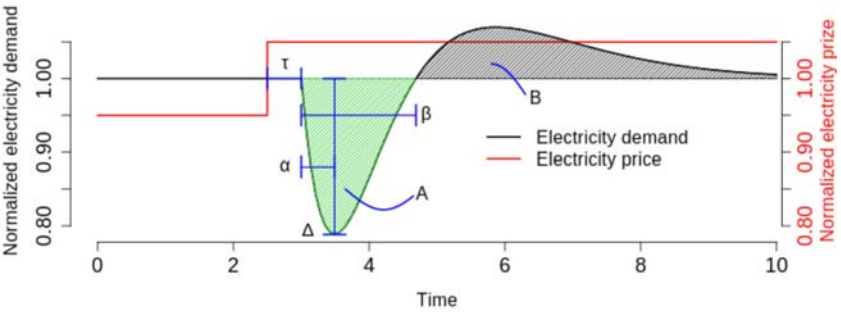


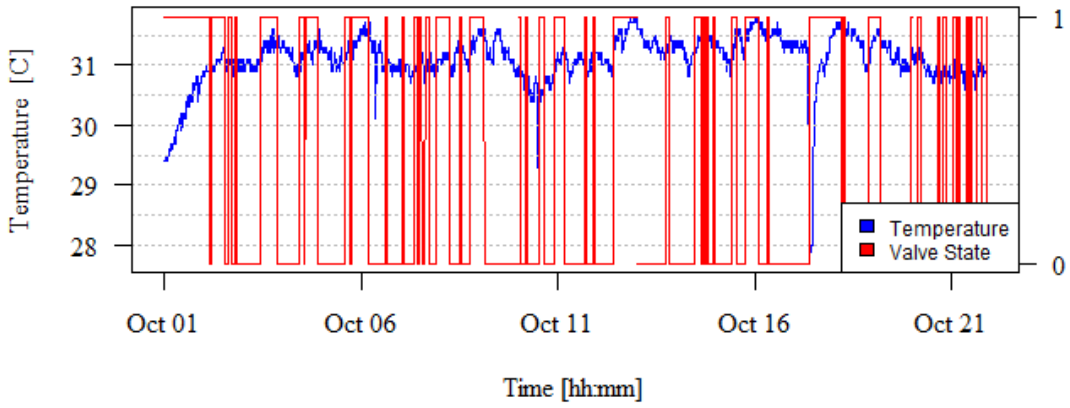
Pilot B: Common TSO-DSO market with pool flexibility

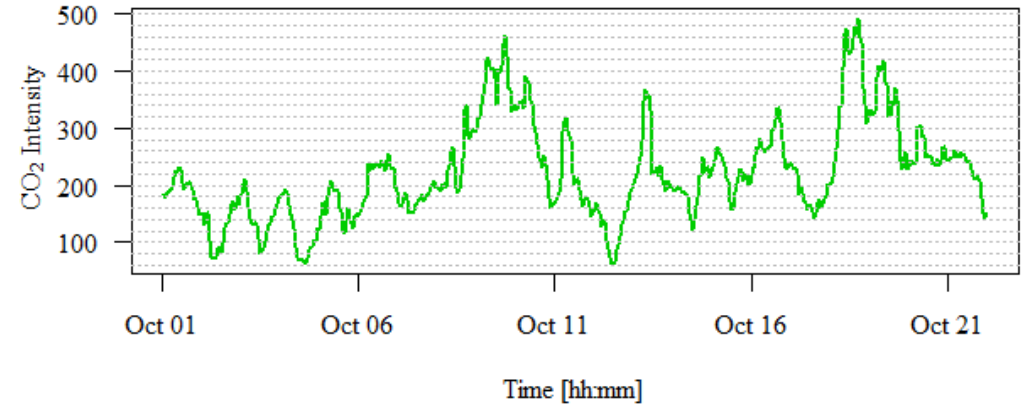
Price-based control
of thermal controllers of swimming pools in summer houses









