

Brussels – Smartnet workshop | 20<sup>th</sup> June 2018

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

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This project has received funding from the European Union's Horizon 2020  
research and innovation programme under grant agreement No 691405

# TSO-DSO coordination schemes: scope and definitions

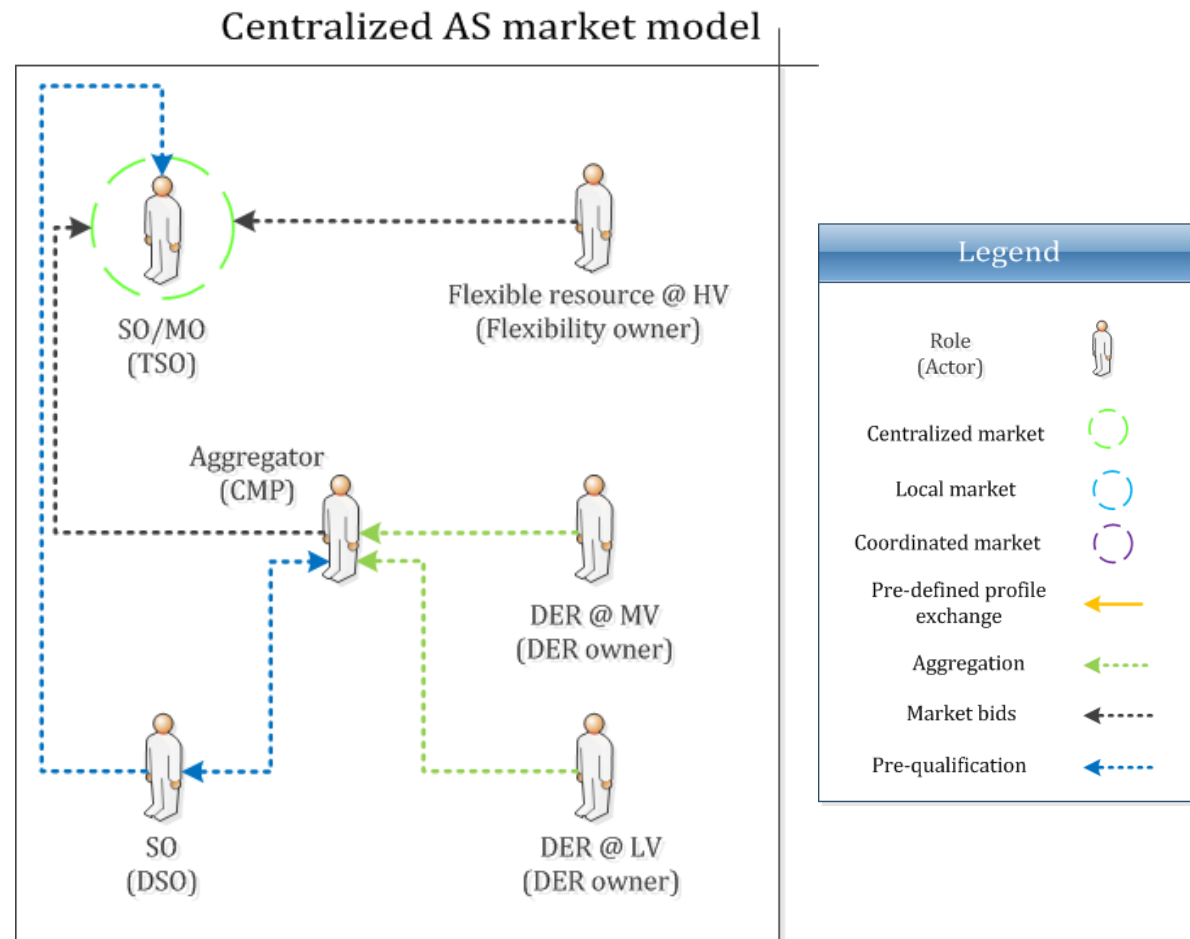
- Objective: analyze TSO-DSO coordination schemes (CSs) for the provision of flexibility-based system services by distributed resources (DG, DSM, ...)
- Analyse each CS, focusing on:
  - envisioned set of roles and responsibilities,
  - potential market architectures, and
  - relevant information exchanges
- Impact on TSO grid operation, DSO grid operation, the role of other market participants and the related market design ⇔ national regulatory frameworks and EU context



