



Research Reel

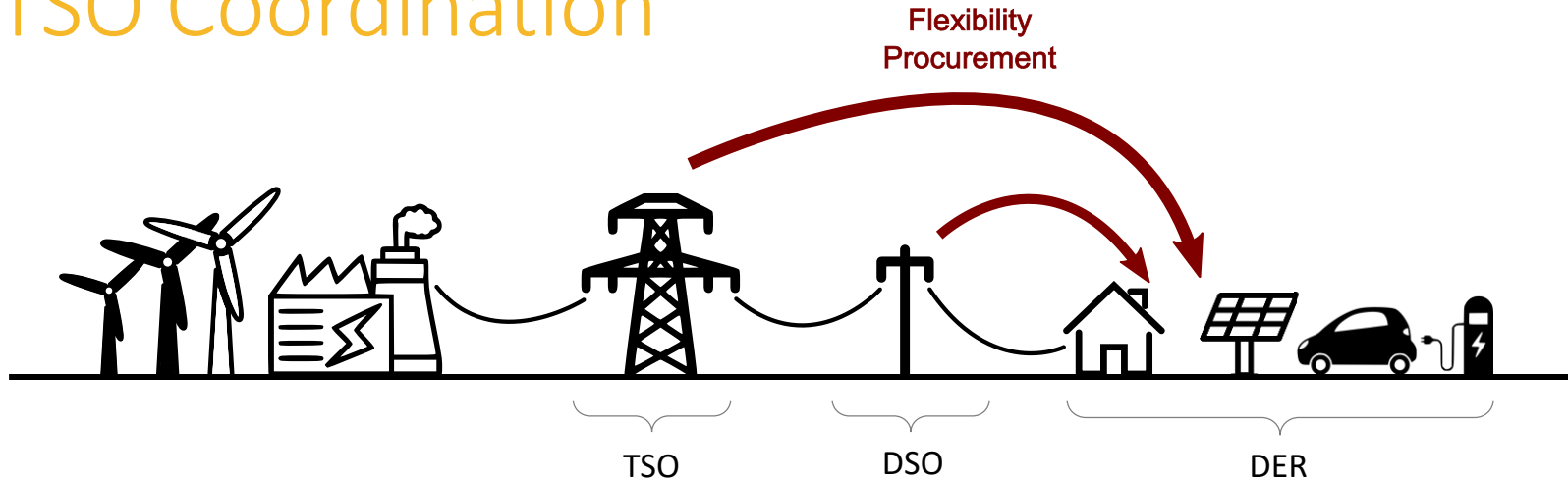
Evaluation Framework for the Assessment of Different TSO-DSO Coordination Schemes

1st IAEE Online Conference
7th – 9th June 2021

Leandro Lind
Rafael Cossent
Pablo Frías

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On the need for DSO-TSO Coordination



