SmartNet

A European research project to study TSO-DSO coordination for ancillary services provision from distribution networks

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Agenda

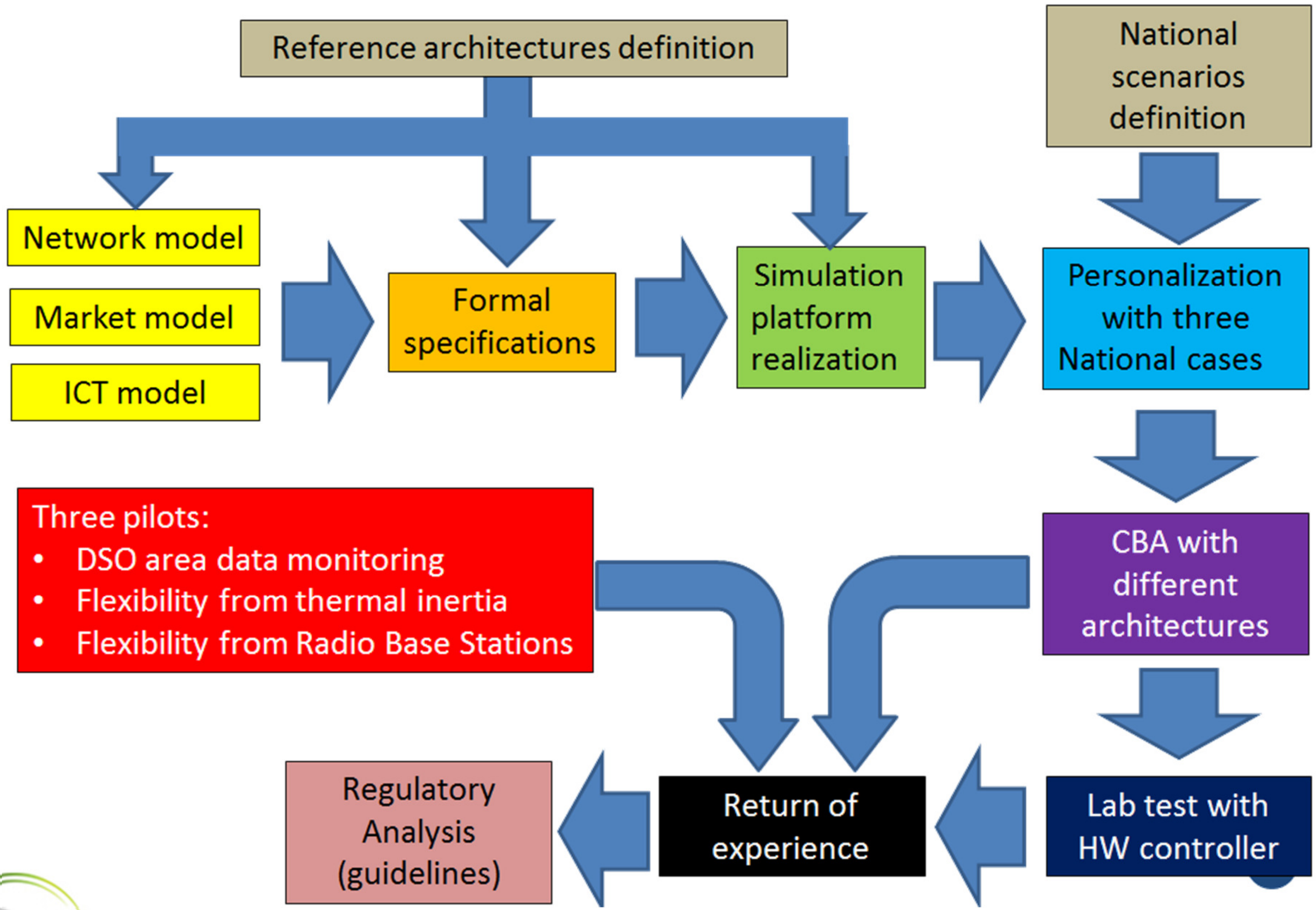
- General project overview
- Scenario analysis
- Use cases
- ICT analysis
- Simulation analysis
- Pilots

Introduction Video

- https://vimeo.com/220969294/73d98edde6

Overall project layout

SCENARIO ANALYSIS 2030



Scenario analysis

Analysis of present and future european scenarios

Overview of the procurement mechanisms used for each type of ancillary service relevant to DER participation per country.

Current situation of TSOs and DSOs contracting AS in the surveyed countries.

	Yes	No
TSO contracting AS from DER directly connected to the DSO-grid		
DSO contracting local services (for own purposes) from DER directly connected to DSO-grid		
DSO contracting AS on TSO's behalf		

! **<u>Deliverables 1.1 – 1.3</u>**

Mapping and modelling of Distributed resources

Technical analysis of the future possible contribution from non conventional resources

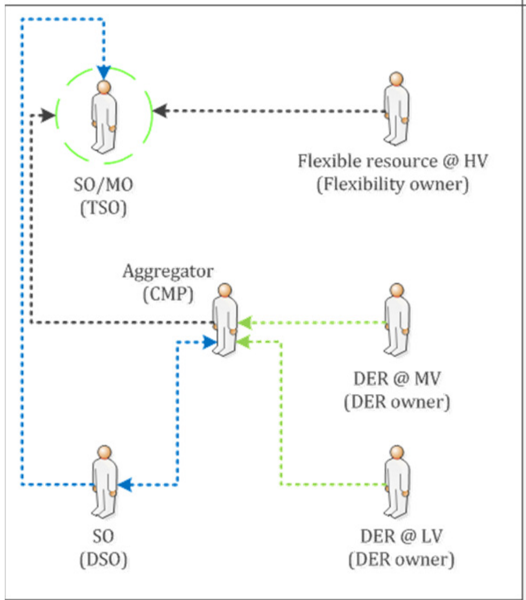
! **Deliverable 1.2**

			RESERVE NEED [MW]	NON CONVENTIONAL RESOURCES [MW]	DISTRIBUTION	TRANSMISISON
Frequency	aFRR	DK1	262	5 000	49 %	51 %
		IT	1 471	33 000	37 %	63 %
		ES	783	19 000	62 %	38 %
	mFRR	DK1	426	4 000	50 %	50 %
		IT	1 523	30 000	33 %	67 %
		ES	5 473	15 500	58 %	42 %