# Five possible TSO-DSO coordination schemes:

## 1) Centralized AS market model

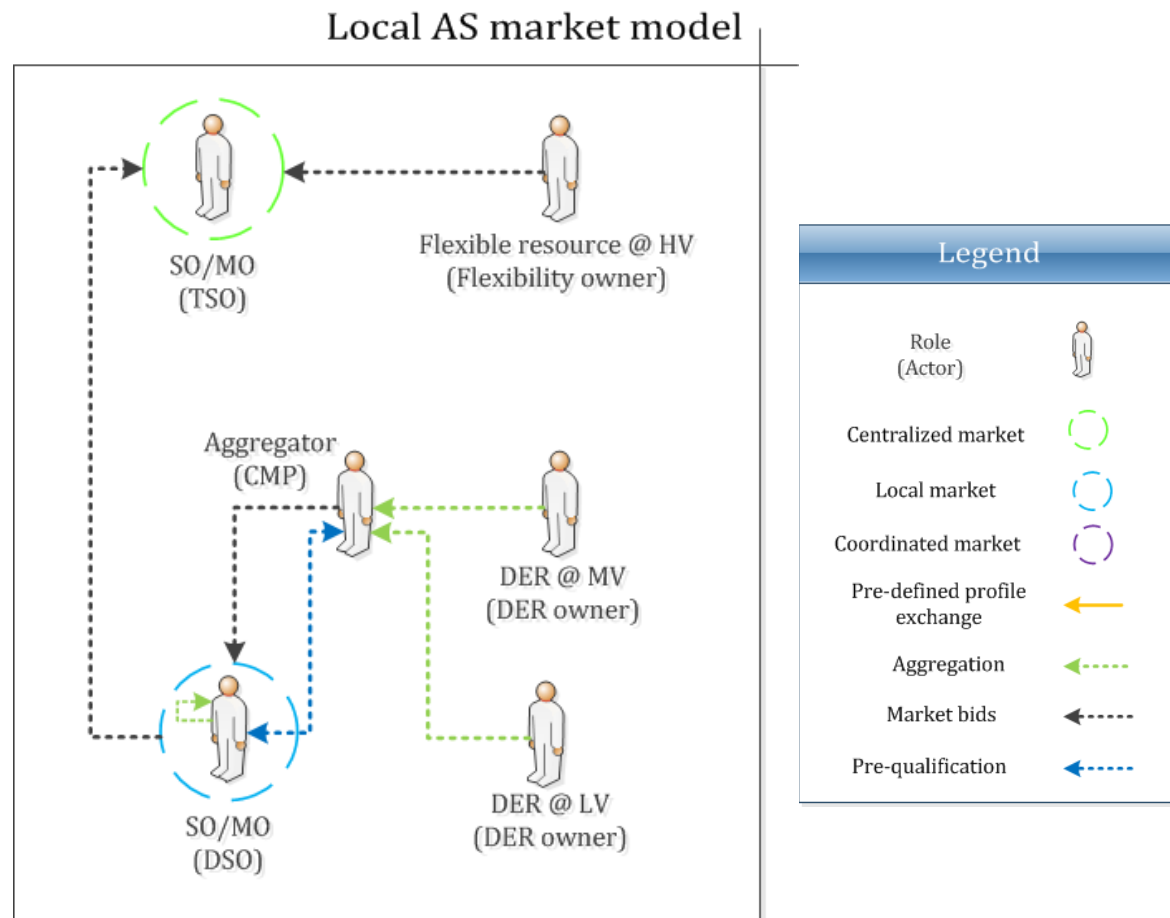
- 1 common ancillary services market managed by TSO
- Separate DSO process for checking distribution constraints (e.g. prequalification)