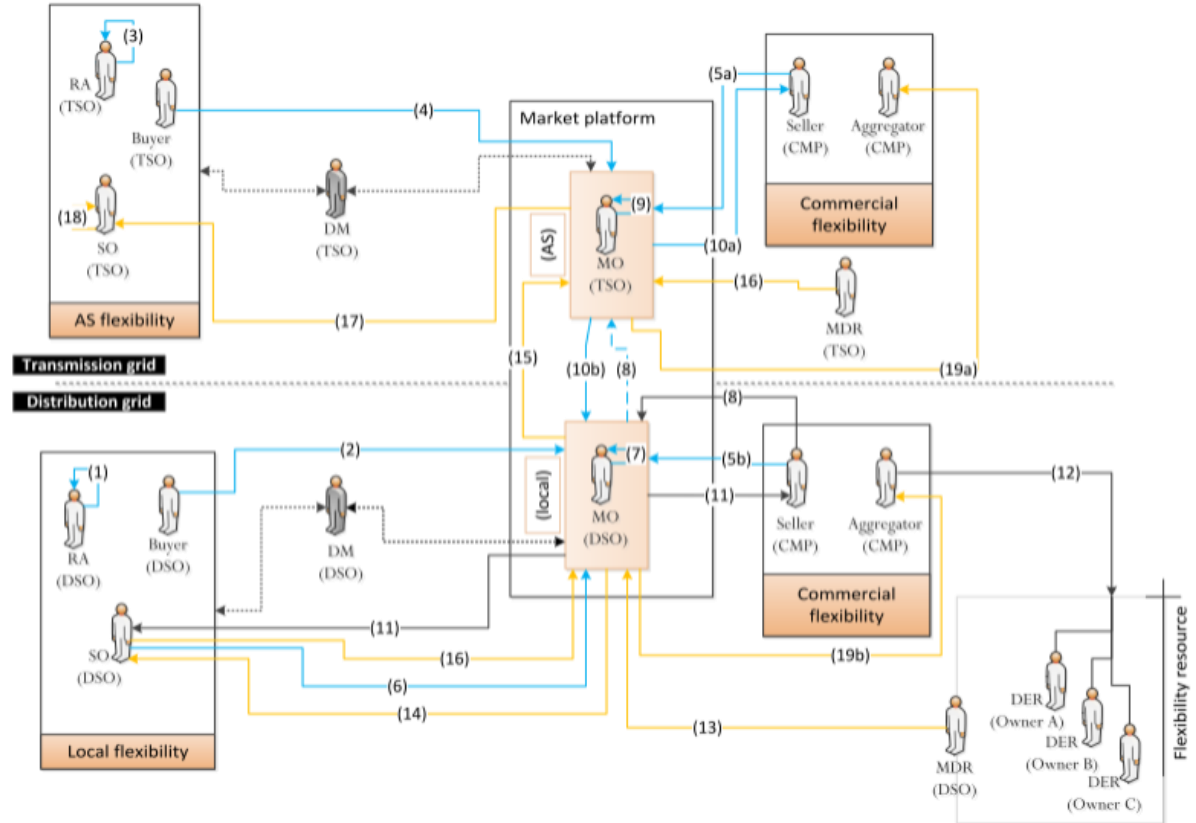
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- Which SO has the priority?
- Who operates each market?
- In which services can DER participate?

Coordination Schemes

Example of a coordination scheme:
Local AS market mode

Source: Gerard, H., Rivero, E., & Six, D. (2016). *Basic schemes for TSO-DSO coordination and ancillary services provision*. SmartNet Project Report. Retrieved from http://smartnet-project.eu/wp-content/uploads/2016/12/D1.3_20161202_V1.0.pdf



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Evaluation of TSO-DSO Coordination Schemes

Dimension	Criteria
Technical	Scalability of Coordination Algorithm
	ICT Requirements
Economic	Short-term cost of activation
	Long-term economic benefit
Regulatory	Fitness to national/regional regulation
	Fitness to national/regional TSO-DSO landscape

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Market sequence

Source: CEDEC, EDSO, ENTSO-E, Eurelectric, & GEODE. (2019). *TSO-DSO Report: An Integrated Approach to Active System Management*.
<https://www.entsoe.eu/news/2019/04/16/a-toolbox-for-tsos-and-dsos-to-make-use-of-new-system-and-grid-services/>

