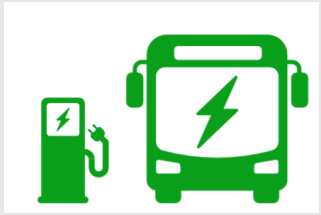
TSO-DSO Coordination Schemes for Accommodating Ancillary Services from Distribution Networks

Helena Gerard

The Challenge…

- ✓ Increase in RES by 2030…

- ✓ Increased electrification



Increased system needs for both **transmission** and **distribution**

- ✓ Congestion management
- ✓ Frequency control
- ✓ Voltage control
- ✓ System restoration
- ✓ System adequacy

EU-SysFlex

Innovations in products and market design

Innovations in grid decision support

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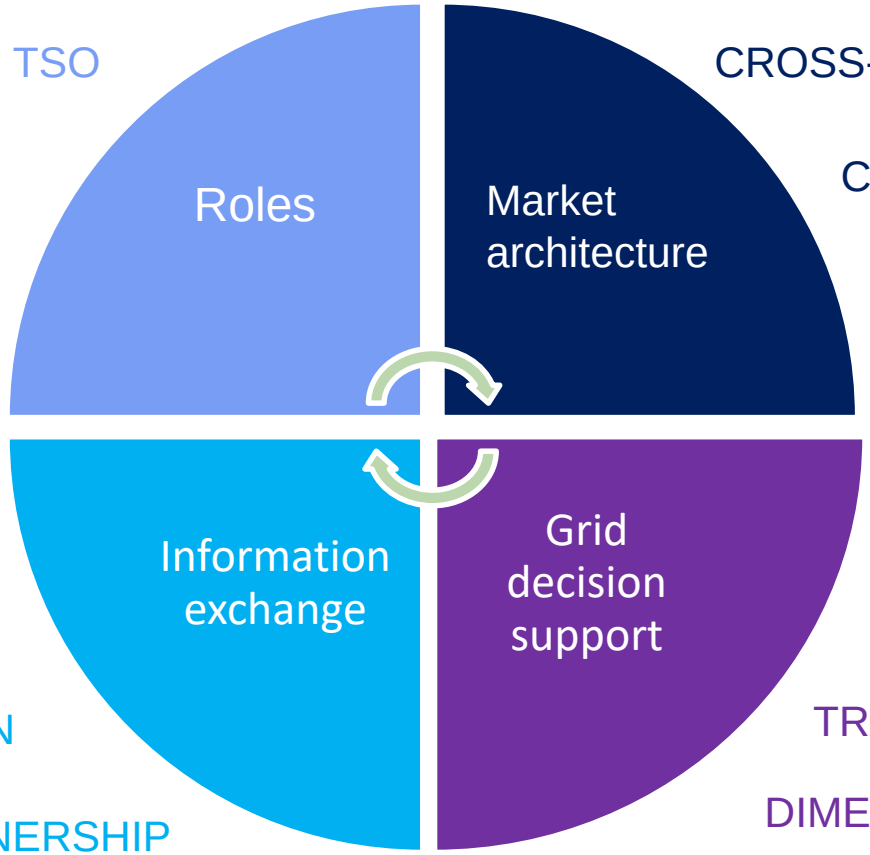
The challenge

TSO-DSO coordination in the center of the debate



TSO

DSO

MARKET OPERATOR

MARKET FACILITATOR

CROSS-BORDER

CENTRAL MARKETS

LOCAL MARKETS

PEER-TO-PEER

TECHNOLOGY

OBSERVABILITY

INFORMATION

OWNERSHIP

CONGESTION FORECASTING

CAPACITY CURTAILMENT

TRAINING SYSTEM OPERATORS

DIMENSIONING FLEXIBILITY

TSO-DSO coordination schemes: scope and definitions

- Analysis of TSO-DSO coordination schemes for the provision of flexibility-based system services by distributed resources

- Key aspects:
  - Roles and responsibilities,
  - Market architecture
  - Information exchange