# Five possible TSO-DSO coordination schemes:

## 2) Local AS market model

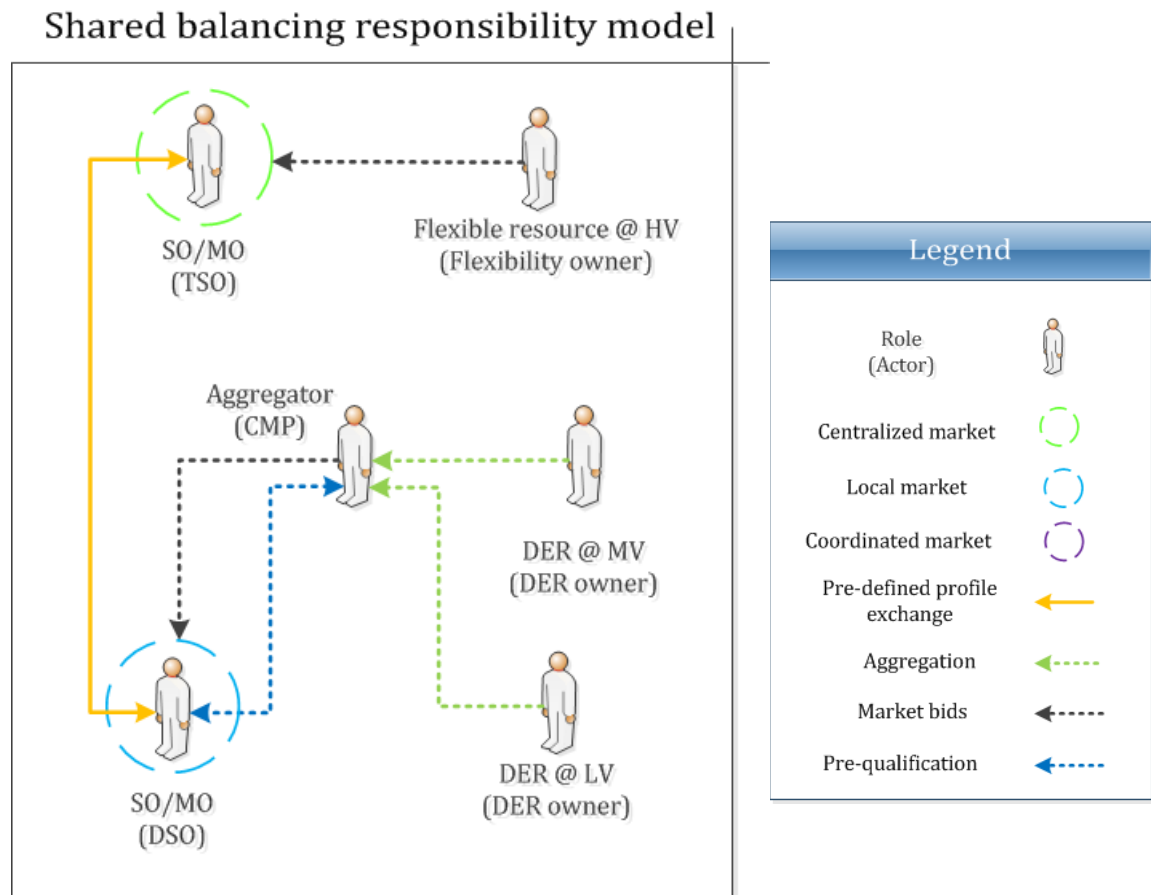
- Separate local market managed by DSO for local issues
- Transfer remaining flexibility to TSO ancillary services market level



