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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SmartNet pilots: The demonstration of TSO-DSO coordination schemes

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Tecnalia

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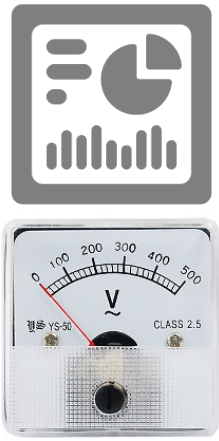
Agenda

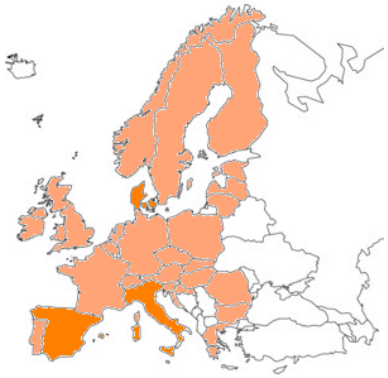
- Aims and goals of pilots
- Link to other SmartNet activities
- Activities description:
  - Italian Pilot
  - Danish Pilot
  - Spanish Pilot
- Key products

Aims and goals of pilots

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.



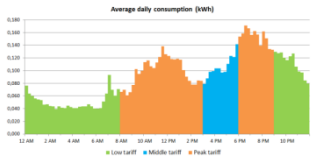


Identification & removal of barriers to facilitate the way to the pan-European market for ancillary services.

Link to other SmartNet activities

Reference architectures

Market & aggregator models



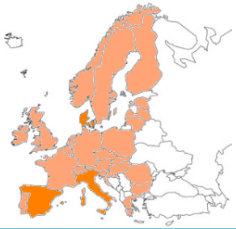
ICT specifications

Laboratory simulations

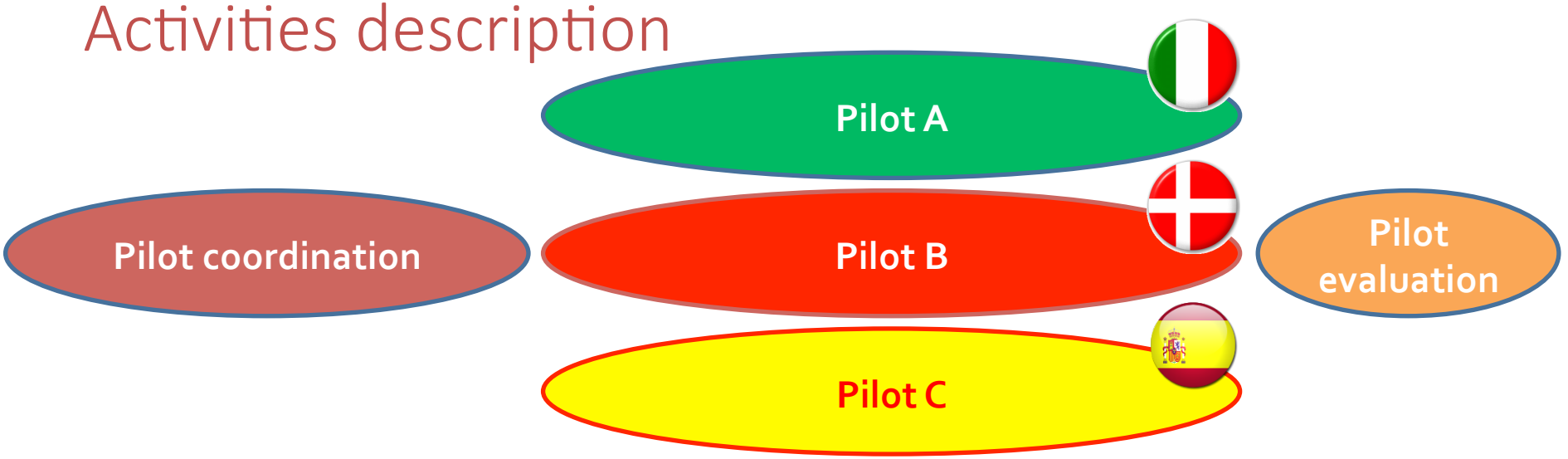
Pilot realisation

Validation of TSO-DSO interactions in real operations

Widespread adoption of SmartNet



Activities description



- Selection & characterisation of test sites
- Decision on infrastructure needs
- Definition of test procedures and scenarios

Implementation

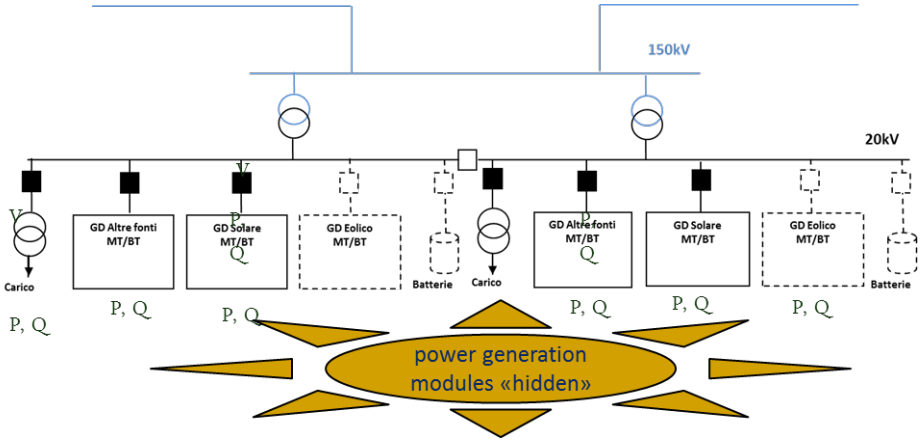
- Assessment of fulfilment of pilot objectives
- Identification of pros vs. cons of TSO-DSO interactions