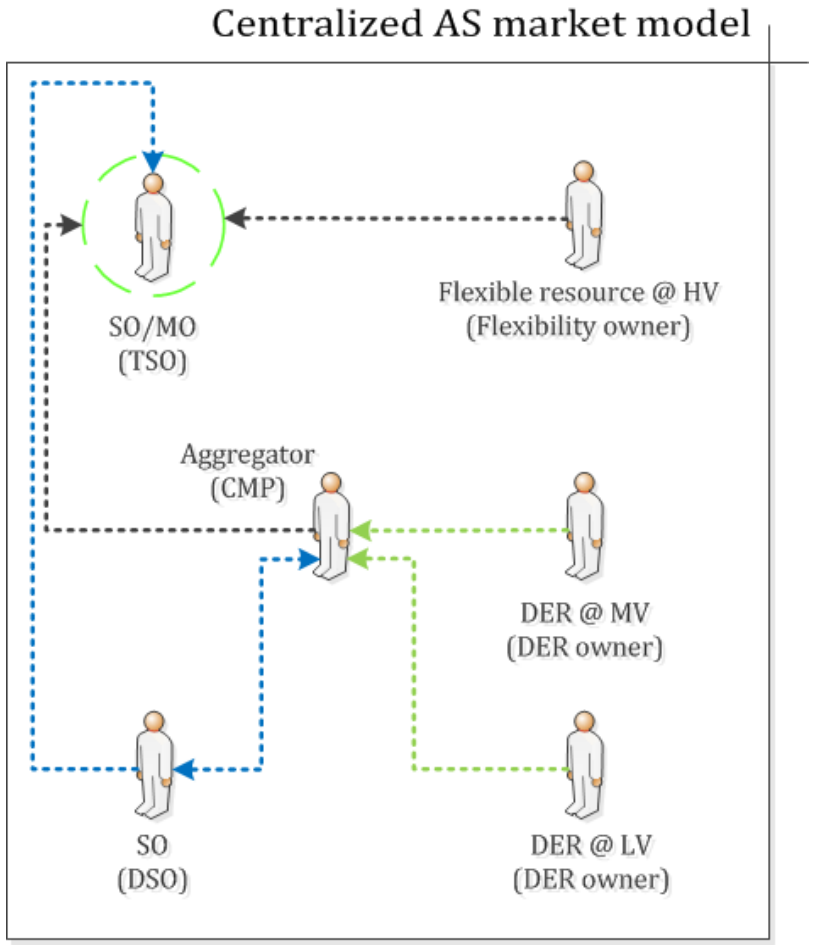
- Impact on
  - TSO grid operation
  - DSO grid operation
  - The role of other market participants
  - The regulatory context

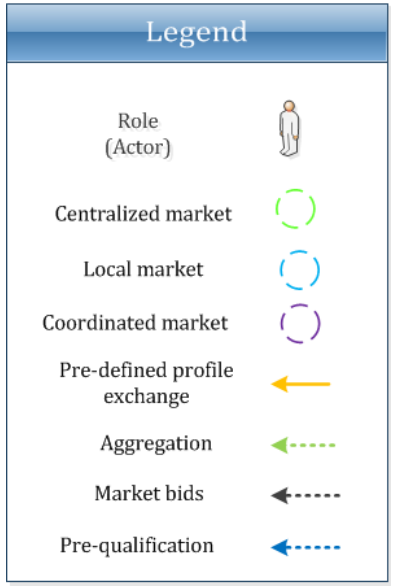
SmartNet

Five possible TSO-DSO coordination schemes:

1) Centralized AS market model

- ✓ 1 common ancillary services market managed by TSO
- ✓ Separate DSO process for checking distribution constraints (e.g. prequalification)