Uses cases

TSO-DSO coordination schemes

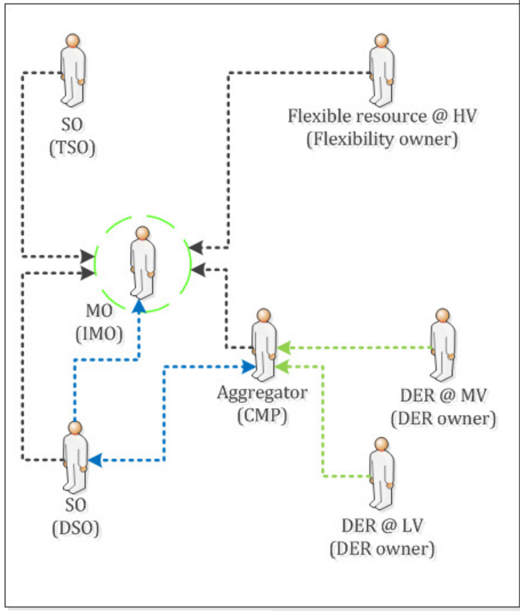
Centralized AS market model



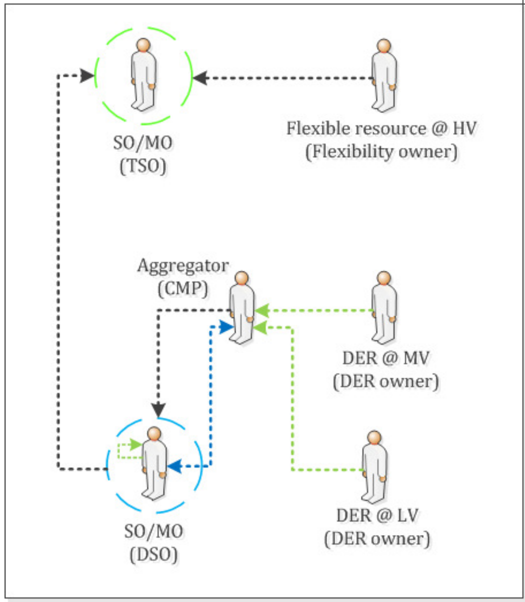
5 possible coordination schemes TSOs & DSOs for AS by distributed flexibility resources

- Centralized AS market model
- Local AS market model
- Shared balancing responsibility model
- Common TSO-DSO AS market model
- Integrated flexibility market model