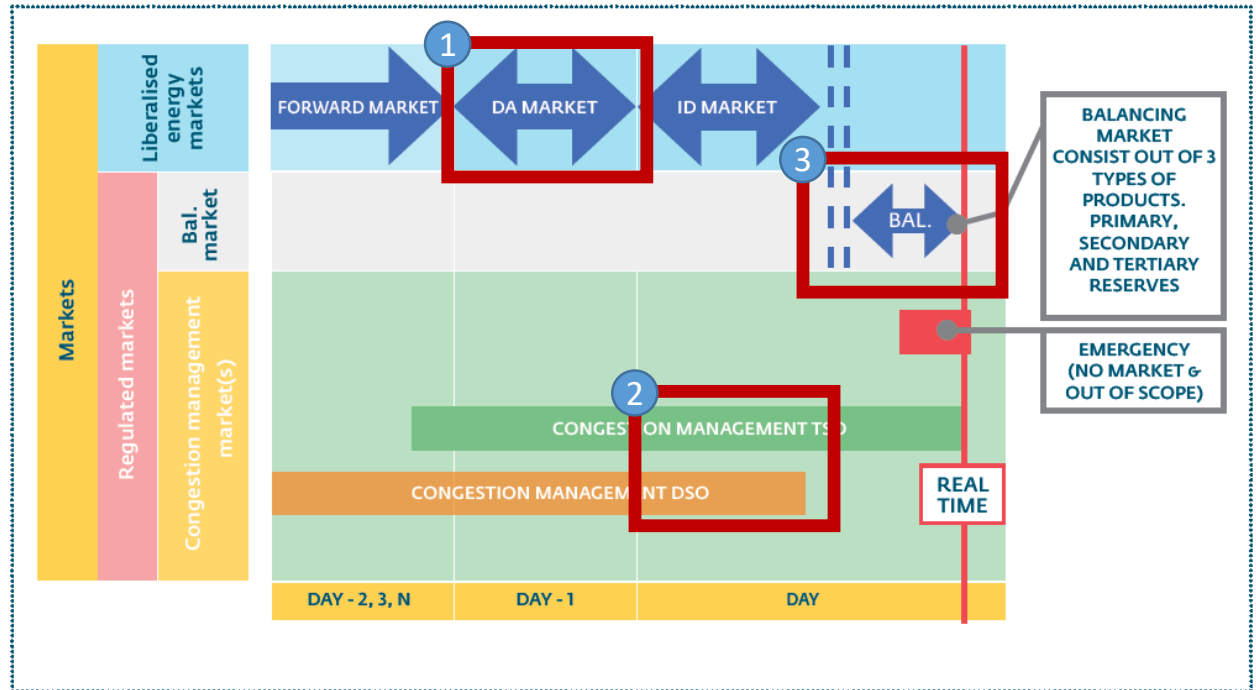


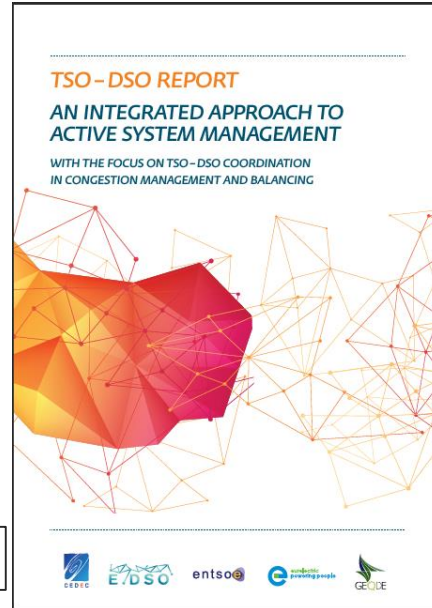
Figure 8: Different markets in the different timeframes

- 1 Day-ahead Market**
What? Merit order list without considering network
- 2 Congestion Management**
Why? Check feasibility of wholesale market and correct congestions.
When? After DA clearing
- 3 Balancing**
Why? Correct deviations between schedule and real-time output/consumption
When? Close to real-time

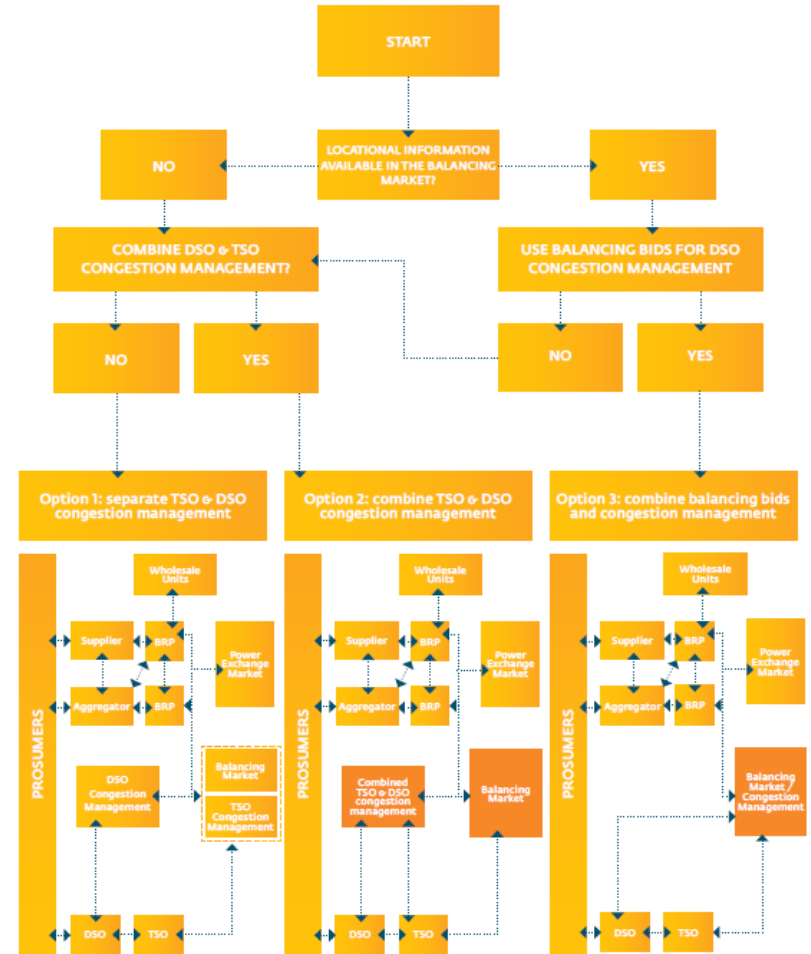
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Active System Management Report