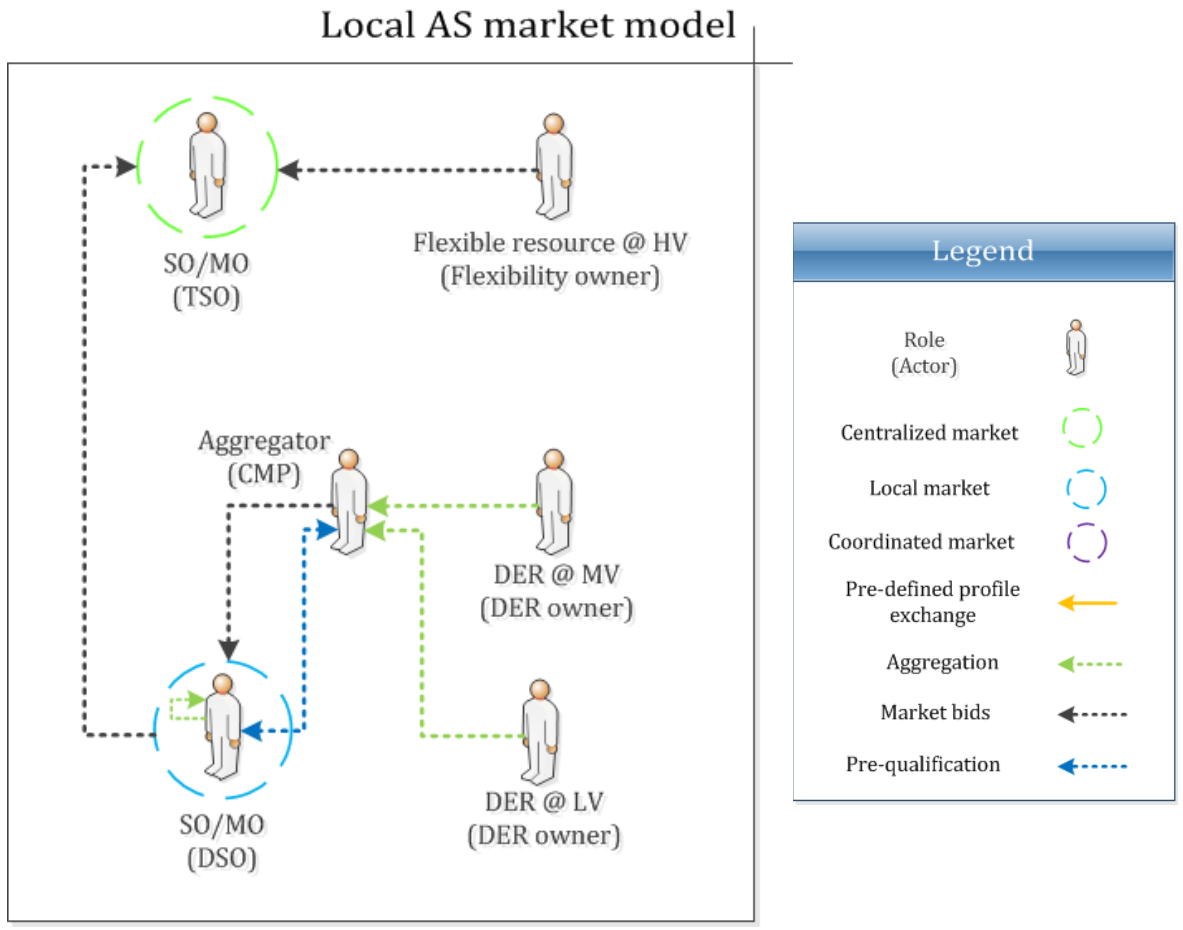




Five possible TSO-DSO coordination schemes:

2) Local AS market model

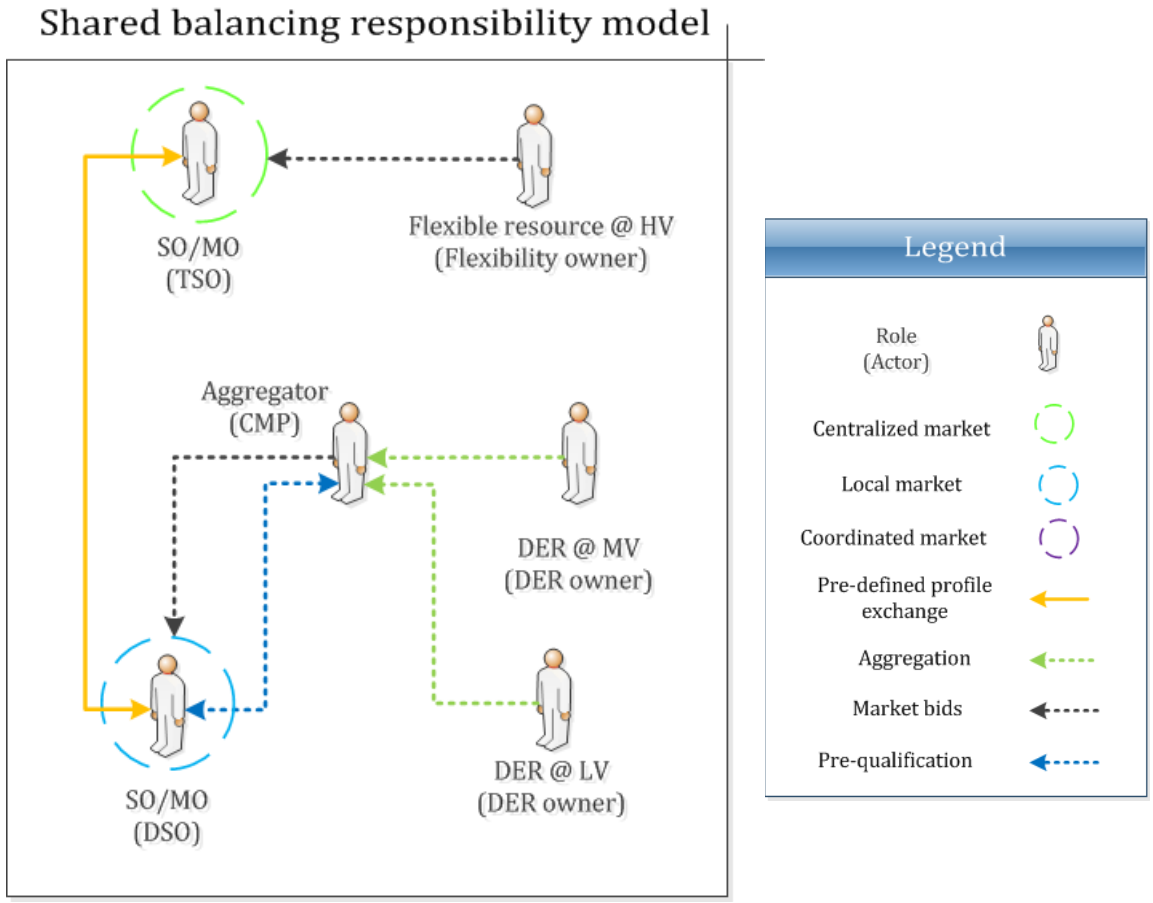
- ✓ Separate local market managed by DSO for local issues
- ✓ Transfer remaining flexibility to TSO ancillary services market level