2016				2017				2018			
Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4

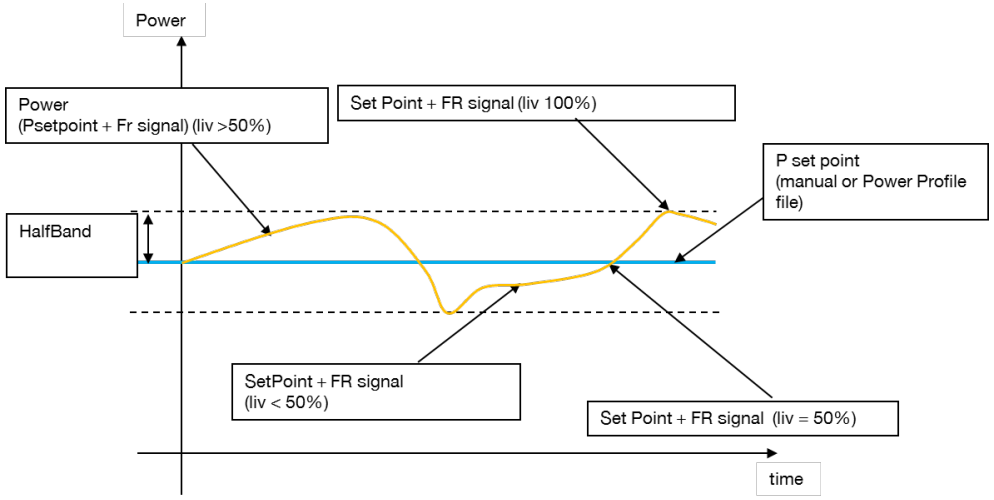
Pilot A

Goals

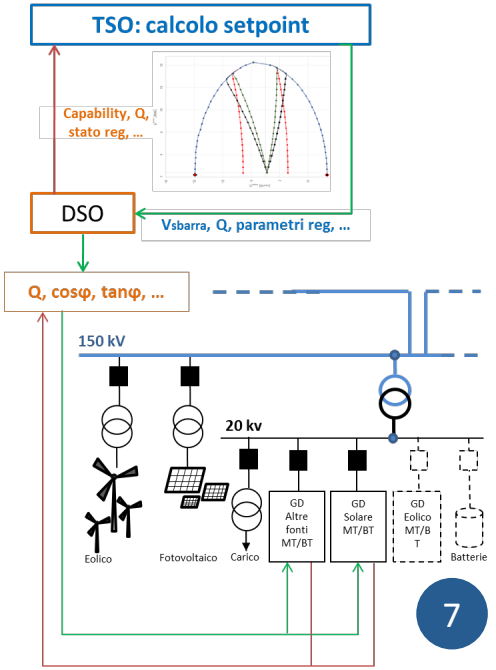
Aggregation of information at electrical node level



Active power regulation and provision of FRR



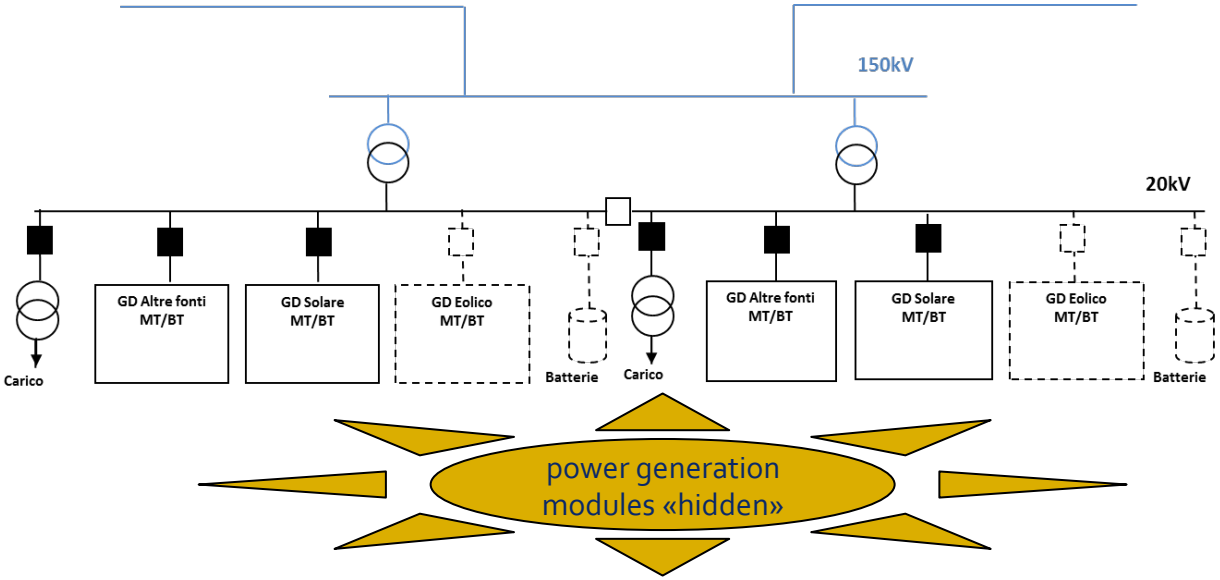
Voltage regulation



Services – Aggregation of information

Data to be aggregated

- Total power per source & load at every HV-MV transformer.
- P&Q per source & load at every HV-MV transformer (max. delay 20 s).
- P forecasts per source (1 h resolution, 72 hour period, update every 3 h).
- P&Q operational limits for the DSO as VPP.