Source: CEDEC, EDSO, ENTSO-E, Eurelectric, & GEODE. (2019). *TSO-DSO Report: An Integrated Approach to Active System Management*.
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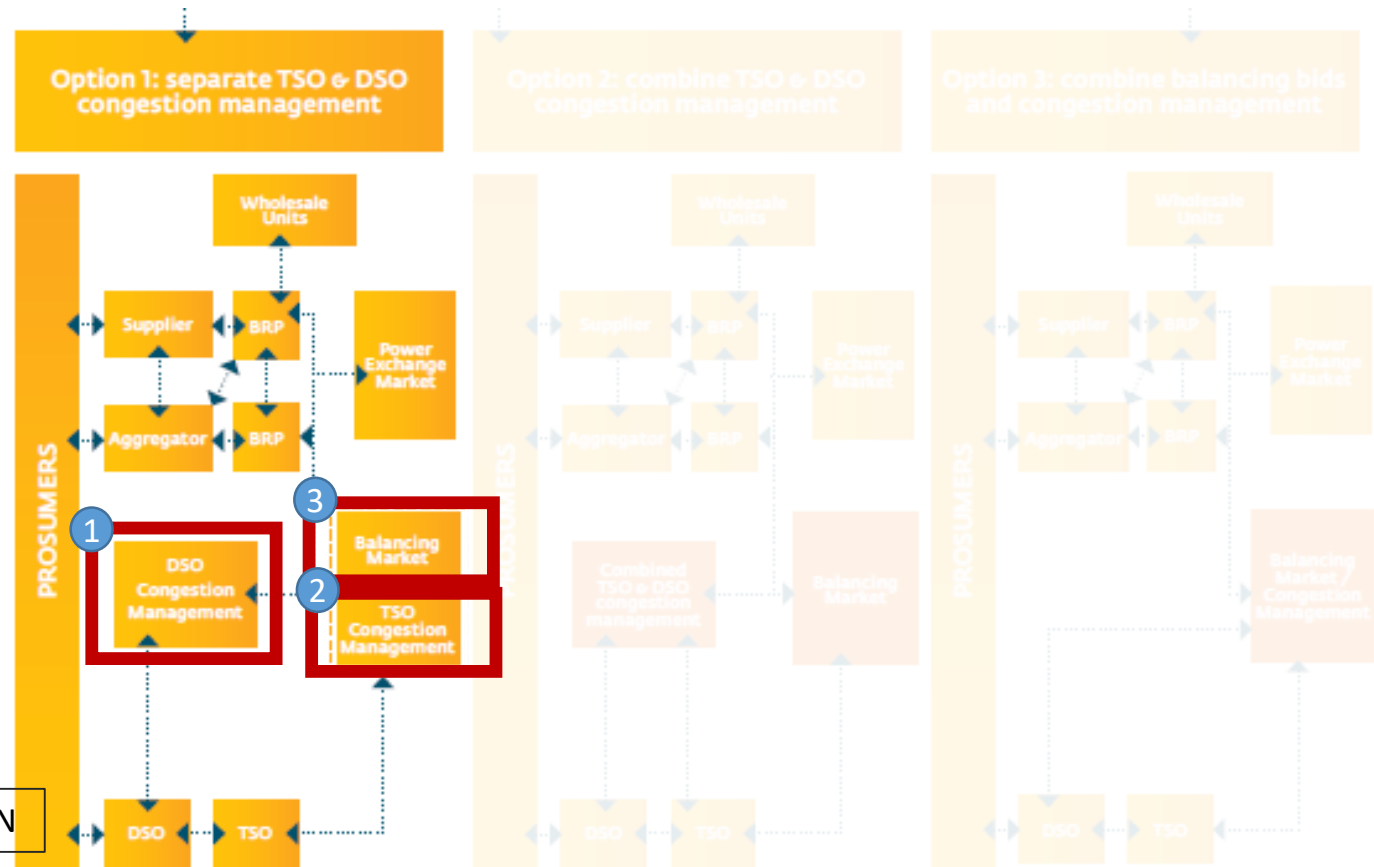


