tecnalia
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

Aggregation of energy resources for grid operation

Carlos Madina (TECNALIA)

CETPartnership TRI 1 Presentation Event

22/09/2022

tecnalia
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

01

Demand Aggregator

Flexibility

Definition

Capacity of energy resources to change their power output (input) according to a given control or price signal

Considerations

- Traditionally flexibility services have been provided by conventional power plants connected at transmission level but:
- Increase in renewable energy generation
- Electrification of new energy vectors (mobility, heat)
- Digital technologies for monitoring and control

} Demand side resources as providers of flexibility

Demand Side Flexibility

Consumption, generation and storage resources connected at the distribution level (LV, MV):

- **Heating and Cooling systems**:
  - Thermal inertia allows modulating the consumed power within acceptable temperature limits
  - Control based on changing temperature setpoints or switching on/off the units.
  - Heat Pumps, HVAC systems in buildings, water heaters, electric heaters, etc.
- **Electric Vehicles**: The charging start time can be changed, charging power modulated and power injected with V2G technologies
- **Electric storage**: Charging/discharging of batteries
- **Shiftable consumption**:
  - Start time selection.
  - Examples in the residential sector: washing machine, dishwasher, dryer
- **Renewable generation**: Can be curtailed to provide downwards flexibility

Aggregation

Aggregator Role

- Intermediary between flexibility providers (end use technologies) and flexibility markets/users
    1. Designs and implements market participation strategies (when, where, volume, price)
    2. Allows complying with service requirements: volume, interactions with agents
    3. Controls end use resources to comply with market agreement and flexibility activations
    4. Manages contracts with flexibility providers
    5. Manages settlements, penalties from deviations, etc.

02

Aggregation Platform (AggreFlex)

https://coordinet-project.eu/publications/deliverables

CoordiNet at a glance

Large-scale TSO-DSO-Consumer demonstrations of innovative network services through demand response, storage and small-scale distributed generation

Project Timeline: 1st of January 2019 – 30th of June 2022

Project Budget and funding : 19.2M€ - 15.1M€

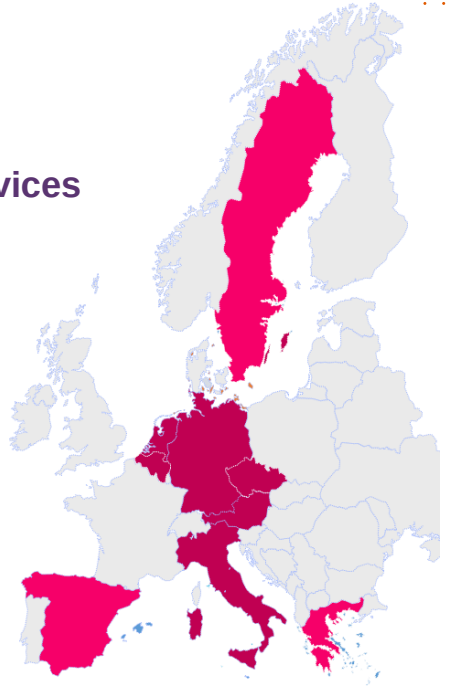
Total number of partners: 23 + 10 Linked Third Parties

Overarching Goals:

⇨ OG1: Demonstrate the activation and provision of services through a **TSO-DSO-customer coordination**