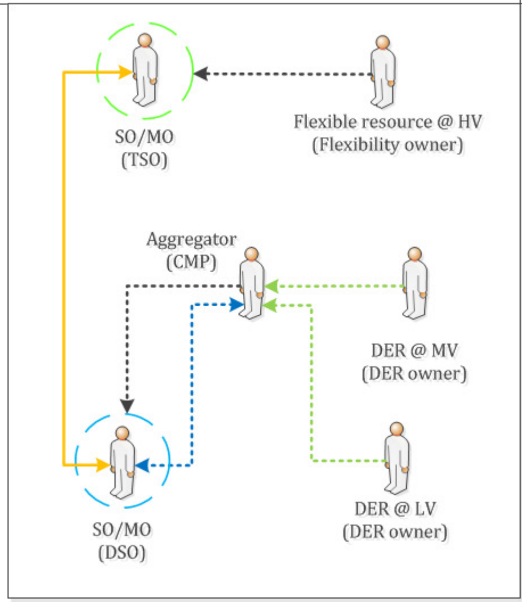
Integrated flexibility market model



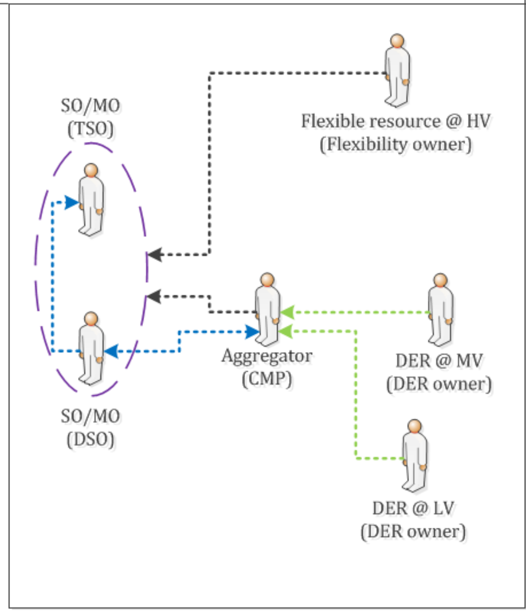
Local AS market model

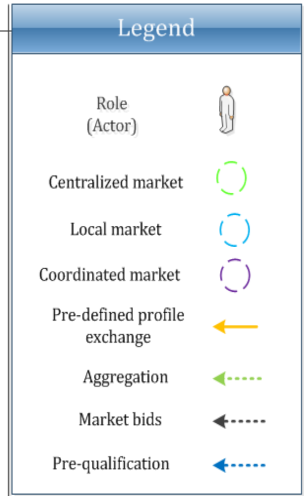


Shared balancing responsibility model

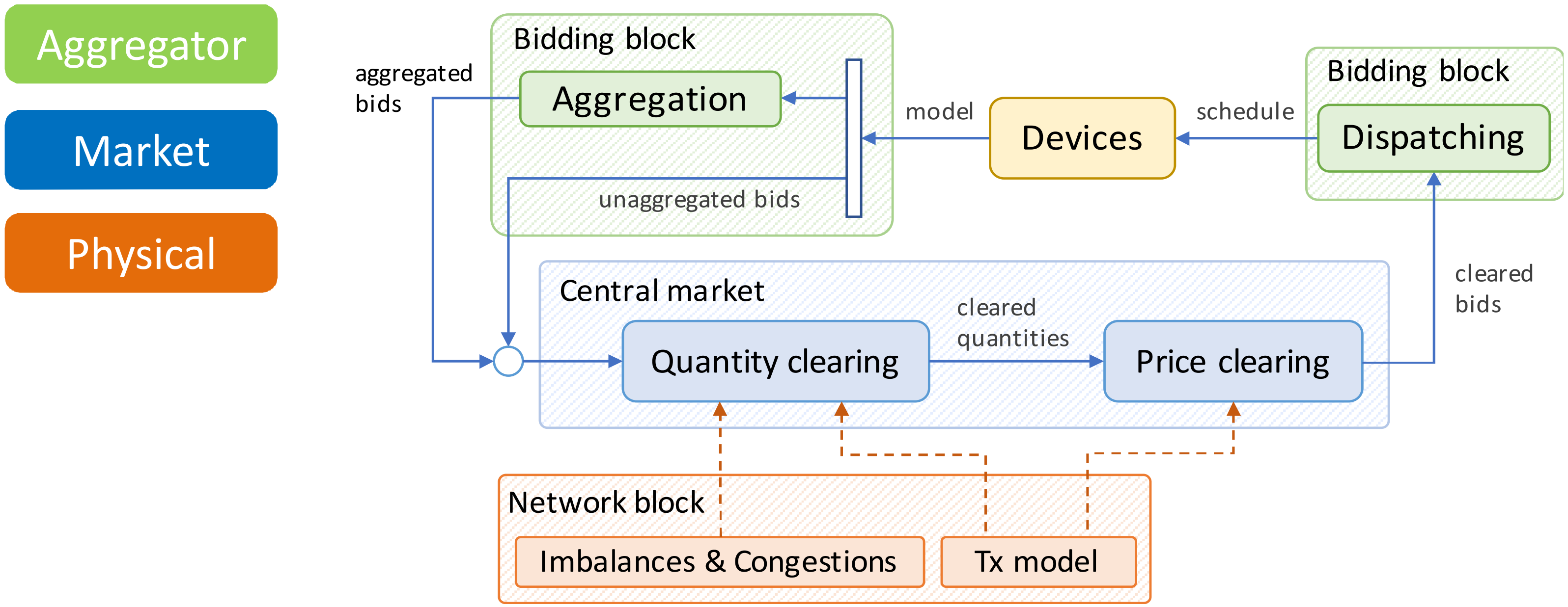


Common TSO-DSO AS market model



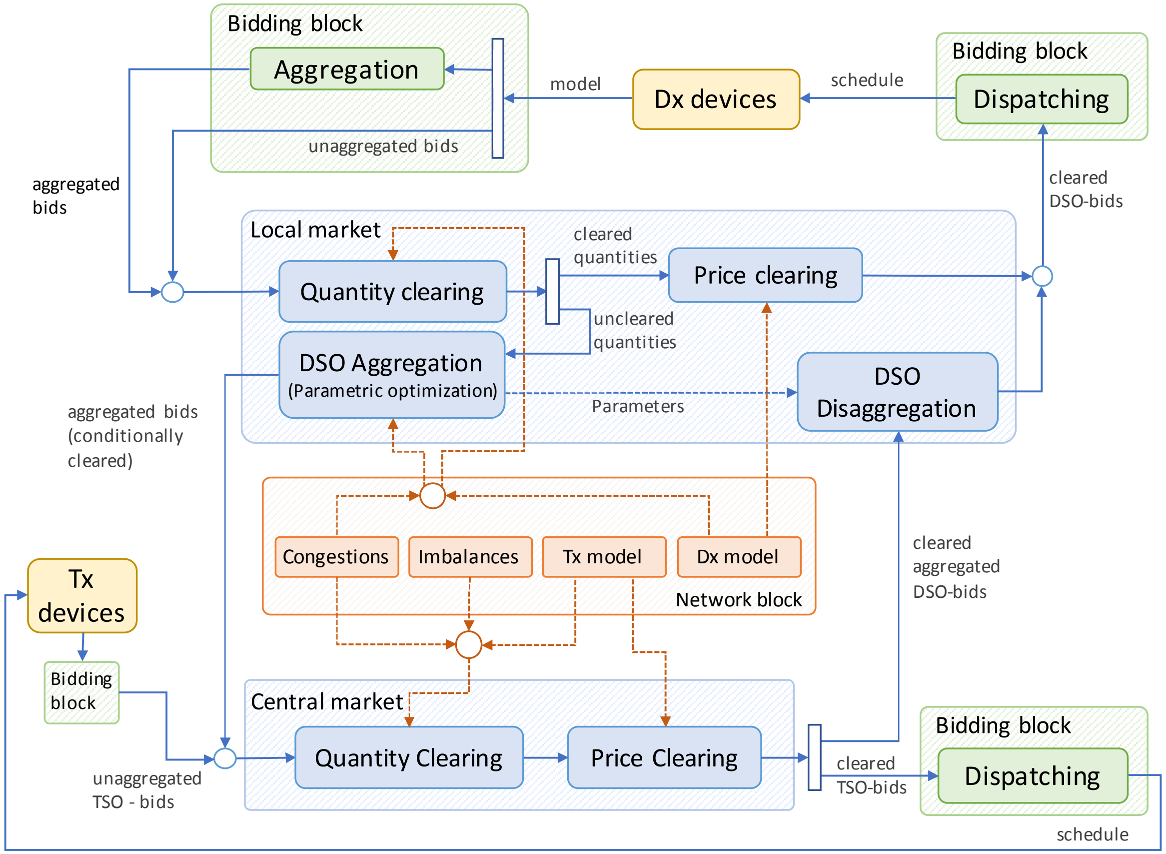


Centralized AS market model



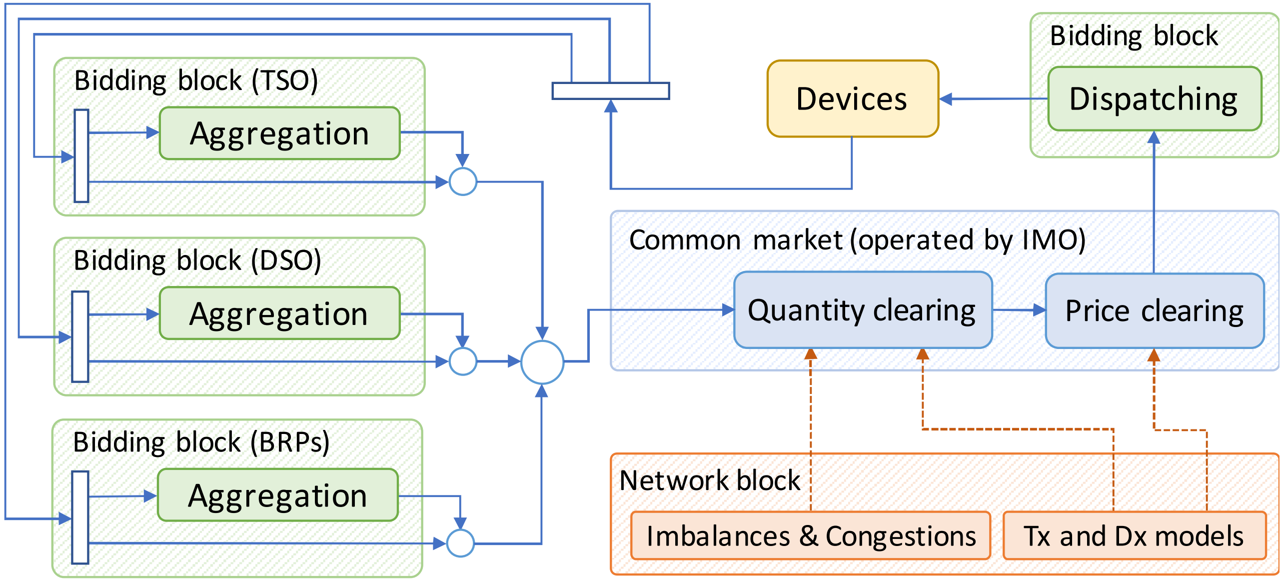
Benefits	Attention points
▪ Aggregation could use resources from different DSO-areas. ▪ Few communication between system operators needed ▪ One central market can function at low operational costs	▪ DSO grid constraints not included ▪ DSOs do not benefit from possible advantages of the use of flexibilities

Local AS market model



Benefits	Attention points
▪ DSO grid constraints included ▪ Nodal detail of transmission network	▪ Complex market architecture, which can result in higher costs ▪ Risk of non liquid markets