Five possible TSO-DSO coordination schemes:

3) Shared balancing responsibility model

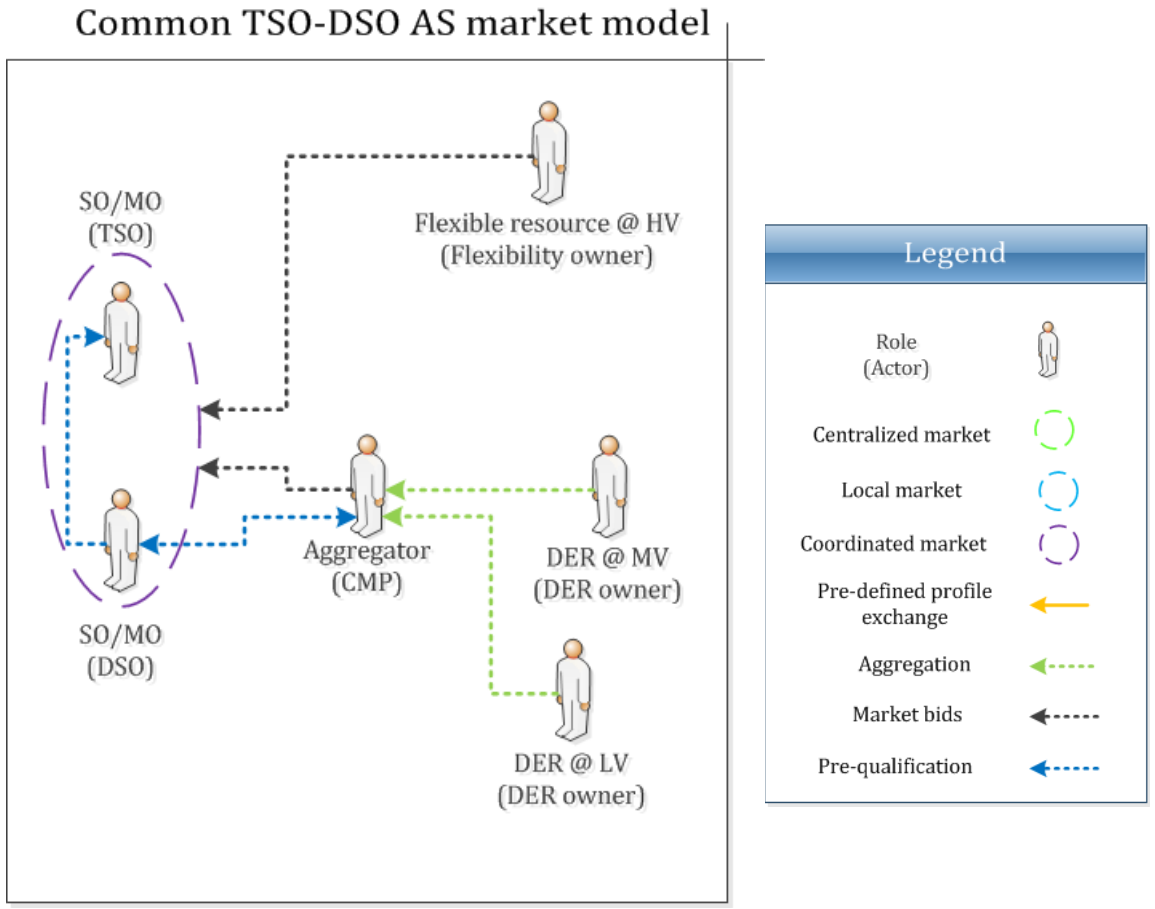
- ✓ Ancillary services market for transmission grid-connected resources managed by TSO
- ✓ Local market for distribution grid-connected resources
- ✓ Agreed pre-defined TSO-DSO scheduled profile