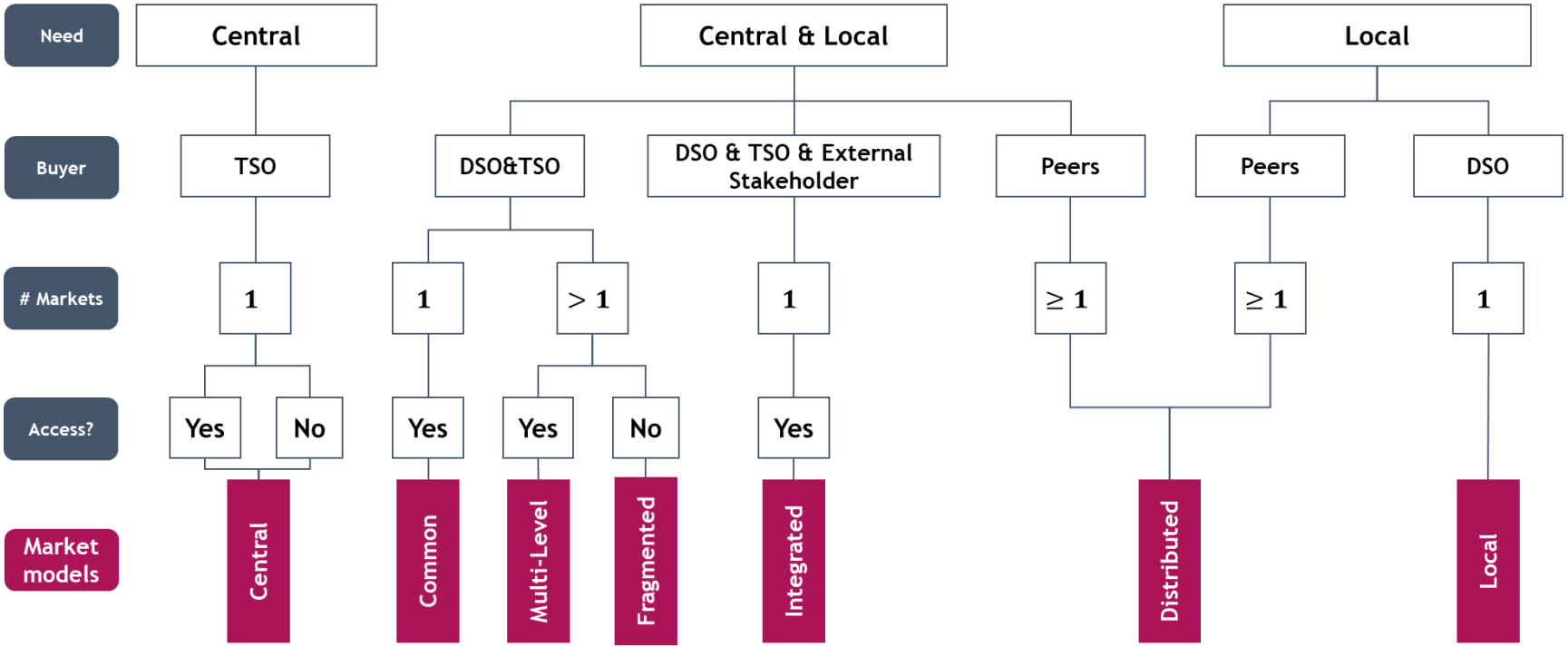
⇨ OG2: Define and test **standard products** that provide services to the network operators.

⇨ OG3: Develop a **TSO-DSO-consumer collaboration platform** in demonstration areas to pave the way for the **interoperable development of a pan-European market.**