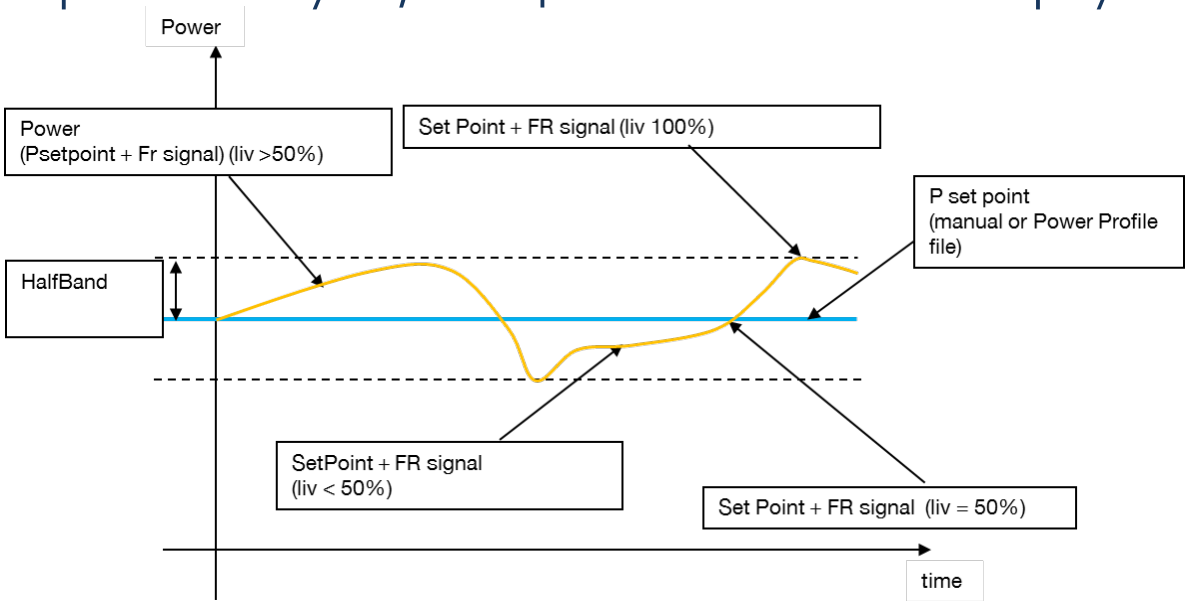


Aggregation of information at electrical node level

Services – Active power regulation and FRR provision

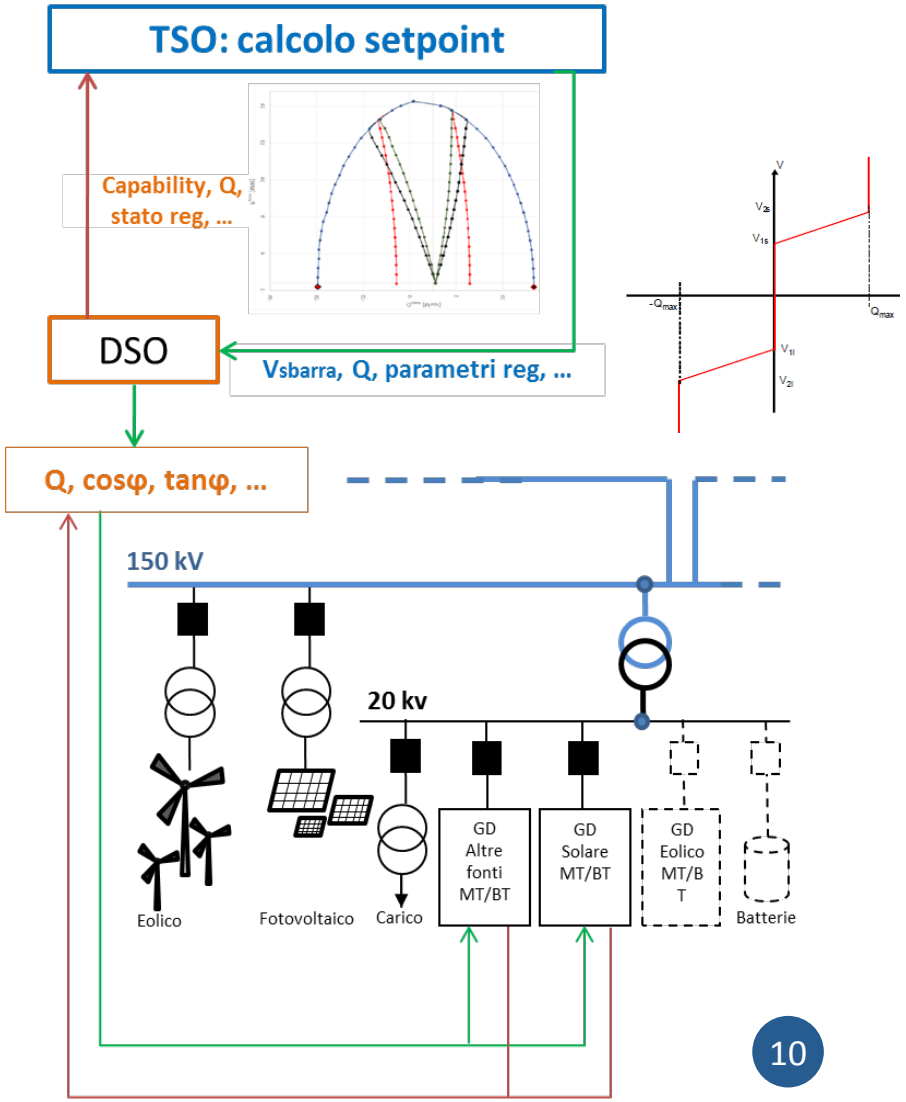
FRR

- Power variation, around a program level, following a set-point by the TSO.
- Set-point is % of the regulation band made available by the provider.
- Same set-point for the whole area ➔ easy to implement by DG.
- Set-point updated every 8 s, with 4% variation. Closed-loop cycle is 200 s.