Integrated flexibility market

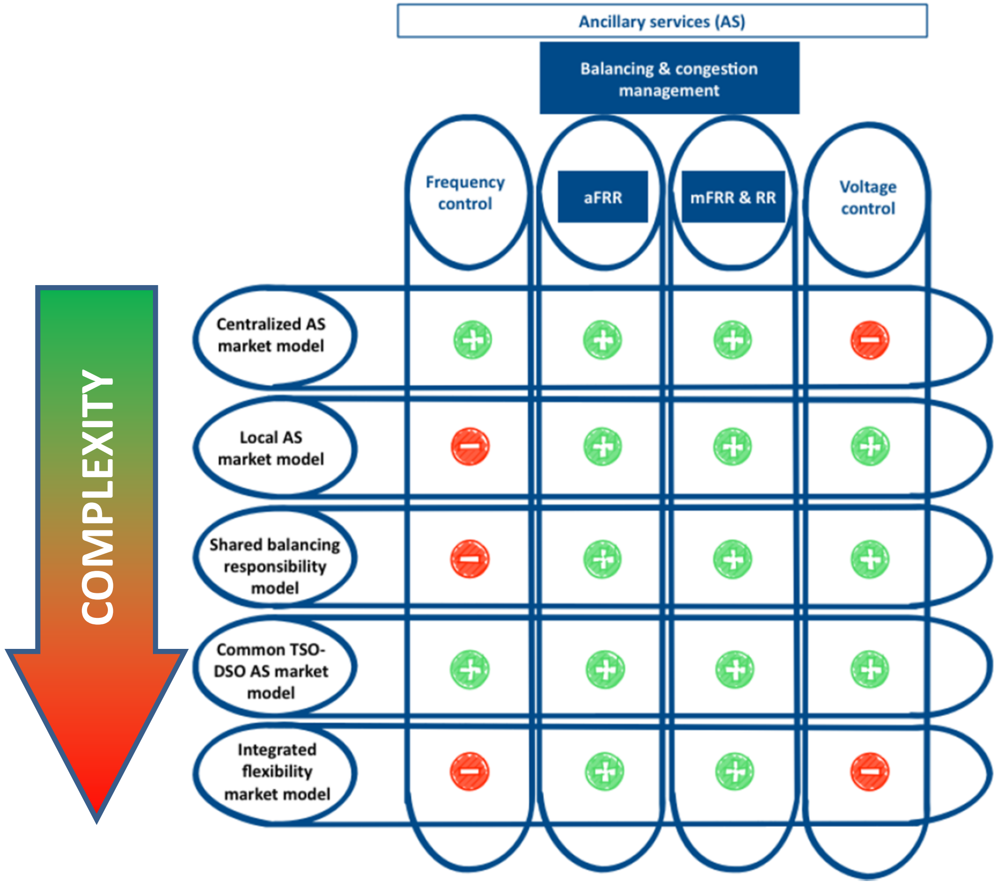


! **Deliverable 2.3**

Deliverable 2.4

Benefits	Attention points
▪ All constraints included	▪ Very complex market
▪ Most efficient solution in theory	▪ Numerical unfeasibility

Application of coordination schemes



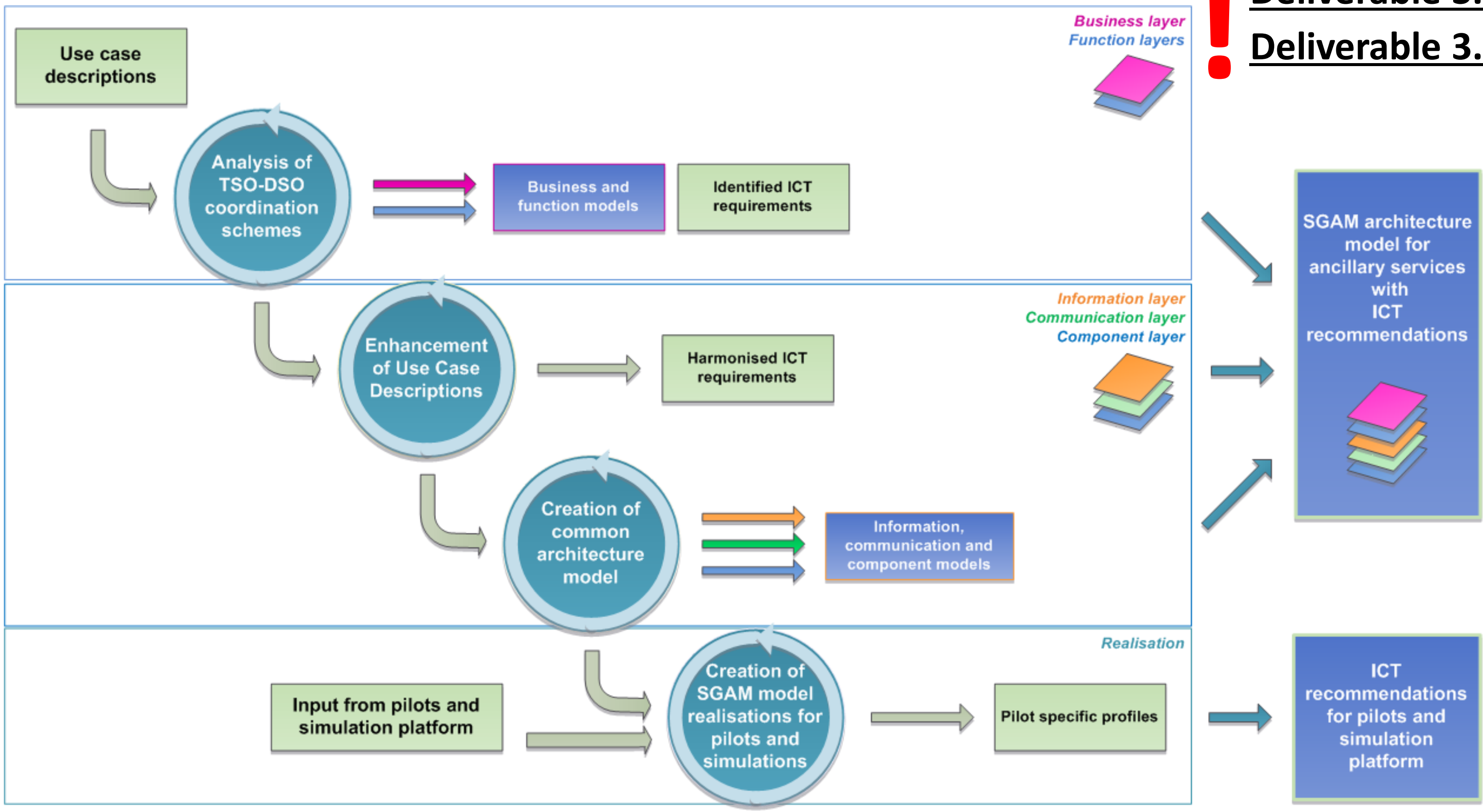
From these analysis is already possible to draw a big picture of the pro and cons of each coordination scheme and the application of different services.