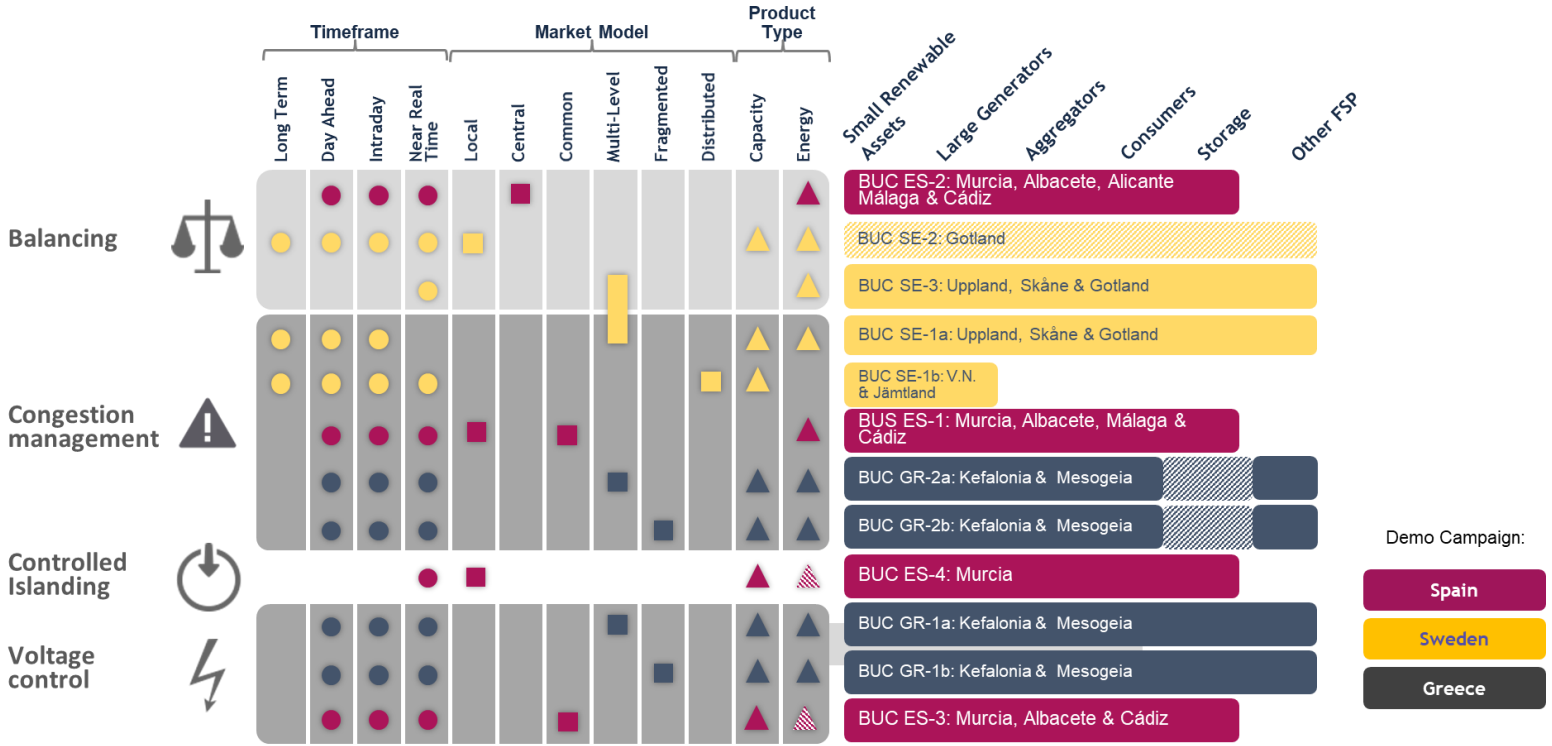


This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824414

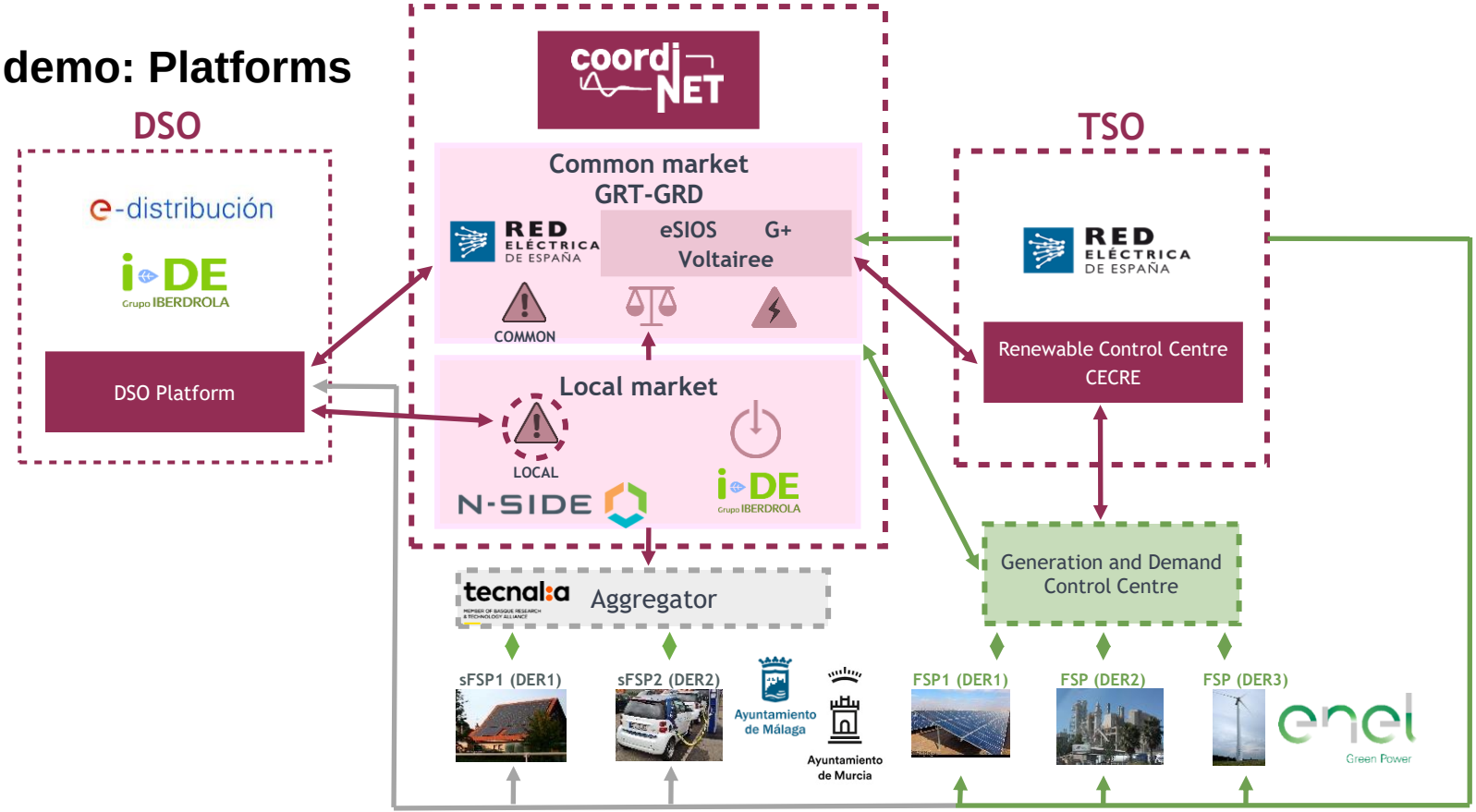
Coordination schemes



CoordiNet demonstrators



Spanish demo: Platforms



AggreFlex: Introduction