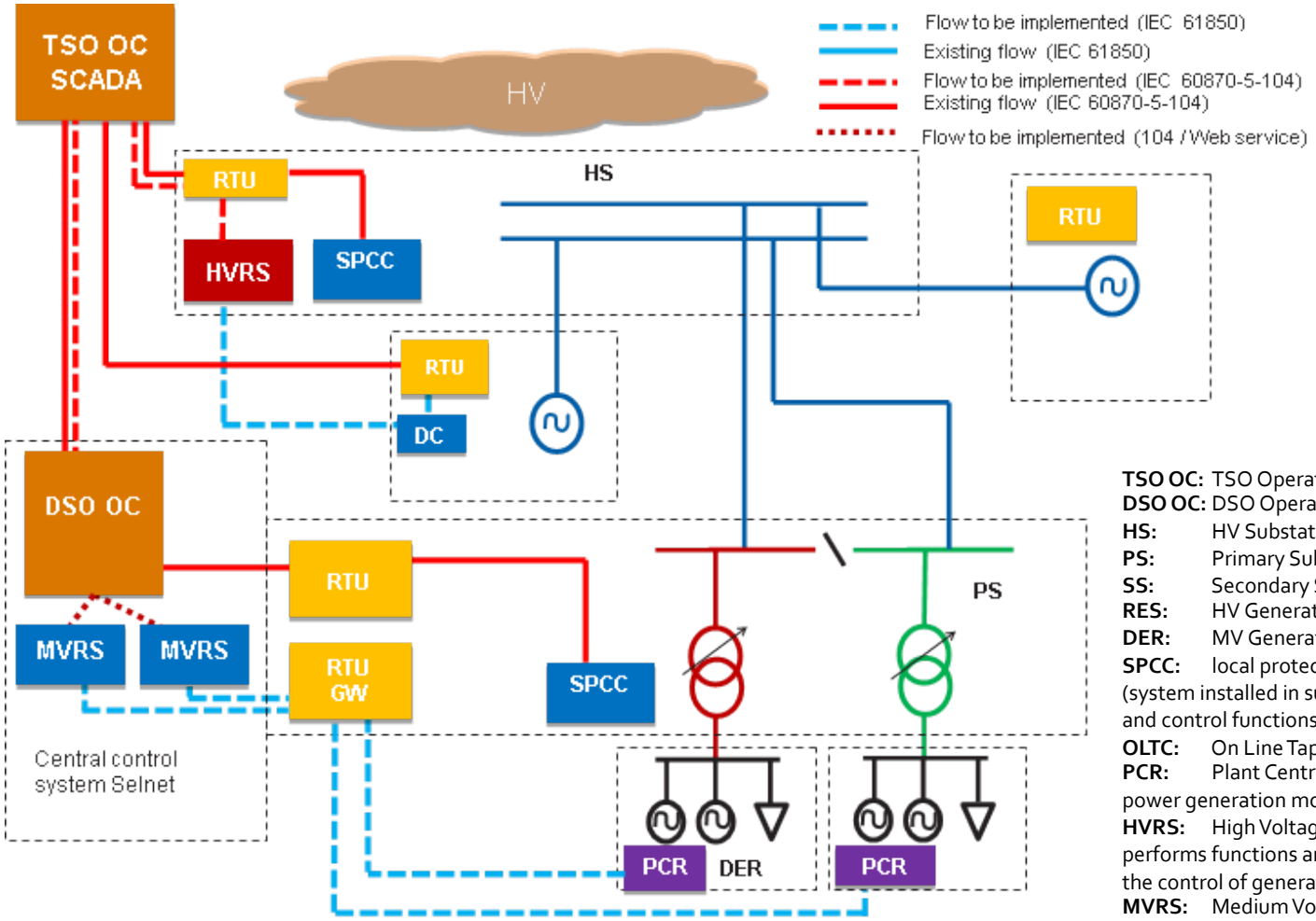


Services – Voltage regulation

- TSO uses an optimisation algorithm for the HV grid operation.
- TSO calculates a voltage set-point a the TSO-DSO interconnection point.
- The DSO receives the V set-point
- DSO calculates the set-point for individual DG units connected at distribution level.
- DG management must be compatible with hierarchical regulation on HV networks in terms of time of regulation. MV generation regulation must be decoupled from HV regulation (slower).