Five possible TSO-DSO coordination schemes:

4) Common TSO-DSO AS market model

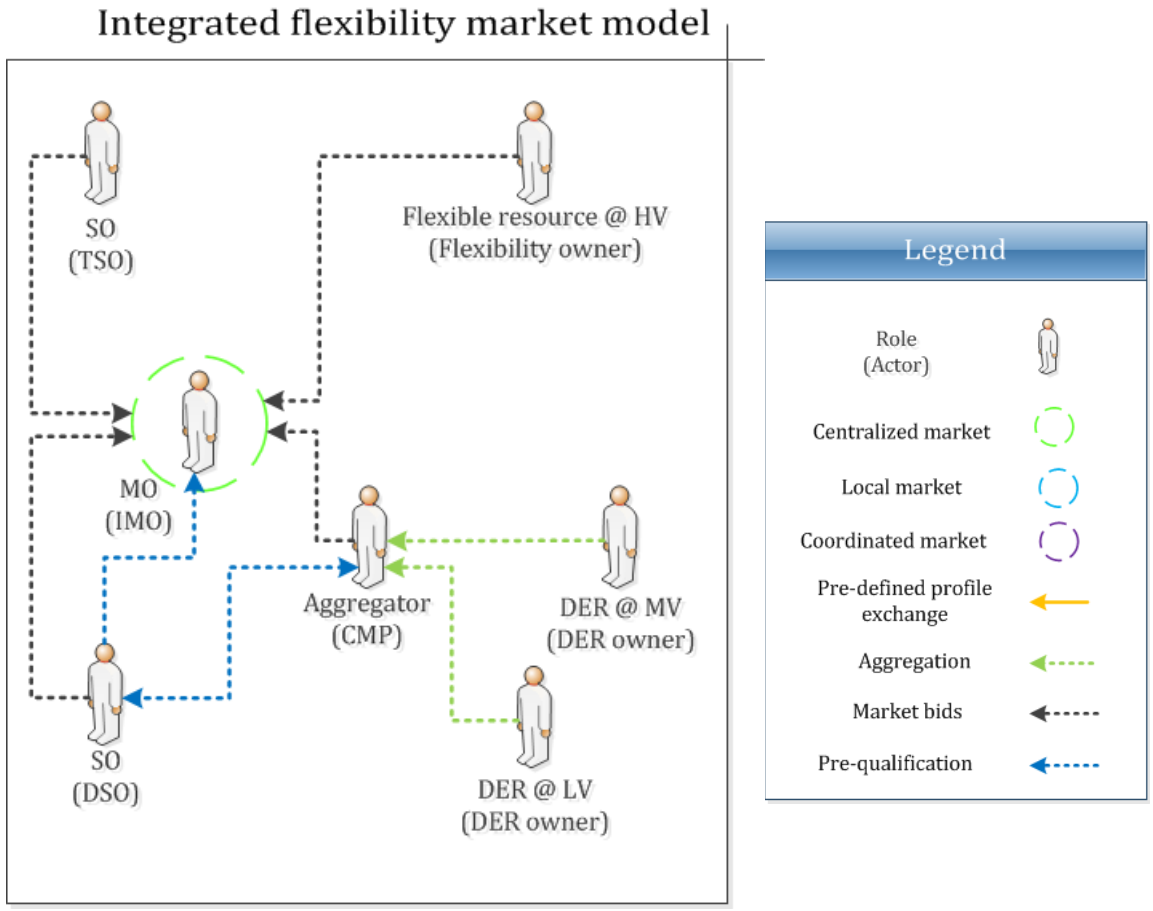
- ✓ Common flexibility market managed jointly by TSO & DSO
- ✓ Variants:
  - ➢ One optimization with all grid constraints
  - ➢ Two optimizations: distribution & transmission constraints separately



Five possible TSO-DSO coordination schemes:

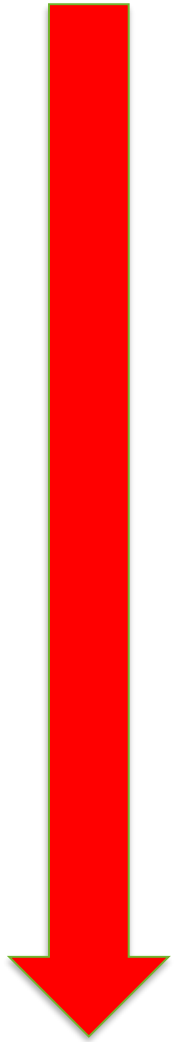
5) Integrated flexibility market model

- ✓ Common flexibility market managed by an independent neutral market operator
- ✓ No priority for TSO, DSO or commercial market player



Summary coordination schemes

Coordination scheme	Role of the DSO
Centralized AS market model	• Limited to possible process of prequalification
Local AS market model	• Organization of local market • Buyer of flexibility for local congestion management • Aggregation of resources to central market
Shared Balancing Responsibility model	• Organization of local market • Buyer of flexibility for local congestion management and balancing
Common TSO-DSO AS market model	• Organization of flexibility market in cooperation with TSO • Buyer of flexibility for local congestion management
Integrated Flexibility market model	• Buyer of flexibility for local congestion management

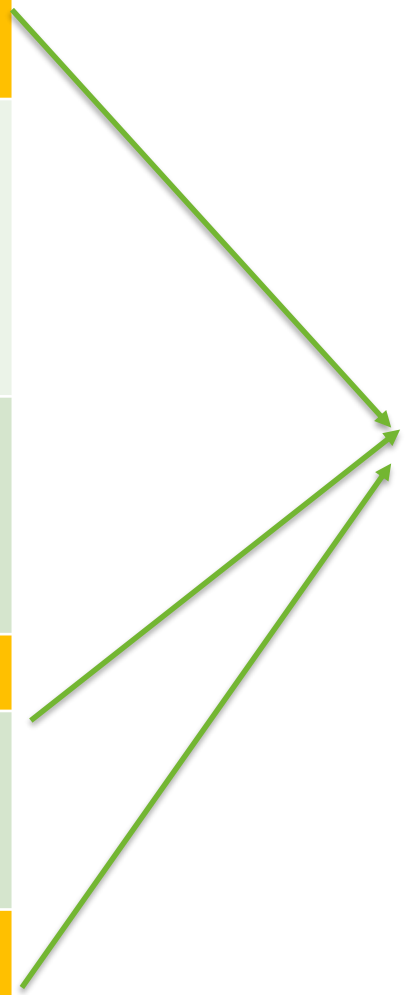


- ✓ Gradual increase of the role of the DSO
- ✓ Increased level of TSO-DSO interaction

Gerard,H. et al. (2017), Coordination between transmission and distribution system operators in the electricity sector: A conceptual framework, *Utilities Policy, Available online 28 October 2017, In Press, Corrected Proof*

Summary coordination schemes

Coordination scheme	Market organization (market operator)
Centralized AS market model	Common market (TSO)
Local AS market model	Central market (TSO) Local market (DSO)
Shared Balancing Responsibility model	Central market (TSO) Local market (DSO)
Common TSO-DSO AS market model	Common market (TSO and DSO)
	Central market (TSO) Local market (DSO)
Integrated Flexibility market model	Common market (independent market operator)



- ✓ Concepts based on a common market for resources connected to the transmission and distribution grid

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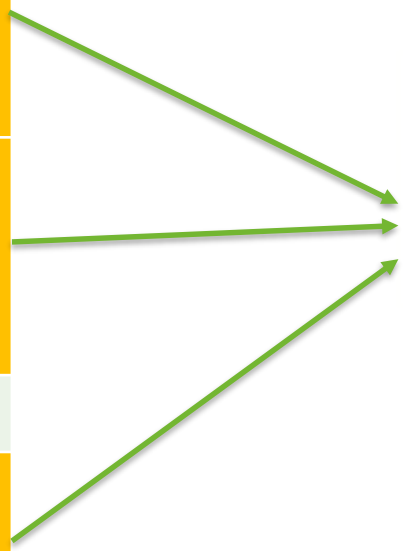

- ✓ Concepts based on a separate market for resources connected to the transmission and distribution grid -> smart coupling between markets

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Summary coordination schemes

Coordination scheme	Allocation principle of flexibility from the distribution grid
Centralized AS market model	Priority for the TSO
Local AS market model	Priority for the DSO
Shared Balancing Responsibility model	Exclusive use for the DSO
Common TSO-DSO AS market model	Minimization of total costs of TSO and DSO
Integrated Flexibility market model	Highest willingness to pay