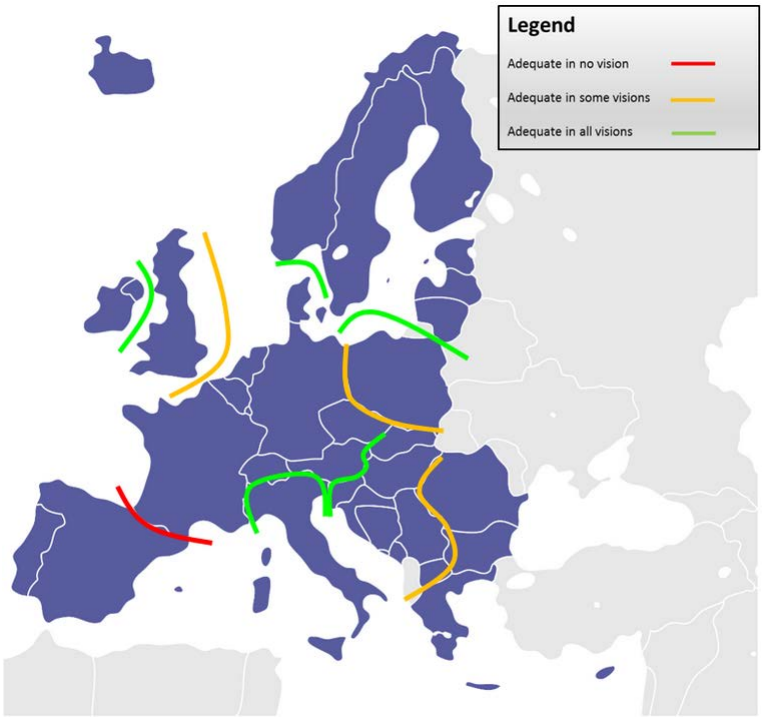


Pilot B: Common TSO-DSO market with pool flexibility

- Indirect control is useful for controlling DER
- Indirect control can be based on prices or other penalties, such as CO2-content
- Challenges in estimating flexibility function, but lightweight approach
- Need to have a strong communication network ➔ Focus on urban areas