Architecture



TSO OC: TSO Operation Center
DSO OC: DSO Operation Center
HS: HV Substation
PS: Primary Substation
SS: Secondary Substation
RES: HV Generation/Customer
DER: MV Generation/Customer
SPCC: local protection, command and control system (system installed in substation for the protection, command and control functions at local level)
OLTC: On Line Tap Changer
PCR: Plant Central Regulator (device to interface the power generation module control system to the MVRS)
HVRS: High Voltage Regulation System (device which performs functions and algorithms for the aggregation and the control of generation at high voltage level)
MVRS: Medium Voltage Regulation System (device which performs functions and algorithms for the aggregation and the control of dispersed generation)

Pilot B

Goals

- Demonstrate aggregation services (30 summer houses).
- Implementation in field of ICT technology to exchange data between TSO, DSO, aggregator and smart homes.
- Use of online web-based services for price, load, and wind power forecasting.
- Development of architecture for all 3 services.

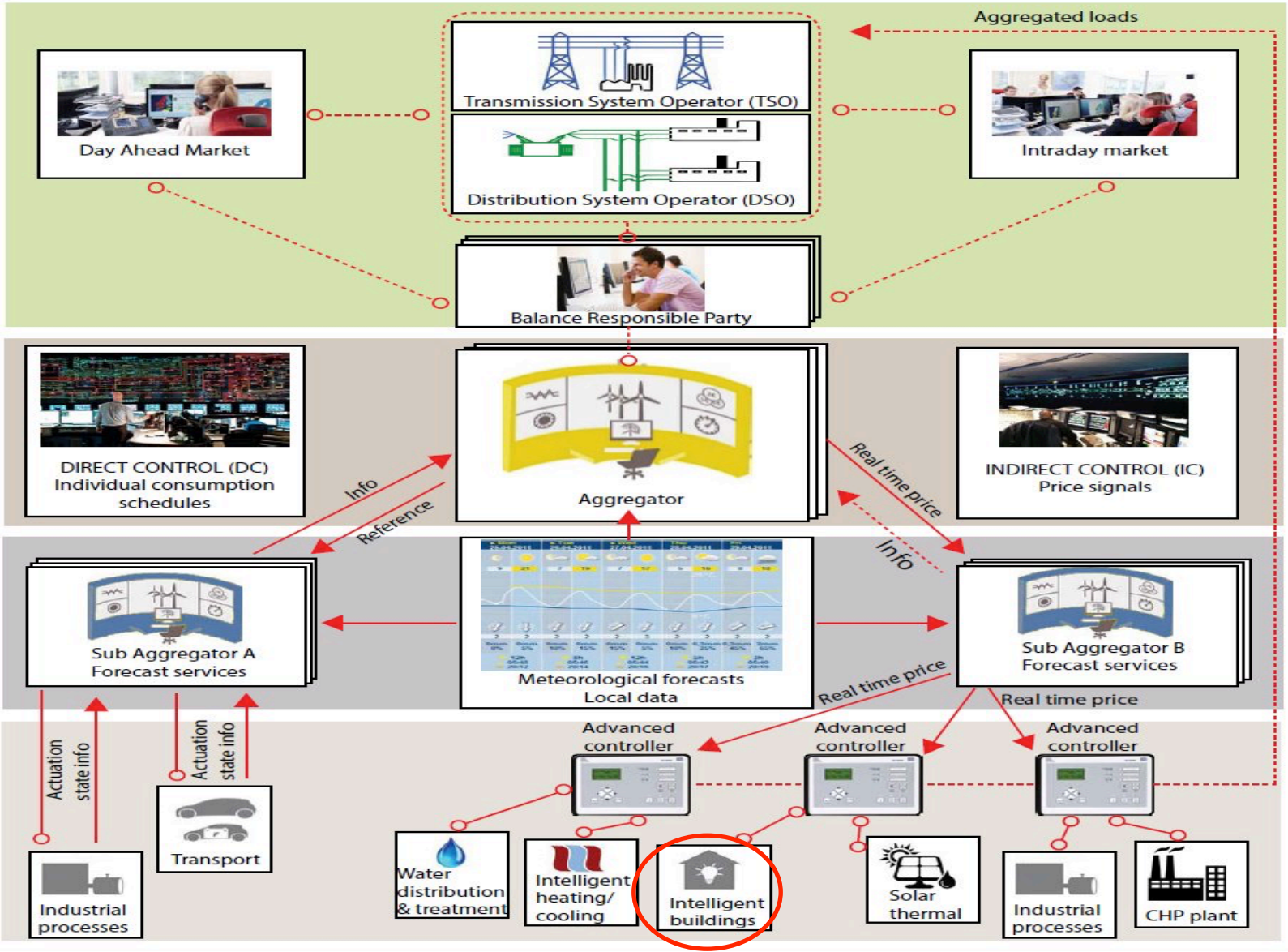
Aggregation

Communication

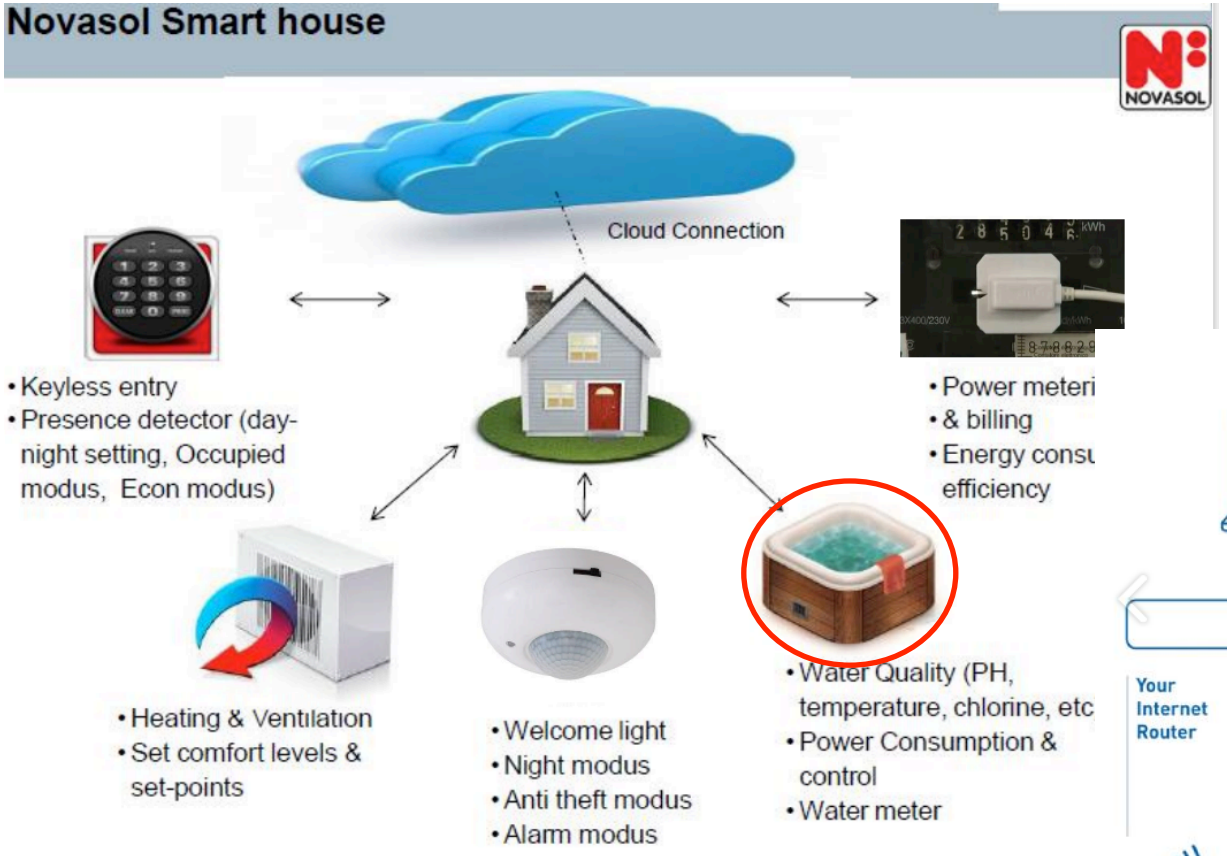
Forecasting

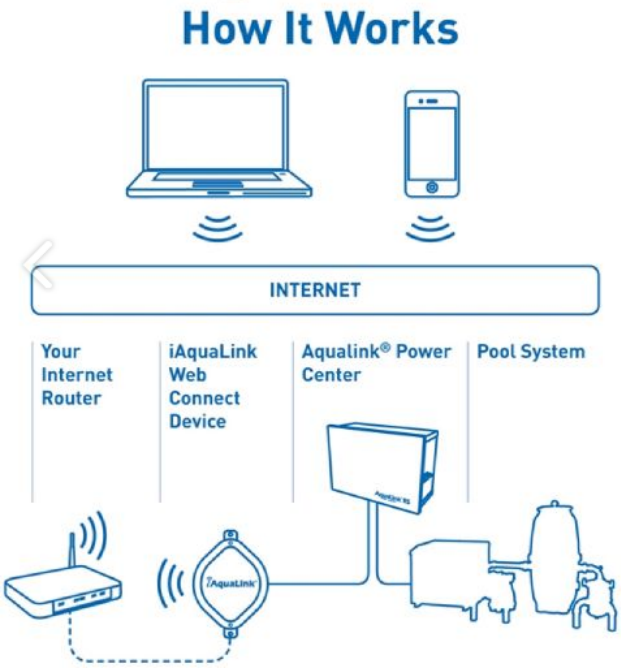
Ancillary services

Architecture



Smart house concept





Services

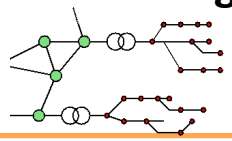
Balancing

- The large inertia of pools allows for shift of electricity consumption by several hours.

Voltage regulation (DSO)

- Via active coordination of the flexibility below a critical node on the DSO grid.