ICT analysis

ICT Architecture Design Specification

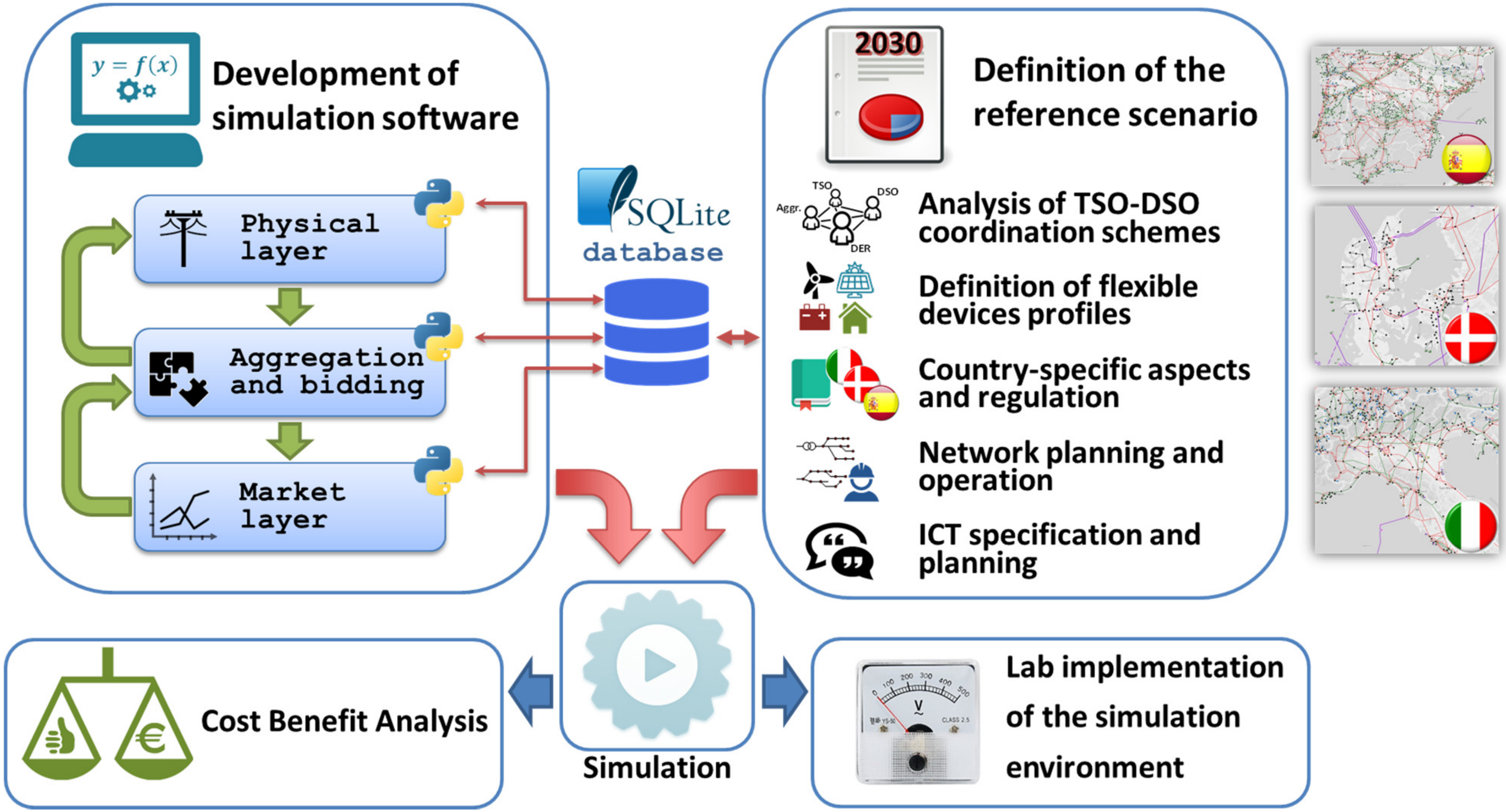
Deliverable 3.1

Deliverable 3.2



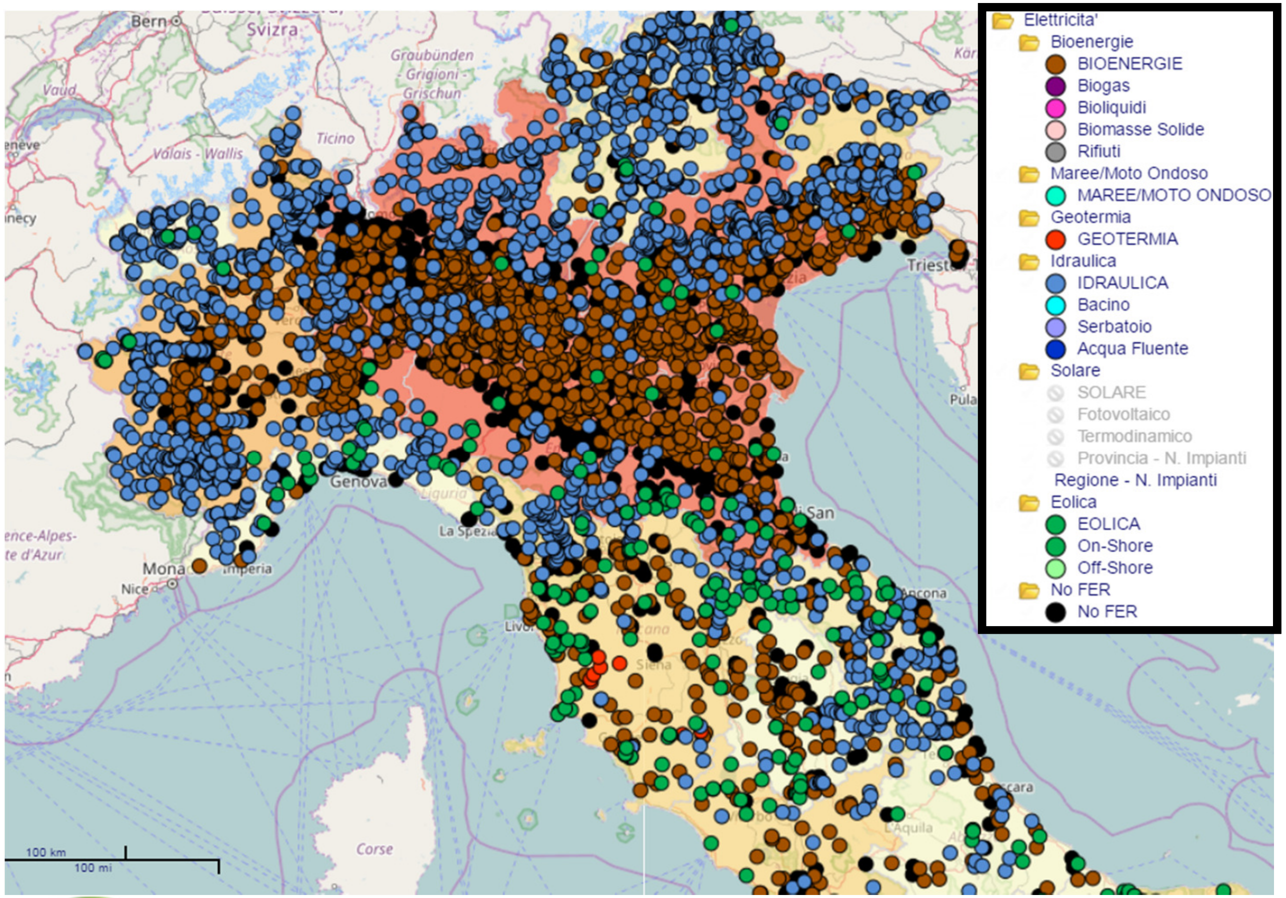
Simulation analysis

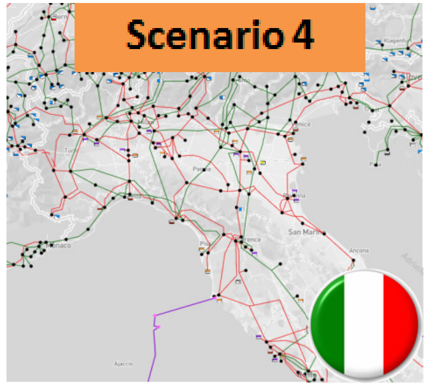
Comparison of the national cases in a simulation environment and laboratory testing