Shared responsibility with base station flexibility

Spanish context

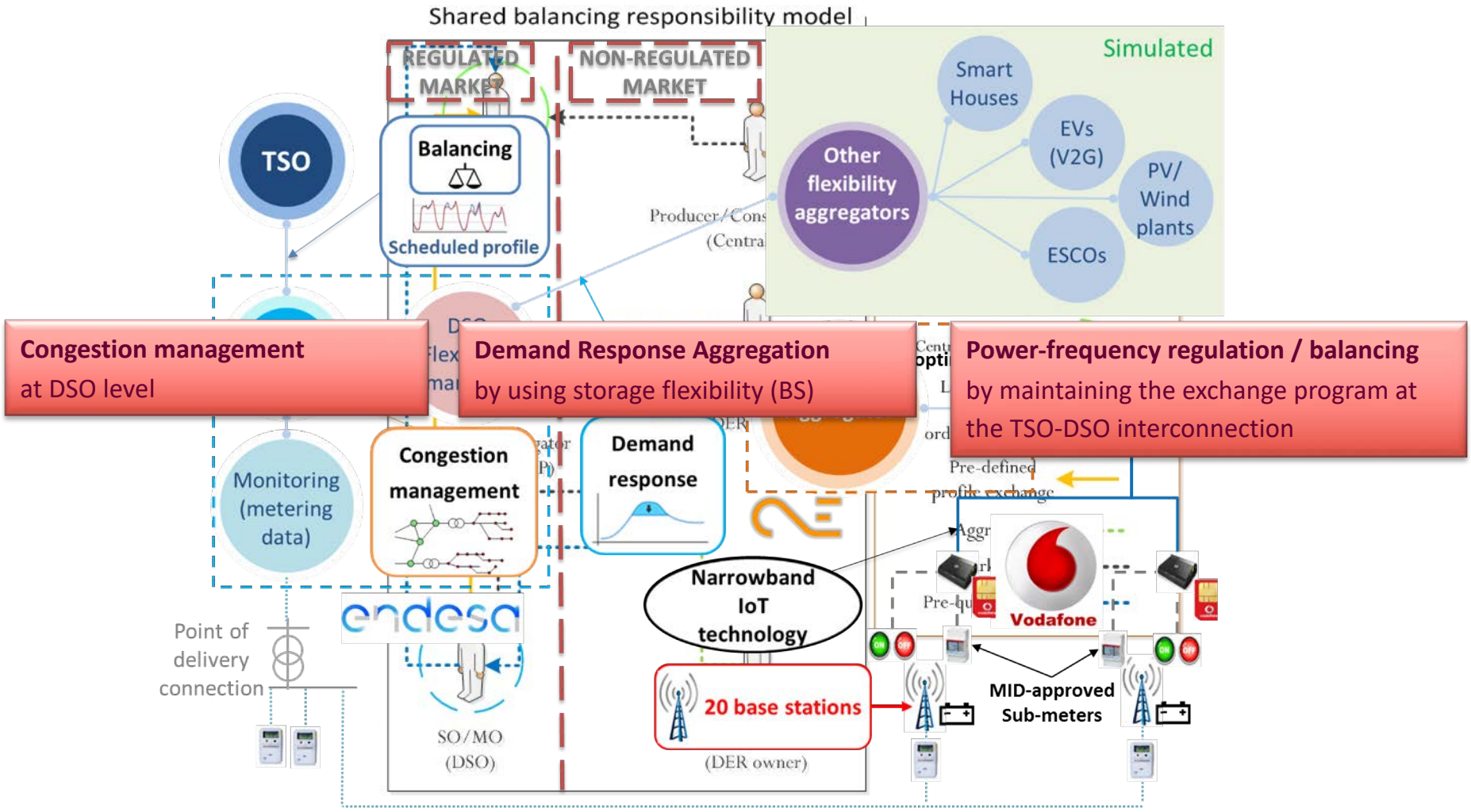


2030 Transmission adequacy (TYNDP'16)
http://tyndp.entsoe.eu/exec-report/

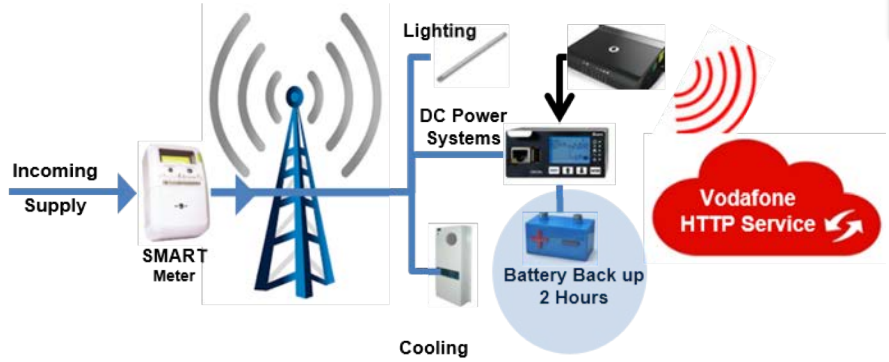
Poor interconnections

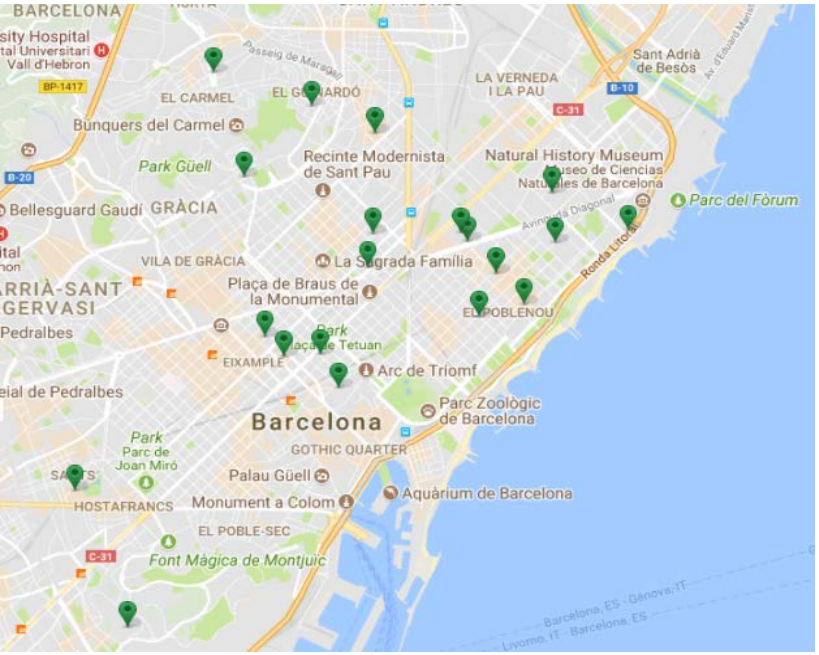
Big contribution by highly-variable RES production