Objective

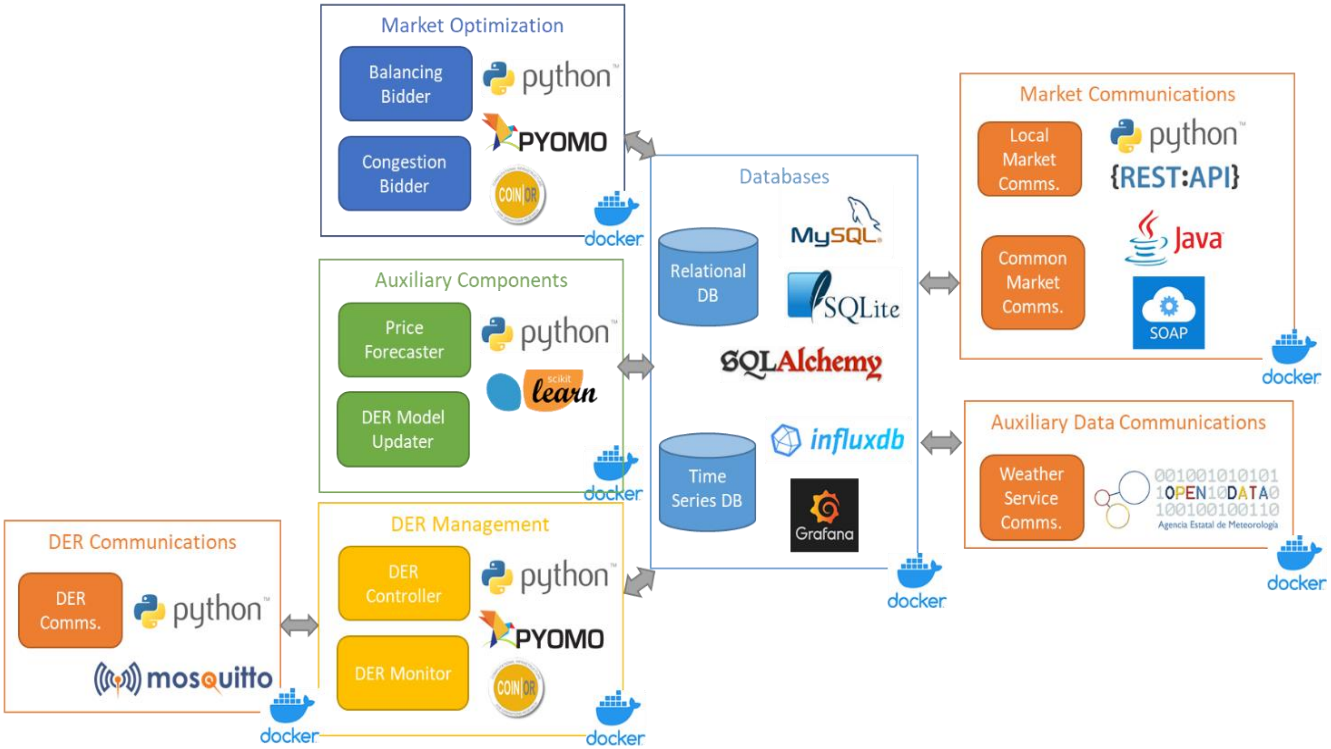
- Software tool for aggregating DER flexibility and participation into Common (TSO and DSO) and Local (DSO) markets.
- DERs: Heating and cooling loads, Electric vehicles, batteries, PV installations.