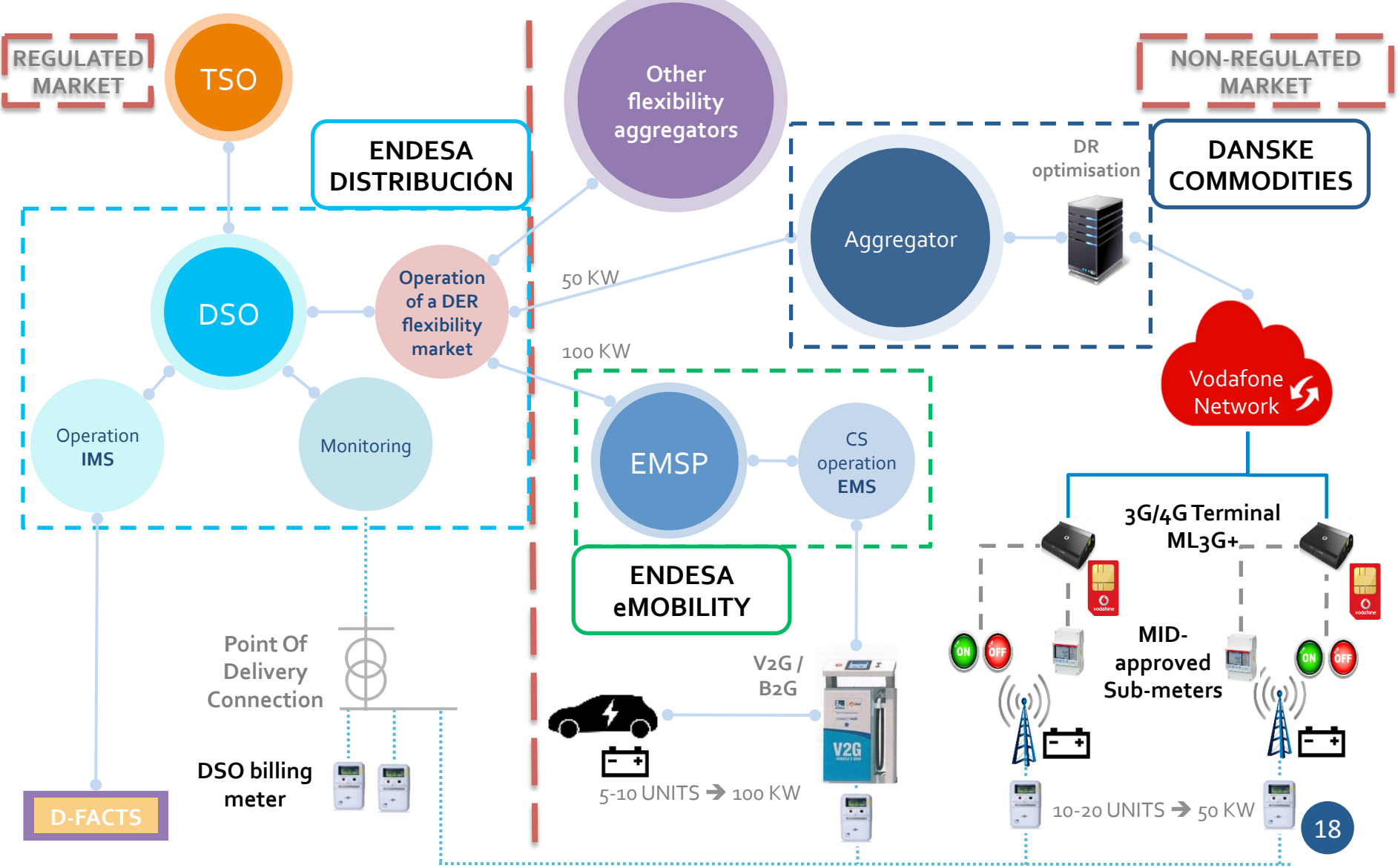
Congestion management



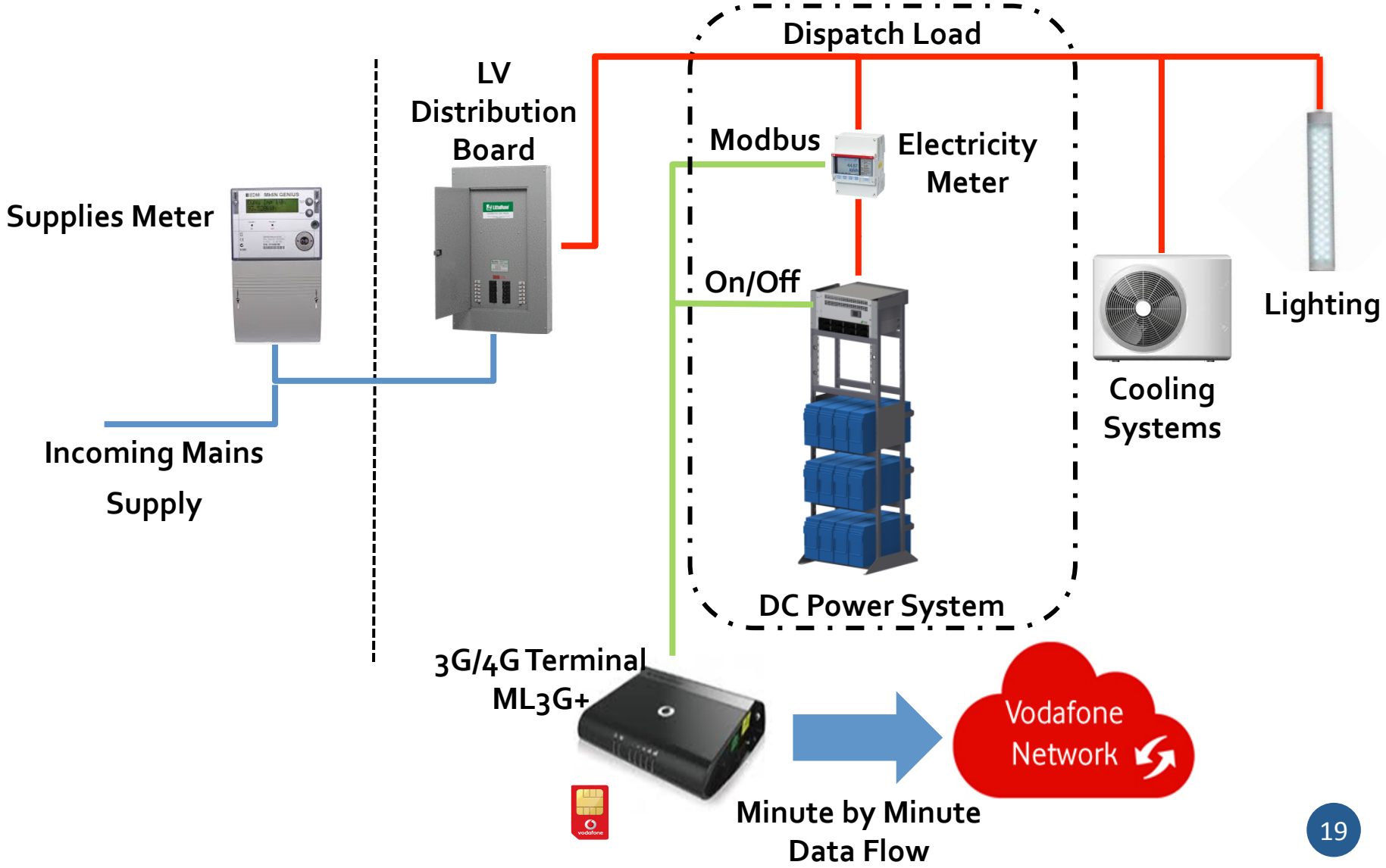
- Active load management to help finding an optimal routing of the power.

Pilot C

Architecture



Flexibility sources: load



Flexibility sources: V2G

Cars give energy to cities: The V2G project

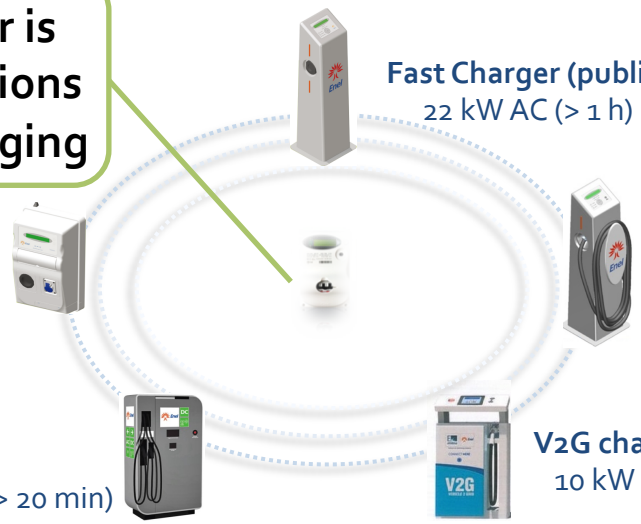
- EVs can be managed smartly to store clean energy and inject it based on the grid's actual needs and power the daily life of cities.
- "Electric drivers" can:
  - Recharge batteries when energy costs & demand are low.
  - Use EVs as "four-wheel mobile plants" and feed the energy stored back into the grid, with direct economic returns.

Barcelona

V2G Hub

ON GOING