# Five possible TSO-DSO coordination schemes:

## 3) Shared balancing responsibility model

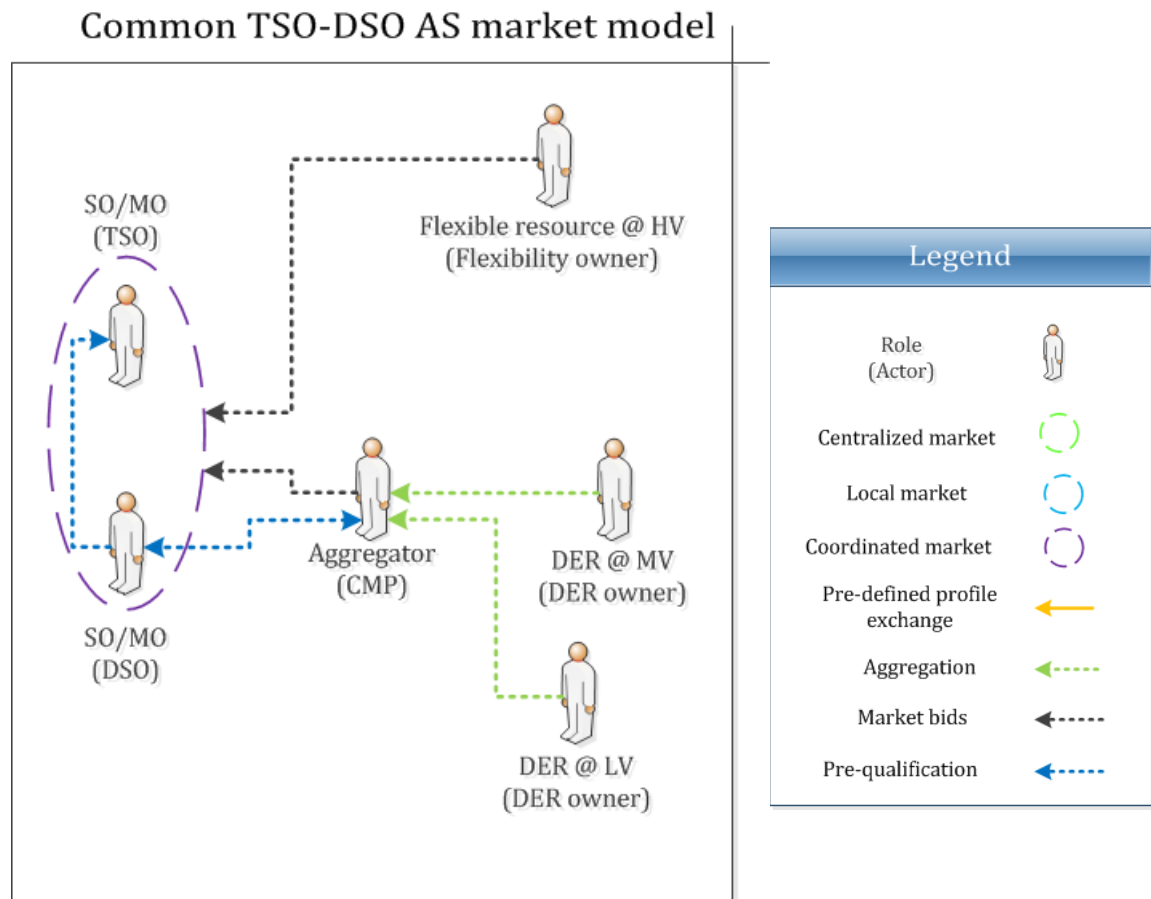
- Ancillary services market for transmission grid-connected resources managed by TSO
- Local market for distribution grid-connected resources
- Agreed pre-defined TSO-DSO scheduled profile