Functionalities

Aggregation	Dissagregation	Communication	Others

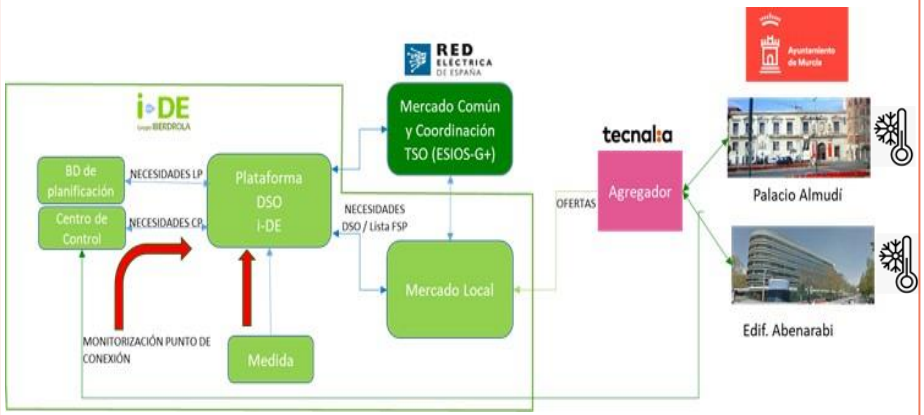
• Creation of flexibility bids:
  • Upwards/downwards flexibility
  • Price
	• Determination of operation setpoints in real time	• Markets (common/local)
		• DERs (monitoring and control)
		• External services (weather forecasts)
			• Calibration of model parameters
			• Price forecasting
			• Data Storage