ENEL's smart meter is integrated in all stations to enable smart charging



Fast Charger (public)
22 kW AC (> 1 h)

Slow Charger (private)
3.7 kW AC (6 h)

Fast Charger (public)
43 kW AC (30 min)

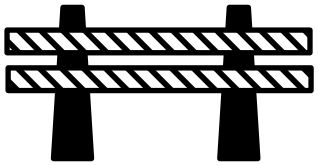
Multistandard Charger (public)
43 kW AC, 50 kW DC, 22 kW AC (> 20 min)

V2G charger
10 kW DC

Key products

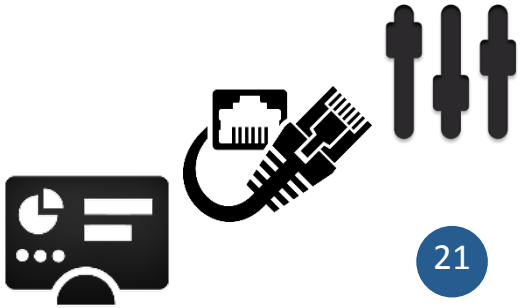
Validated TSO-DSO interactions (technical + operational)

Demonstrated interoperability and scalability to the whole European system.



Identified barriers for real implementation and regulatory proposals

Guidelines on best practices to implement the considered TSO-DSO schemes



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