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Benefits and attention points

Domain	Performance criteria	Coordination scheme				
		Centralized AS market model	Local AS market model	Shared Balancing Responsibility model	Common TSO-DSO market model	Integrated Flexibility market model
Interaction between system operators	Adequacy of existing communication channels, including the use of common data					
Grid operation	Respecting distribution grid constraints					
	Use of resources from the distribution grid by the TSO					
	Recognition of the evolving role of the DSO					
Market operation	Possibility to lower market operation costs					
	Liquidity of the market					
	Economies of scale					

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Benefits and attention points

Domain	Performance criteria	Coordination scheme				
		Centralized AS market model	Local AS market model	Shared Balancing Responsibility model	Common TSO-DSO market model	Integrated Flexibility market model
Interaction between system operators	Adequacy of existing communication channels, including the use of common data	High				
Grid operation	Respecting distribution grid constraints	Low				
	Use of resources from the distribution grid by the TSO	High				
	Recognition of the evolving role of the DSO	Low				
Market operation	Possibility to lower market operation costs	High				
	Liquidity of the market	Medium				
	Economies of scale	Medium				

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Benefits and attention points

Domain	Performance criteria	Coordination scheme				
		Centralized AS market model	Local AS market model	Shared Balancing Responsibility model	Common TSO-DSO market model	Integrated Flexibility market model
Interaction between system operators	Adequacy of existing communication channels, including the use of common data	High	Medium	Medium		
Grid operation	Respecting distribution grid constraints	Low	High	High		
	Use of resources from the distribution grid by the TSO	High	Medium	Low		
	Recognition of the evolving role of the DSO	Low	High	High		
Market operation	Possibility to lower market operation costs	High	Low	Low		
	Liquidity of the market	Medium	Low	Low		
	Economies of scale	Medium	Low	Low		

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Benefits and attention points

Domain	Performance criteria	Coordination scheme				
		Centralized AS market model	Local AS market model	Shared Balancing Responsibility model	Common TSO-DSO market model	Integrated Flexibility market model
Interaction between system operators	Adequacy of existing communication channels, including the use of common data	High	Medium	Medium	Low	Medium
Grid operation	Respecting distribution grid constraints	Low	High	High	High	High
	Use of resources from the distribution grid by the TSO	High	Medium	Low	High	High
	Recognition of the evolving role of the DSO	Low	High	High	High	High
Market operation	Possibility to lower market operation costs	High	Low	Low	Medium	Medium
	Liquidity of the market	Medium	Low	Low	Medium	High
	Economies of scale	Medium	Low	Low	High	High

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TSO-DSO coordination – the story continues

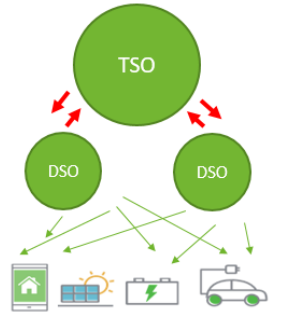
- **Clean Energy for All Europeans package** in final stages of approval

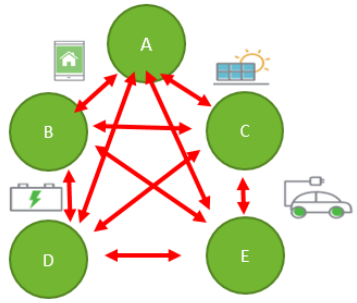
- Important milestone in **recognition of the role of the DSO**
  - ✓ DSOs are allowed to procure and use flexibility
  - ✓ Neutral role of DSO in data management, involvement in storage and EV infrastructure
  - ✓ Set-up of EU DSO entity with focus on coordination with ENTSO-E

TSO-DSO coordination – the story continues (2)

From centralized to decentralized to distributed (Peer-to-Peer) markets

- ✓ What is the appropriate **market design** for each **system service**, including system services for the **future**?
- ✓ Which **services/products** can be **combined** in one coordinated set-up?
- ✓ How do we coordinate the use of the same resources between multiple services and multiple system operators?
- ✓ What is the **role of system operators** in the different market frameworks, in particular for **P2P markets**
- ✓ How to avoid **market distortions** (illiquidity, gaming, lock-in…)