2030 Scenario Data

Geographical allocation of the energy resources expected for 2030

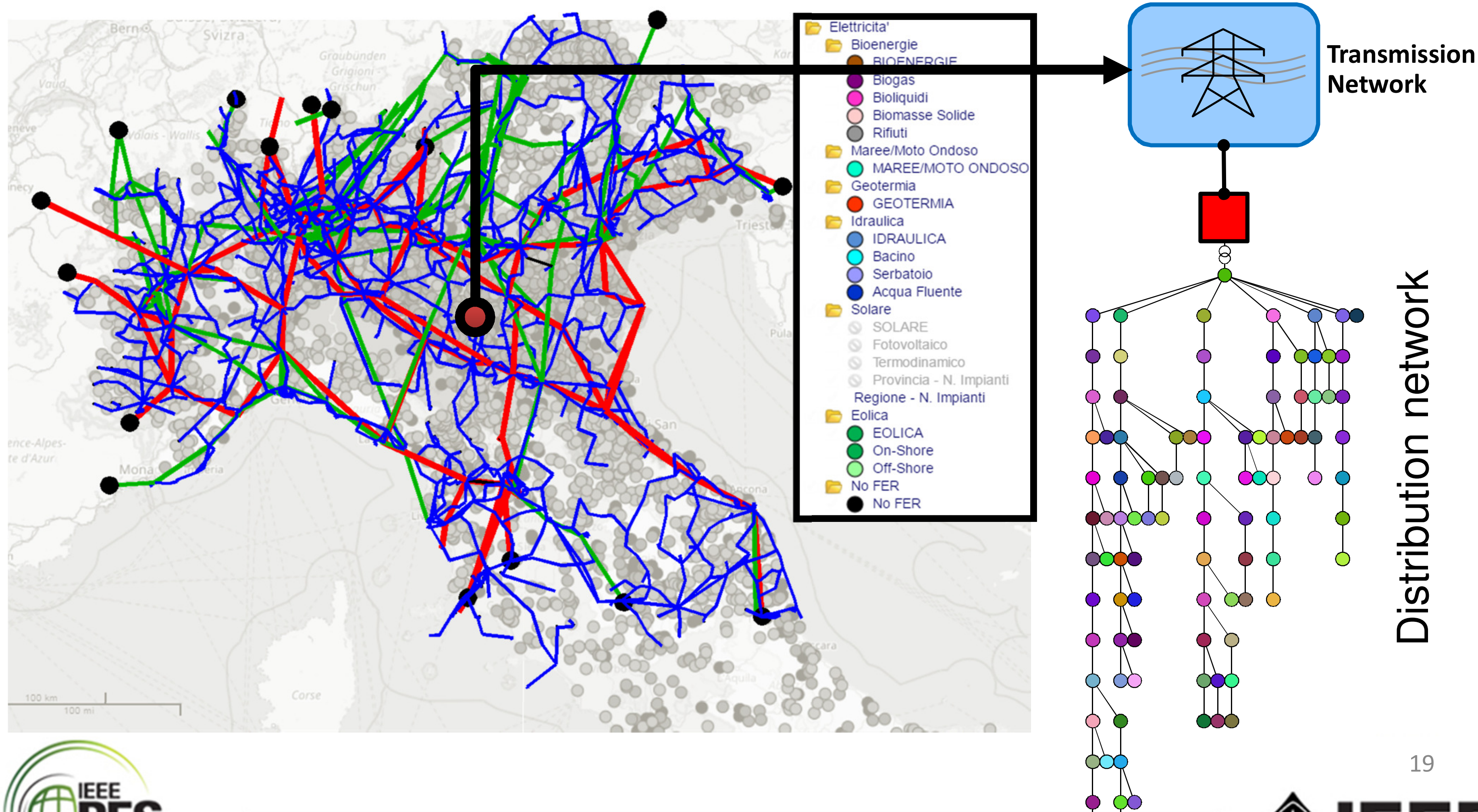




- Population growth
- Renewables expansion
- Exploitation of new electrical devices
- Industrial development

2030 Scenario Data

Mapping of the geographical information on the electricity network



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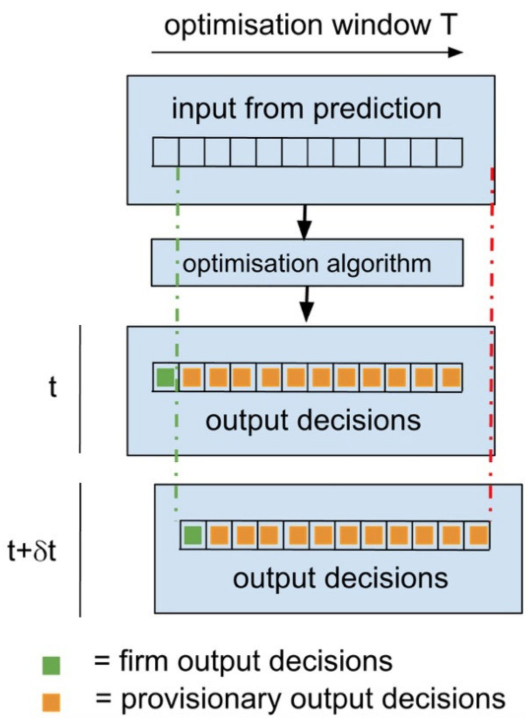
Analysis on the market structure

Timing Dimension

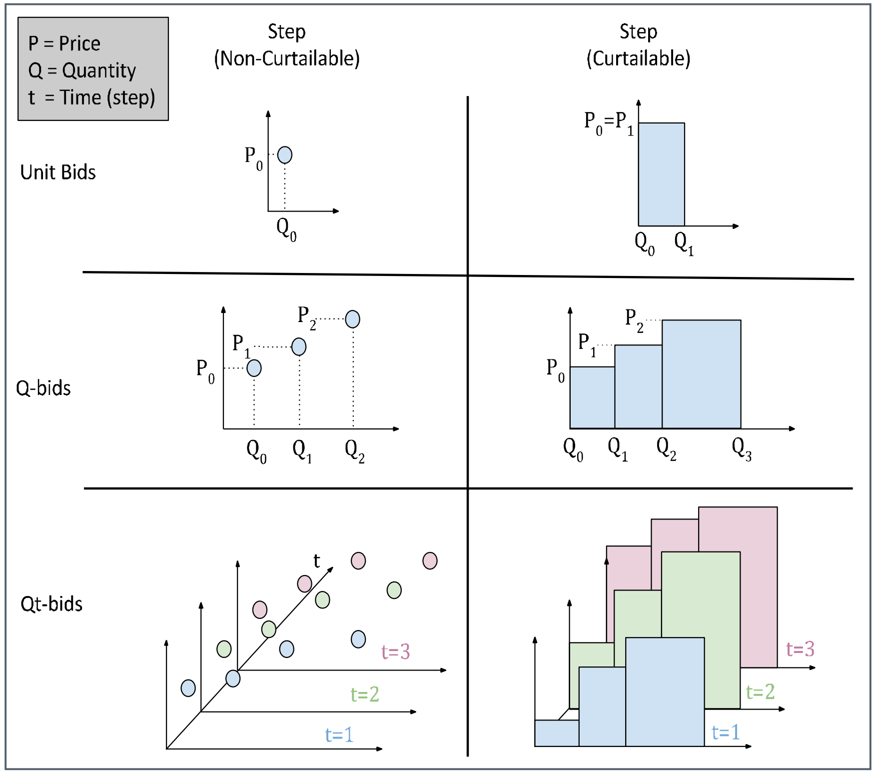
What are the market clearing frequency, time step and horizon ?



Analysis on the market structure

Bidding Dimension

How market actors can bid ? What market products are proposed?

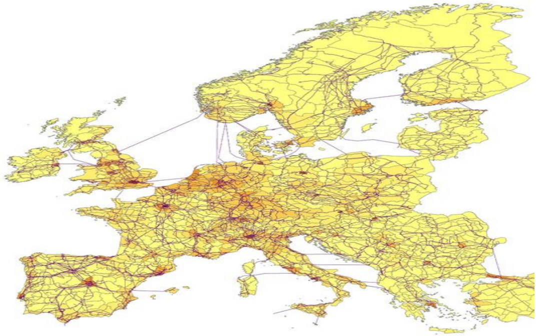


Analysis on the market structure

Network Dimension

How network constraints are taken into account in the market clearing ?