AggreFlex: Implementation



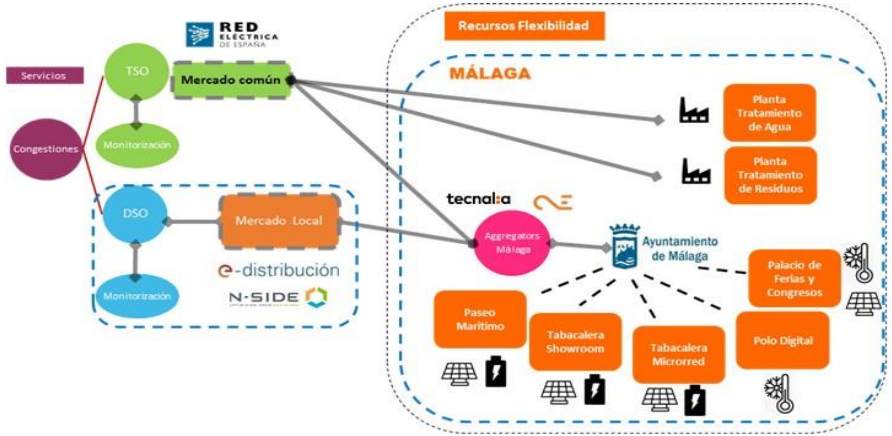
AggreFlex: Demonstration Pilots

Murcia



BUC	Day-Ahead	Intra-Day
Common Congestions		
Local Congestions	✓	

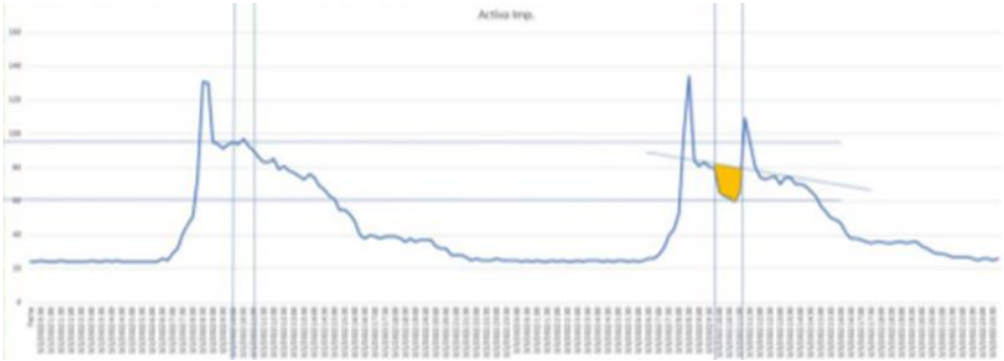
Málaga

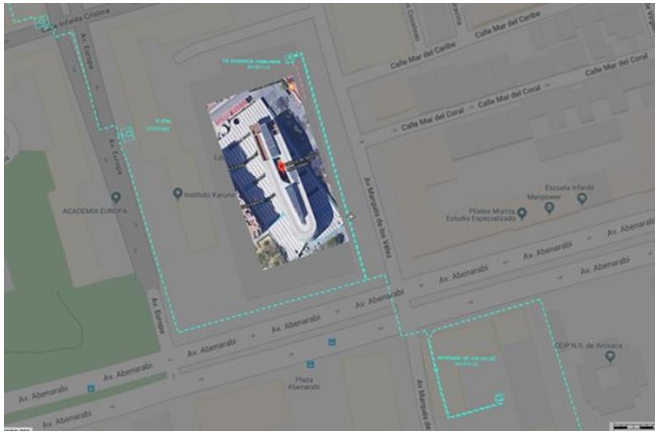


BUC	Day-Ahead	Intra-Day
Common Congestions	✓	
Local Congestions	✓	✓

AggreFlex: Example case (Murcia)

Case Study: Day-ahead Local Congestion Management	
Objective	Day ahead Congestion Management in the MV network
Time Horizon	D-1
Congestion period	10:00-11:00
Flexibility direction	Upwards





Abenarabi Building

- HVAC (200 kW)