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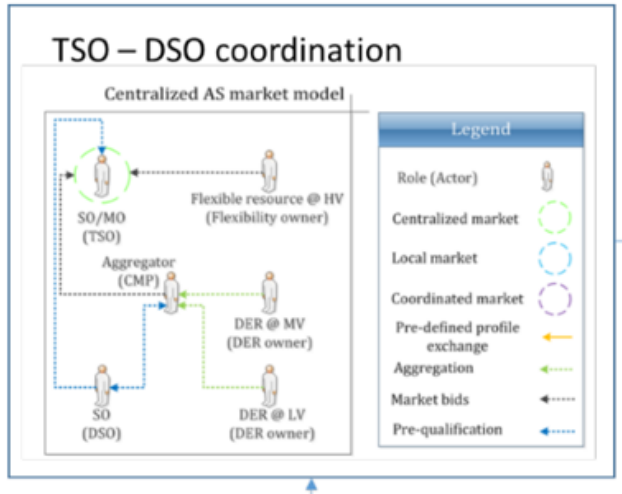
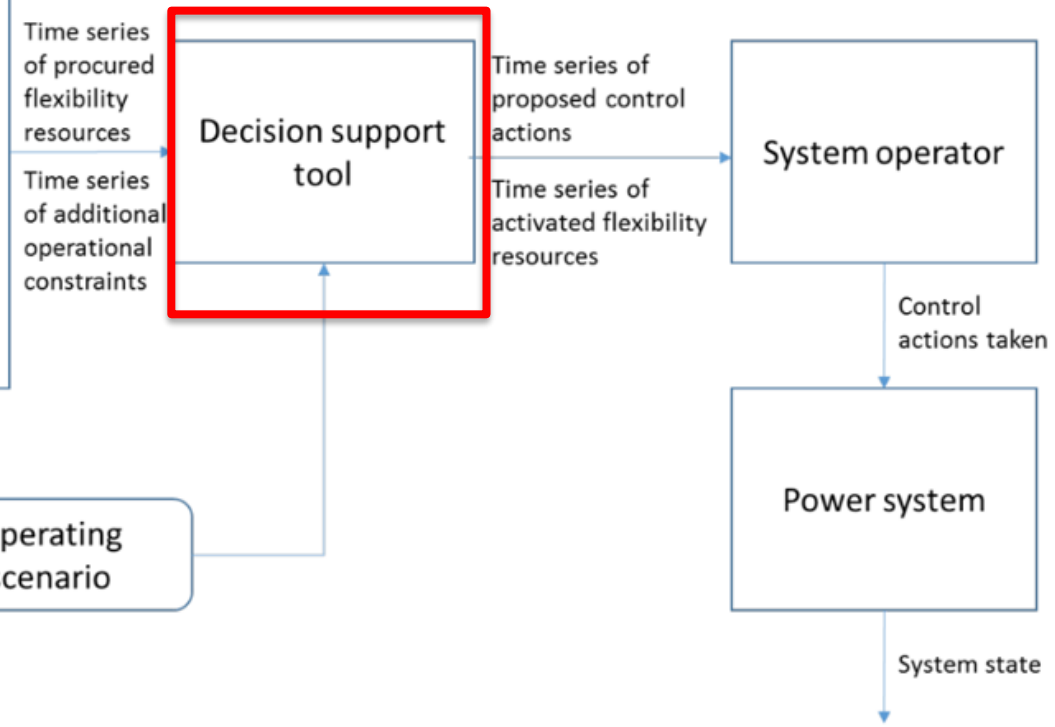
A need for advanced grid decision support

TSO-DSO coordination – grid decision support

From market outcome to control action





- ✓ Real-time operation
- ✓ Training of system operators
- ✓ Frequency control, voltage control

Conclusions

- The increase of DER offers opportunities for system operators to make use of flexibility available in the distribution grid.
- Coordination between system operators (TSO and DSO) is crucial to guarantee an efficient use of these flexible services
- Different possible TSO-DSO coordination schemes have their own benefits and risks.
- The choice of the most suitable coordination scheme depends on several factors:
  - ✓ the type of flexibility service,
  - ✓ the current state of the grid,
  - ✓ the share of RES installed,
  - ✓ the existing market design
  - ✓ the evolution of roles and responsibilities of system operators.
- The feasibility of each of the coordination schemes is dependent on the current and future regulatory framework

Conclusions

- A change from one coordination scheme to another is in principle a question of a change in roles, responsibilities and market design.
- The increased interaction between system operators will impact business processes, information exchanges, communication channels and ICT infrastructure.
- Advanced tools and services should be developed to support grid operators to optimally benefit from the opportunities of the changing market environment

If they want to go fast, system operators could go alone,
If they want to go far, they should go together,
turning challenges into opportunities

Questions?

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