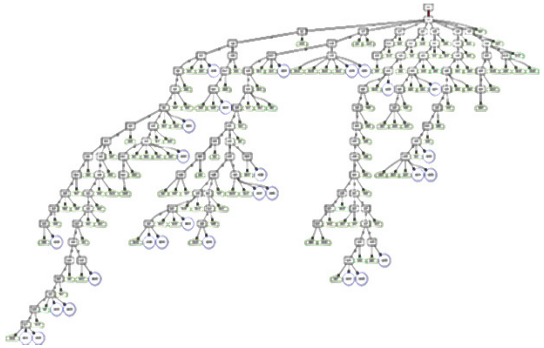
Transmission grid



+ Accuracy

+ Numerical Complexity

MV distribution grid



+ Accuracy

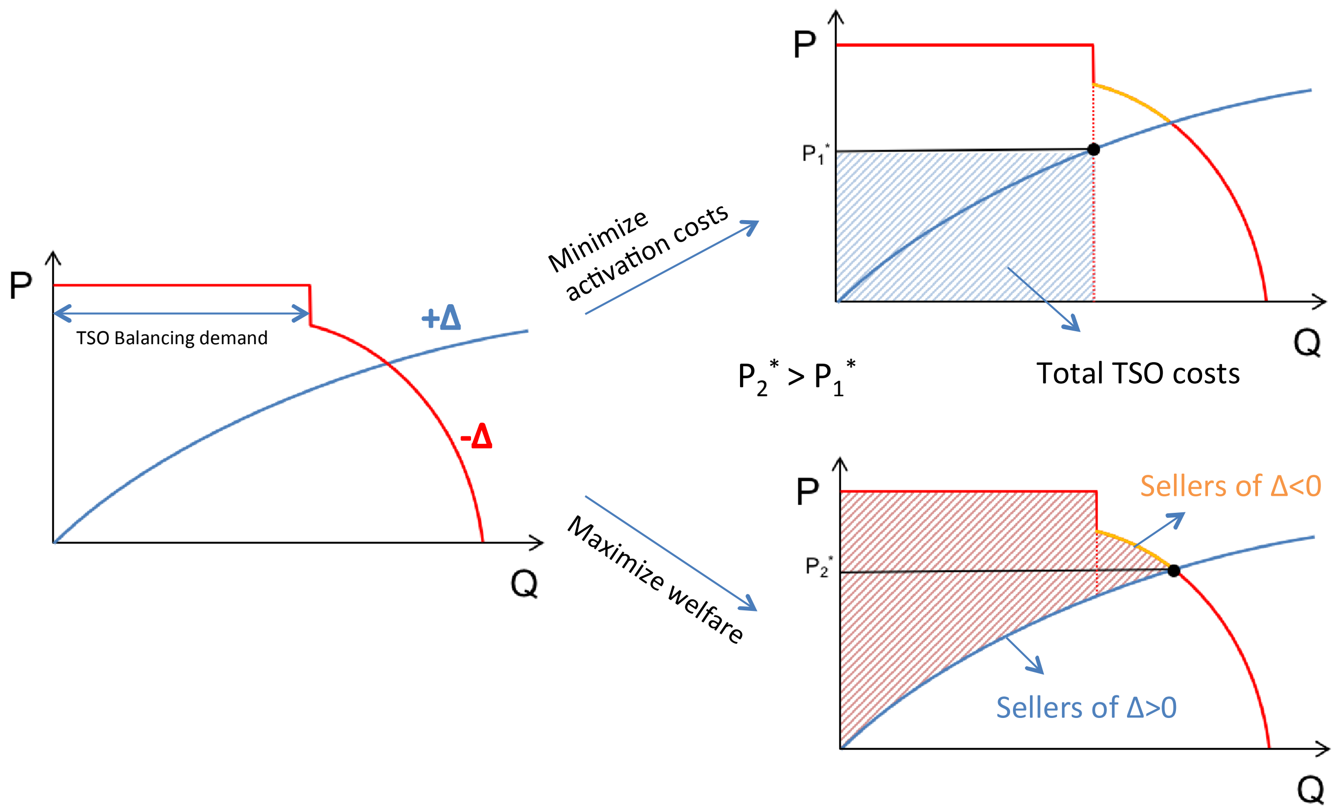
+ Numerical Complexity

[1] Photo source: Technical University of Munich (*http://ens.ei.tum.de*)

Analysis on the market structure

Clearing Dimension

What are the objectives of the market clearing ?



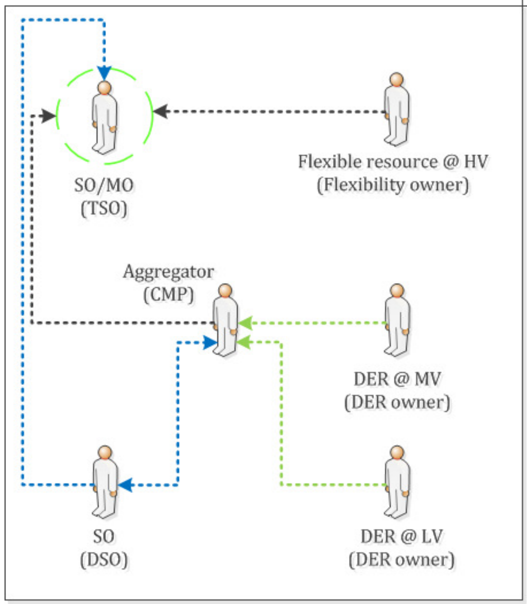
Analysis on the market structure

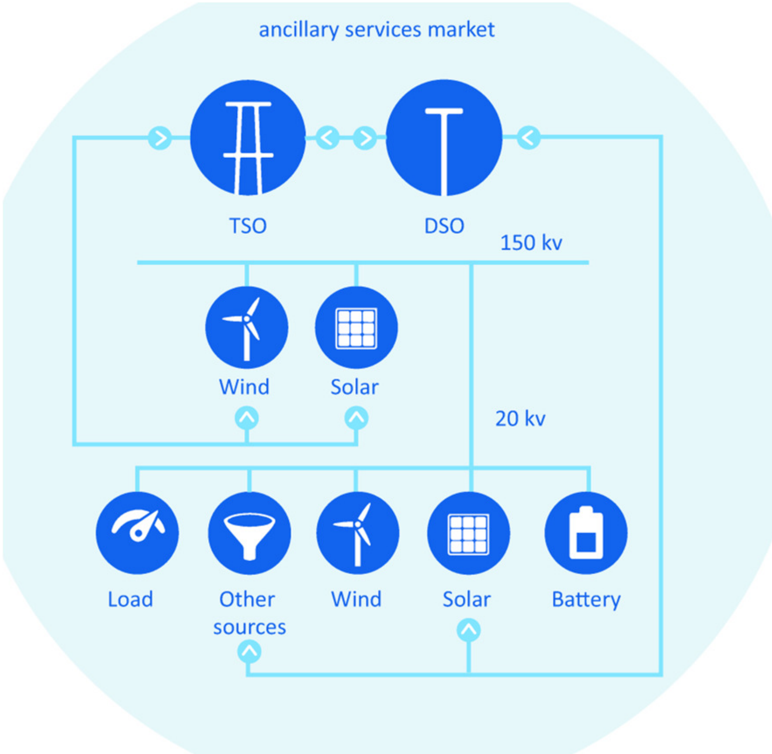
Timing Dimension	What are the market clearing frequency, time step and horizon ?
Bidding Dimension	How market actors can bid ? What market products are proposed?
Network Dimension	How network constraints are taken into account in the market clearing ?
Clearing Dimension	What are the objectives of the market clearing ?
Pricing Dimension	What price is paid to the activated bids ?