Pilot C: Shared responsibility with BS flexibility



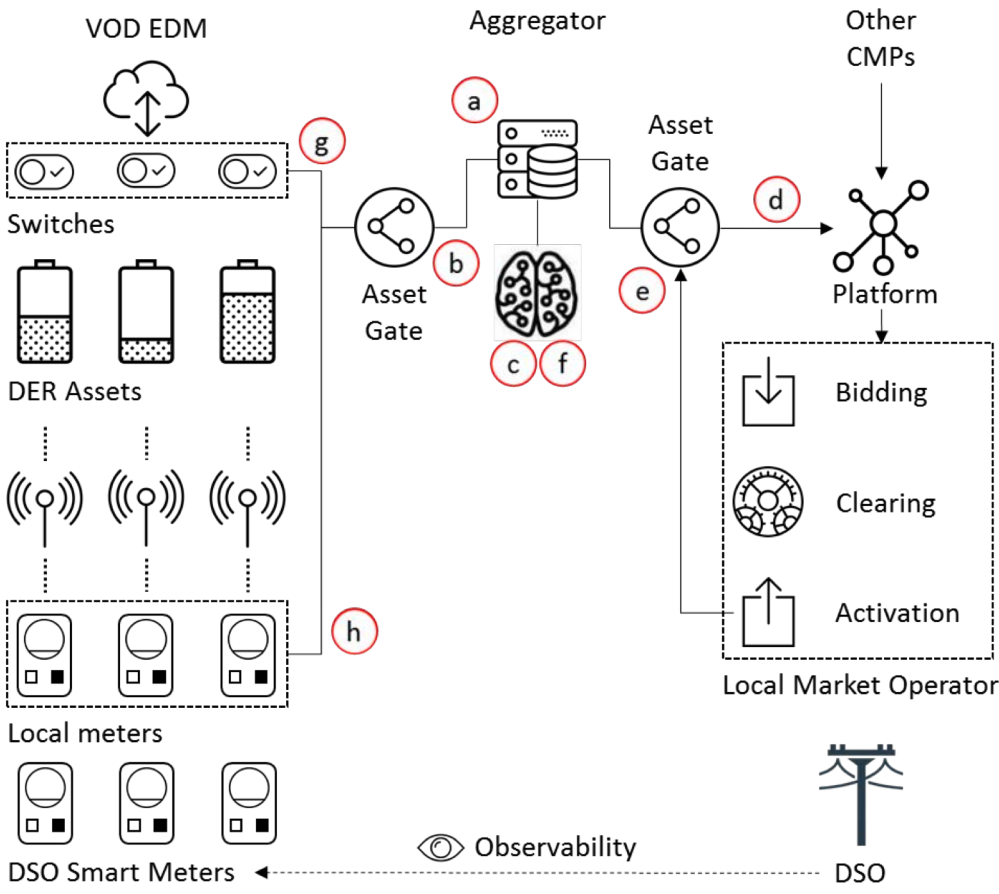
Pilot C: Shared responsibility with BS flexibility