Conclusions: Challenges for the aggregator

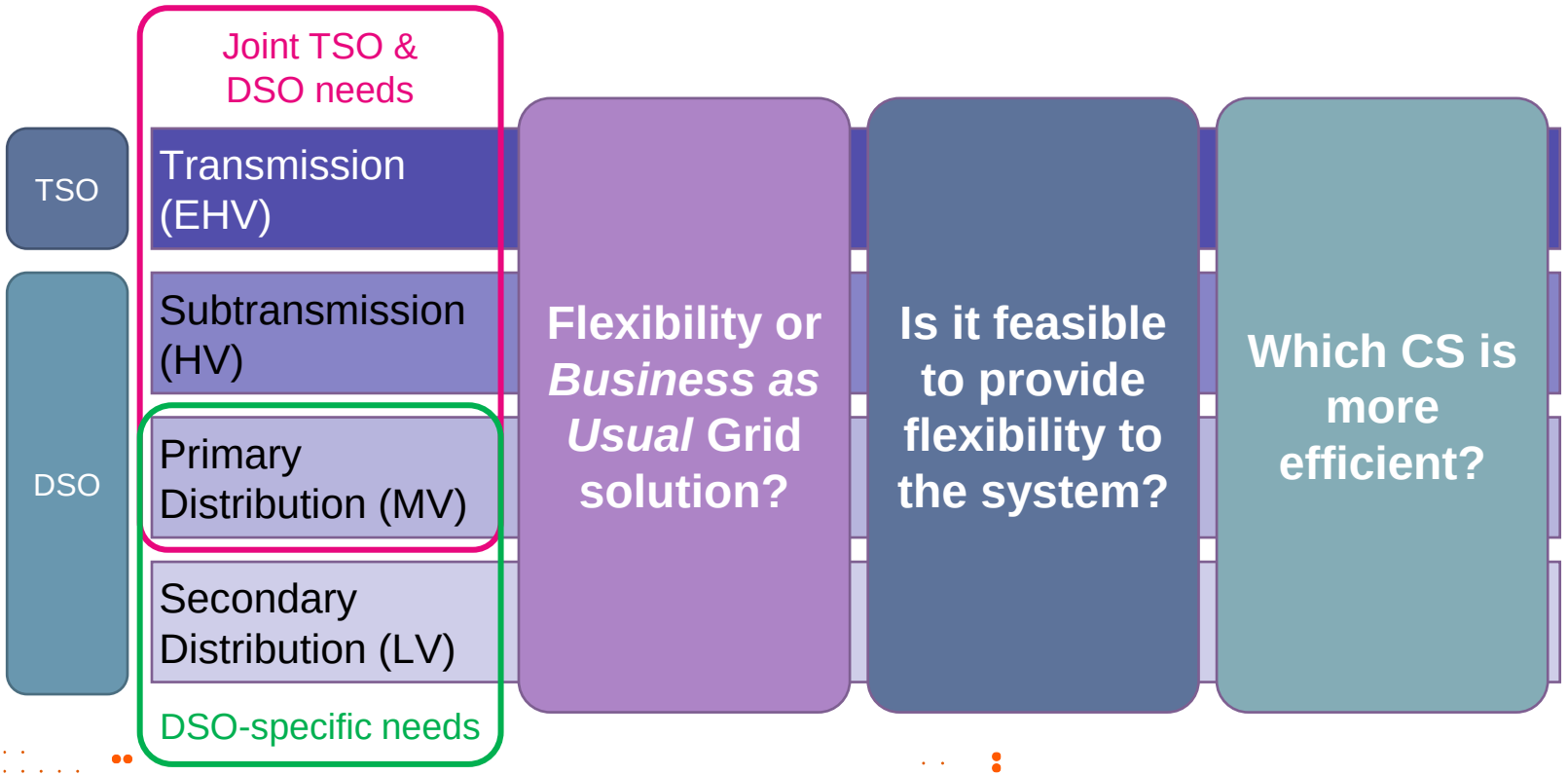
- **Real-time communications** between the aggregator and DERs for monitoring and control: Interfacing with end use equipment can be challenging (proprietary software, systems without communication capabilities, etc.).
- Accurate **models for estimating flexibility** are needed: regression-based models based on historical data for calibrating flexibility parameters.
- **Algorithms for real-time operation** which take into account the state of devices in real-time, in order to avoid deviations: Model predictive control (MPC)-based algorithms.
- Mechanism for **managing the rebound effect**: negotiation in intraday markets.
- Clarification of the **business model**:
  - Market entry costs (platform development, communications, prequalification, market participation fee, etc.) may hinder the participation of small DER in flexibility markets, but…
  - DER participation in local markets is expected to be a reality as congestions become more widespread and there are more needs at local level.