# Five possible TSO-DSO coordination schemes:

## 4) Common TSO-DSO AS market model

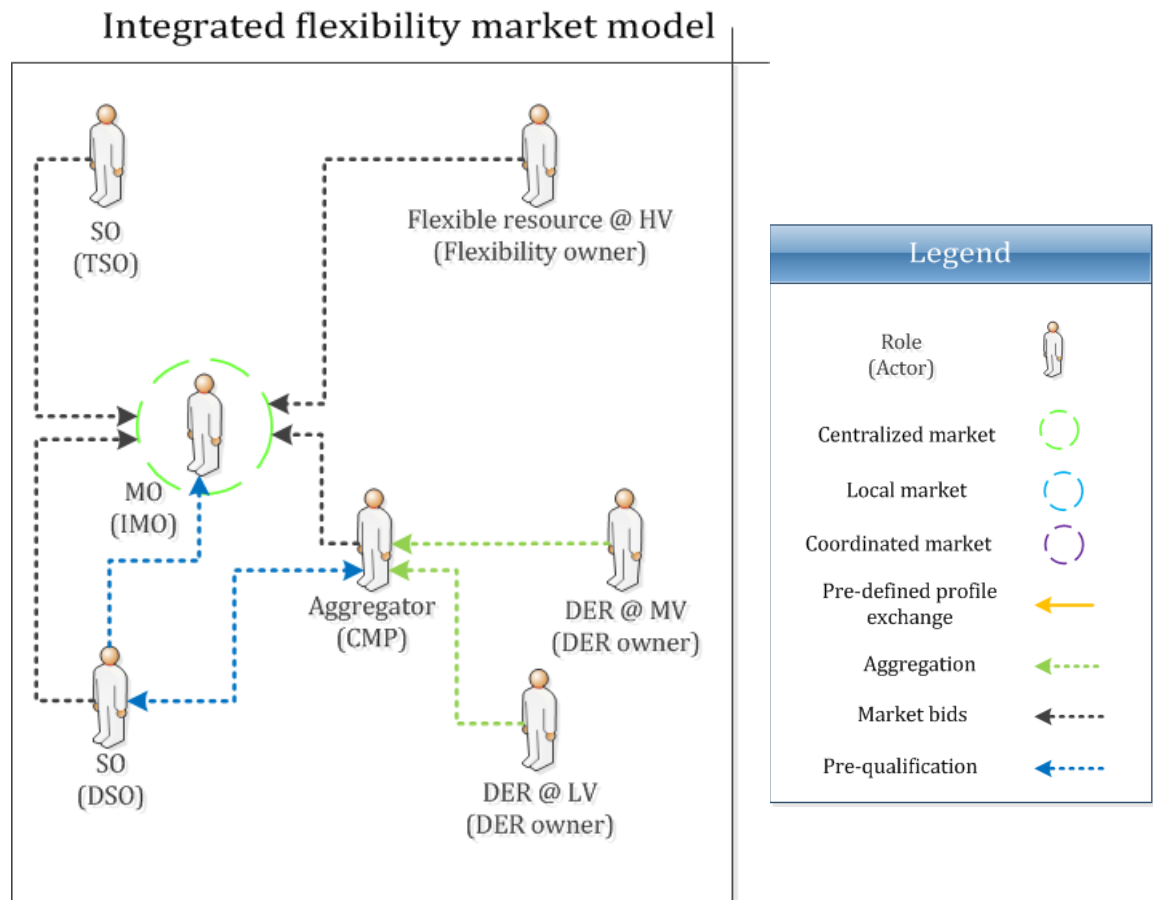
- Common flexibility market managed jointly by TSO & DSO
- Variants:
  - One optimization with all grid constraints
  - Two optimizations: distribution & transmission constraints