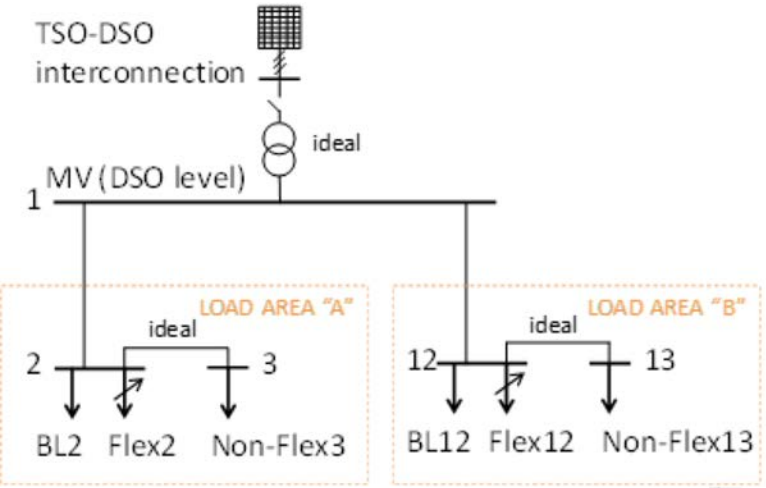
Demand Response Aggregation

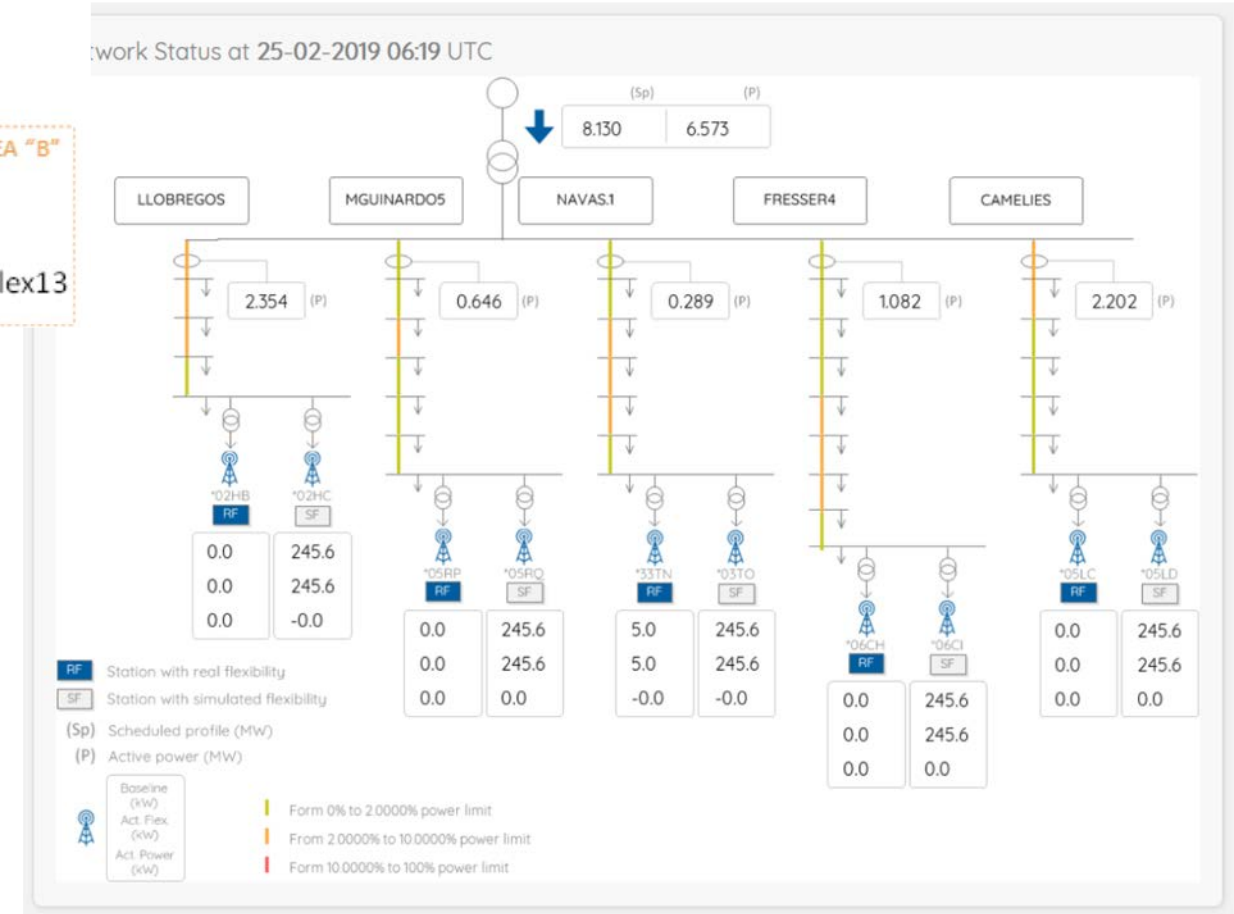
By using storage flexibility (BS)