tecnalia

MEMBER OF BASQUE RESEARCH
& TECHNOLOGY ALLIANCE

carlos.madina@tecnalia.com

Economic assessment: Scope



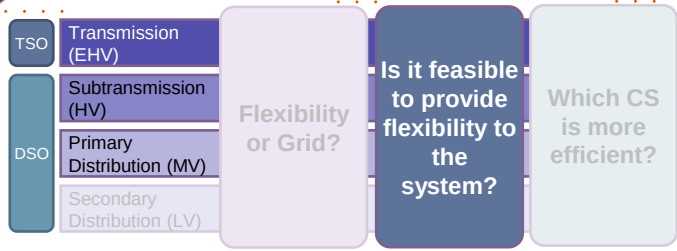
Balancing

Congestion management

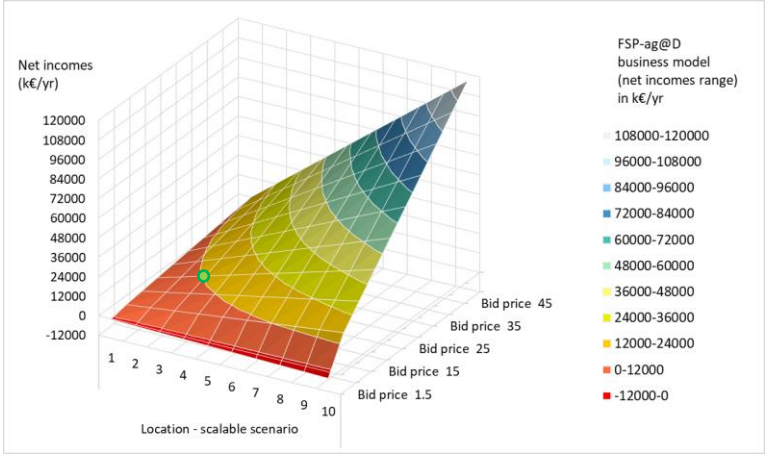
Controlled Islanding

Voltage control

Economic assessment: Joint TSO & DSO needs

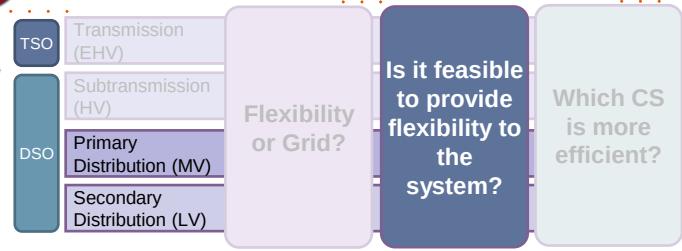


- DSOs do not have local flexibility needs at present at CoordiNet demos (no overloads in distribution grids) ➔ potential congestions are simulated:
  - **Albacete**: ~20% line overload in few hours of several typical days (double-circuit, 132 kV line, with ~10 km length).
  - **Cádiz**: ~20% transformer overload in few hours of several typical days (220/66 kV transformer).
- Real FSPs are producers (wind, 1 CHP, 1 PV) ➔ simulated demand FSPs (from Sweden) are added.
- ICT costs for the demo. Real costs would be much higher to reach an industrialized and integrated solution.

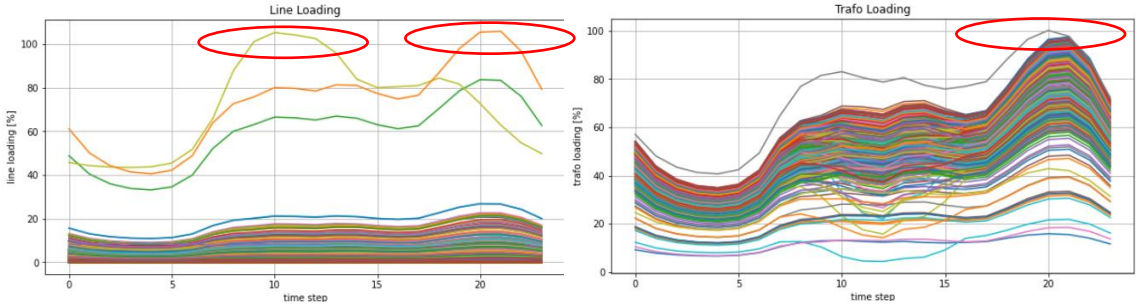


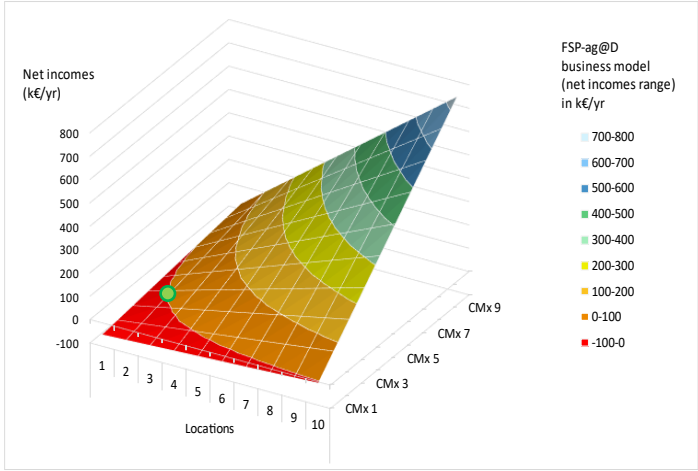
- High cost of SW platform and OPEX.
- Extra market incomes not addressed.
- Sensitivity to revenue sharing between Aggregator & DERs.

Economic assessment: Local DSO needs



- DSOs do not have local flexibility needs at present at CoordiNet demos (no overloads in distribution grids) ➔ potential congestions are simulated:
  - **Málaga (left)**: 2 overloaded lines (LV) over 120% its thermal limit, 4h and 2h per day.
  - **Murcia (right)**: Overloaded substation transformer (101% for 1 hour per day).





- ICT costs for the demo. Real costs would be much higher to reach an industrialized and integrated solution.

- High entry costs (platform development, comms., prequalification, market participation fee, etc.) may refrain small DER from participating in flexibility markets.
- Extra market incomes not addressed.
- Sensitivity to Aggregator & DERs revenue sharing.