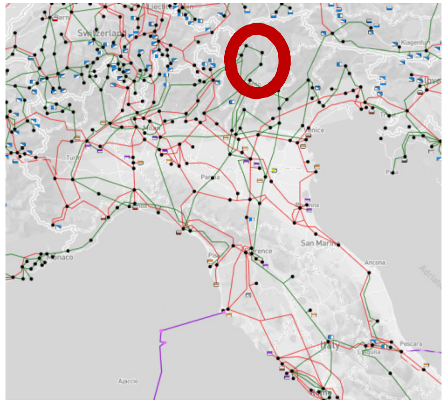
Pilot results

Pilot A: RES sources - Centralized market

Centralized AS market model







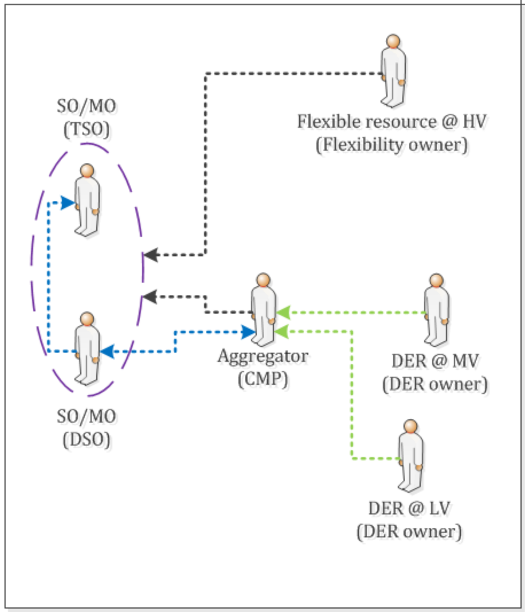
Aggregation of information
In real time at TSO-DSO interconnection (HV/MV transformer)

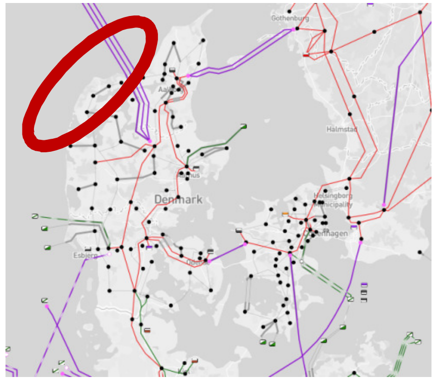
Voltage regulation
By generators connected at HV and MV levels

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

Pilot B: Swimming pool – Common market

Common TSO-DSO AS market model



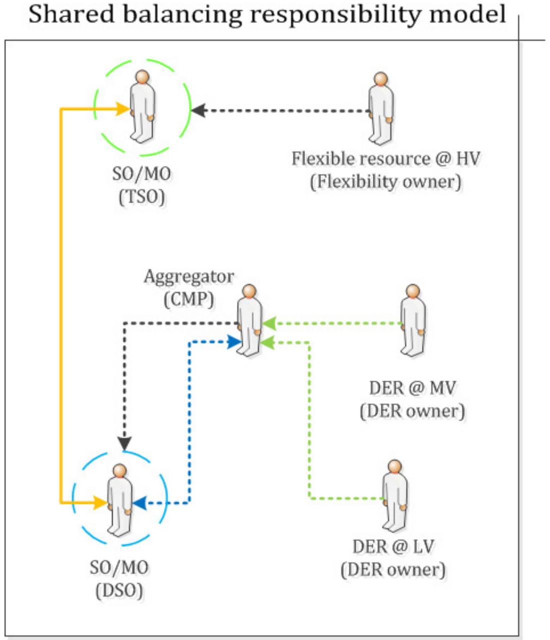


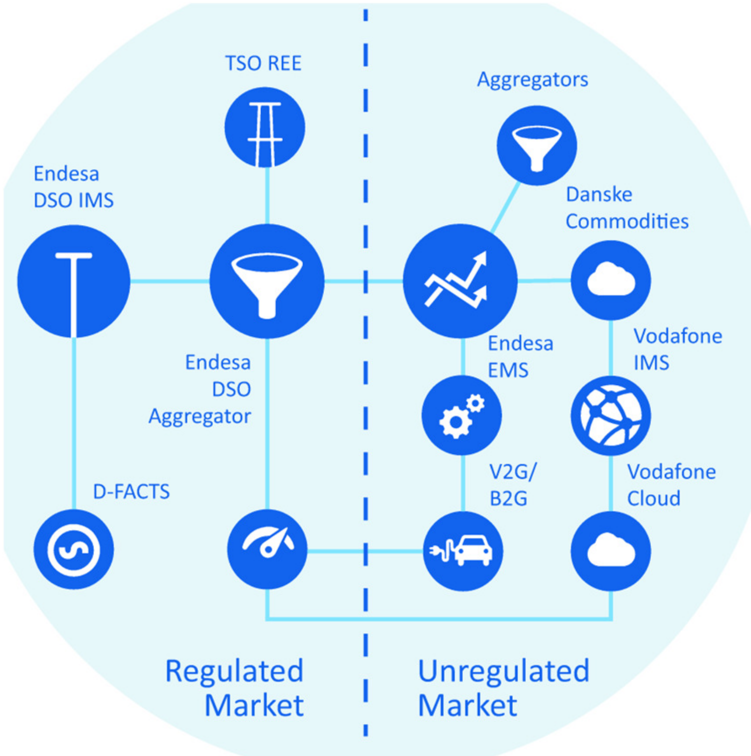
Congestion Management
To better integrate PV, EV and HP

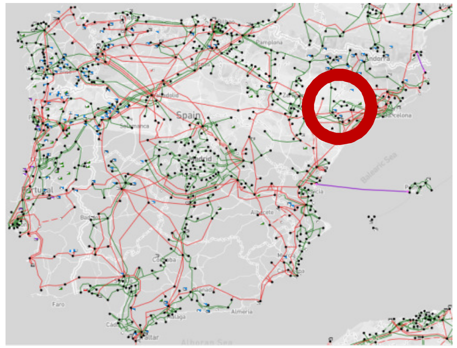
Price-based control
Of thermal controllers of swimming pools in summer houses

Balancing
Of wind power with decreasing conbtribution of thermal units

Pilot C: radio-based station – Shared market







Congestion Management
At DSO level

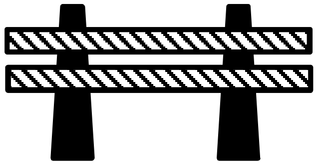
Demand response aggregation
By using storage flexibility (BS and EV)

Power frequency regulation /balancing
By respecting the exchange program at the TSO-DSO interconnection

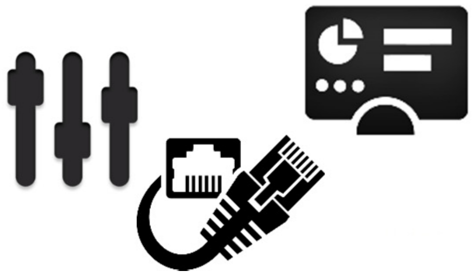
KEY results

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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Thank You

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