# Five possible TSO-DSO coordination schemes:

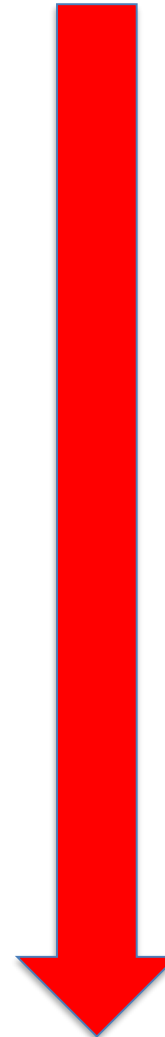
## 5) Integrated flexibility market model

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



# Summary coordination schemes

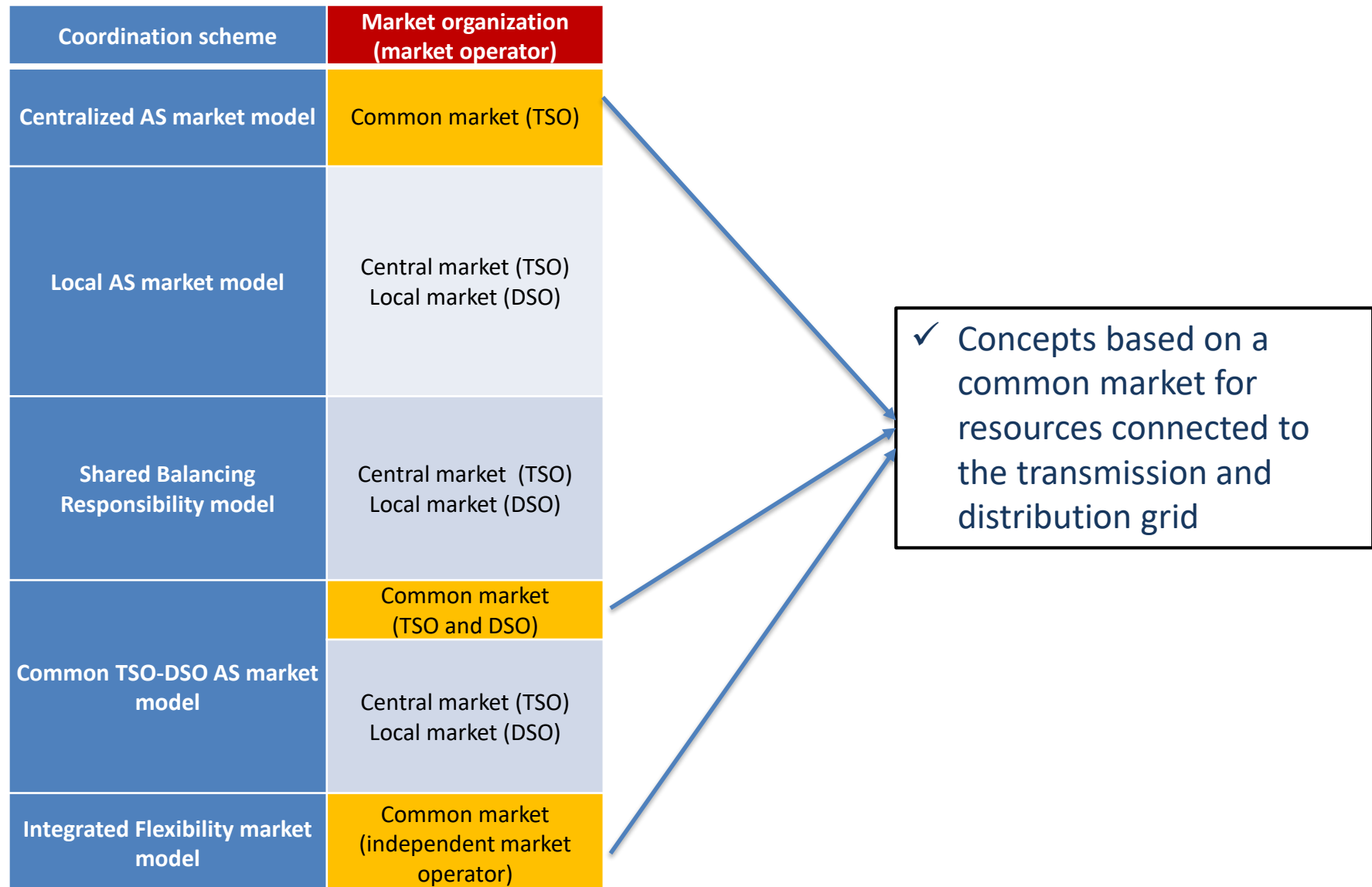
Coordination scheme	Role of the DSO
Centralized AS market model	<ul style="list-style-type: none"> <li>Limited to possible process of prequalification</li> </ul>
Local AS market model	<ul style="list-style-type: none"> <li>Organization of local market</li> <li>Buyer of flexibility for local congestion management</li> <li>Aggregation of resources to central market</li> </ul>
Shared Balancing Responsibility model	<ul style="list-style-type: none"> <li>Organization of local market</li> <li>Buyer of flexibility for local congestion management and balancing</li> </ul>
Common TSO-DSO AS market model	<ul style="list-style-type: none"> <li>Organization of flexibility market in cooperation with TSO</li> <li>Buyer of flexibility for local congestion management</li> </ul>
Integrated Flexibility market model	<ul style="list-style-type: none"> <li>Buyer of flexibility for local congestion management</li> </ul>



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



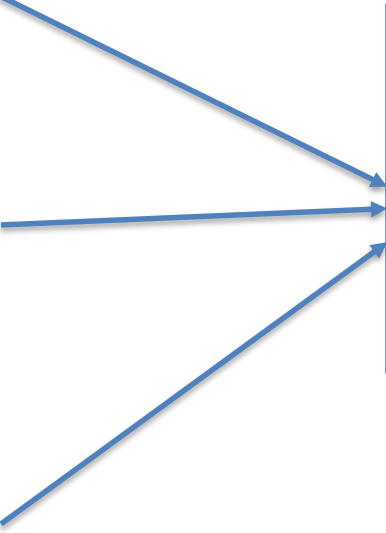
# Summary coordination schemes



# 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 separate market for resources connected to the transmission and distribution grid -> smart coupling between markets



# 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

# 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					

# 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				

# 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		
	Respecting distribution grid constraints	Low	High	High		
Grid operation	Use of resources from the distribution grid by the TSO	High	Medium	Low		
	Recognition of the evolving role of the DSO	Low	High	High		
	Possibility to lower market operation costs	High	Low	Low		
Market operation	Liquidity of the market	Medium	Low	Low		
	Economies of scale	Medium	Low	Low		

# 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
	Respecting distribution grid constraints	Low	High	High	High	High
Grid operation	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

- ✓ 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.



-  The choice of any particular coordination scheme at any moment in time still allows the possibility to evolve to another coordination scheme in the future.
-  A change from one coordination scheme to another is in principle a question of a change in roles, responsibilities and market design.
-  It remains essential that the chosen national coordination scheme is embedded in the ongoing processes of harmonization and integration of power systems across the European Union
-  The increased interaction between system operators will impact business processes, information exchanges, communication channels and ICT infrastructure.

***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***

# Q&A

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