Pilot C: Shared responsibility with BS flexibility

Congestion management
at DSO level

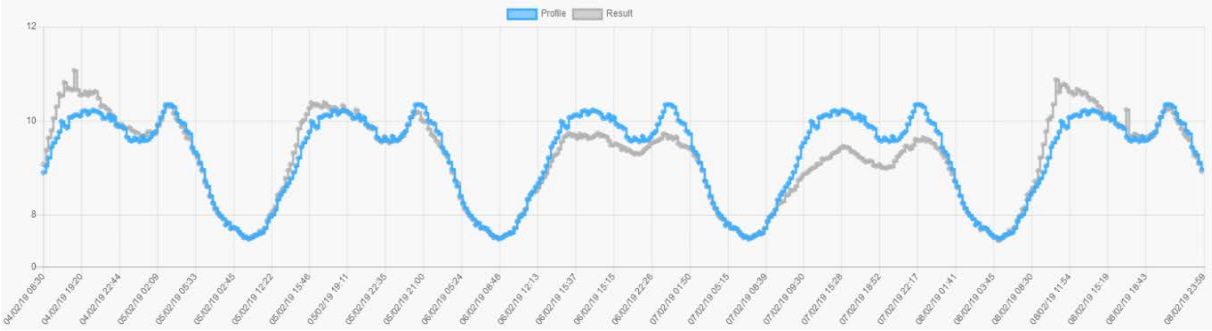


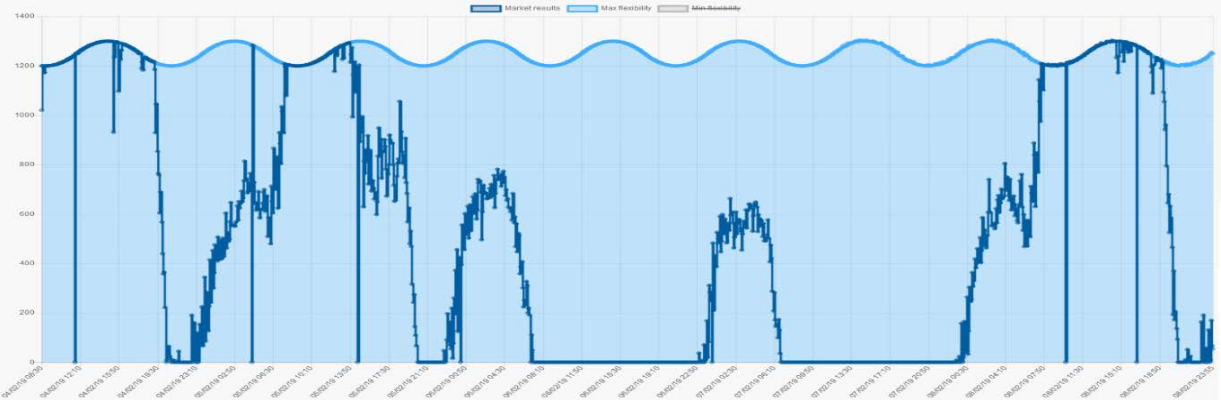


Pilot C: Shared responsibility with BS flexibility

Power-frequency regulation / balancing

by maintaining the exchange program at the TSO-DSO interconnection





Pilot C: Shared responsibility with BS flexibility

- DSO can operate local markets to avoid congestions and maintain scheduled profile:
  - Perfect matching between real exchange and scheduled profile, except:
    - When downward balancing was needed
    - There was not enough flexibility available
- CBA shows CS C as the least efficient one. However, from a practical point of view, it worked.
- No impact on Vodafone's service
- High replicability: More than 250 MW available on Vodafone's sites across Europe

SmartNet

SmartNet-Project.eu

Thank You

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