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3 Coordination Schemes

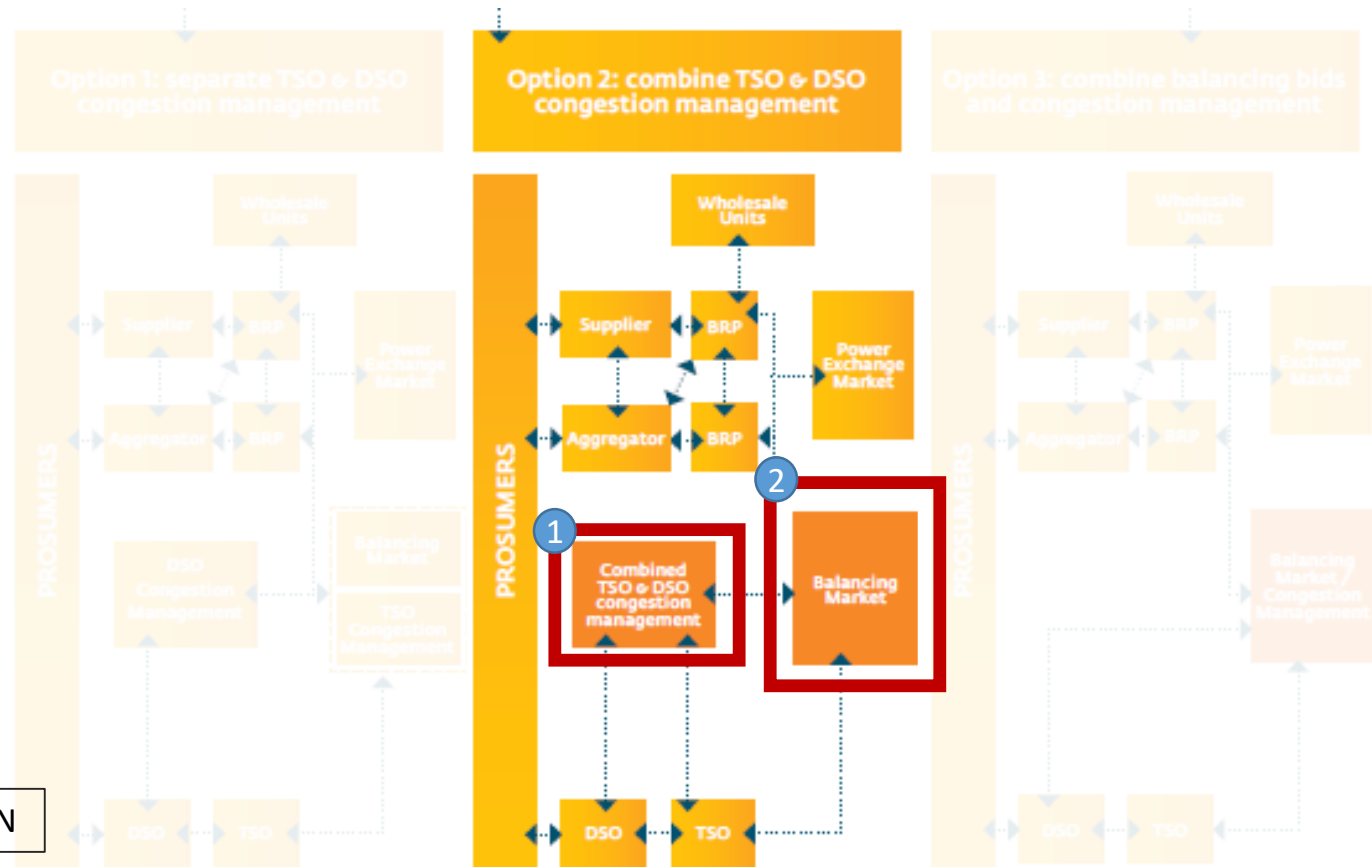
Source: CEDEC, EDSO, ENTSO-E, Eurelectric, & GEODE. (2019). *TSO-DSO Report: An Integrated Approach to Active System Management*.
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3 Coordination Schemes

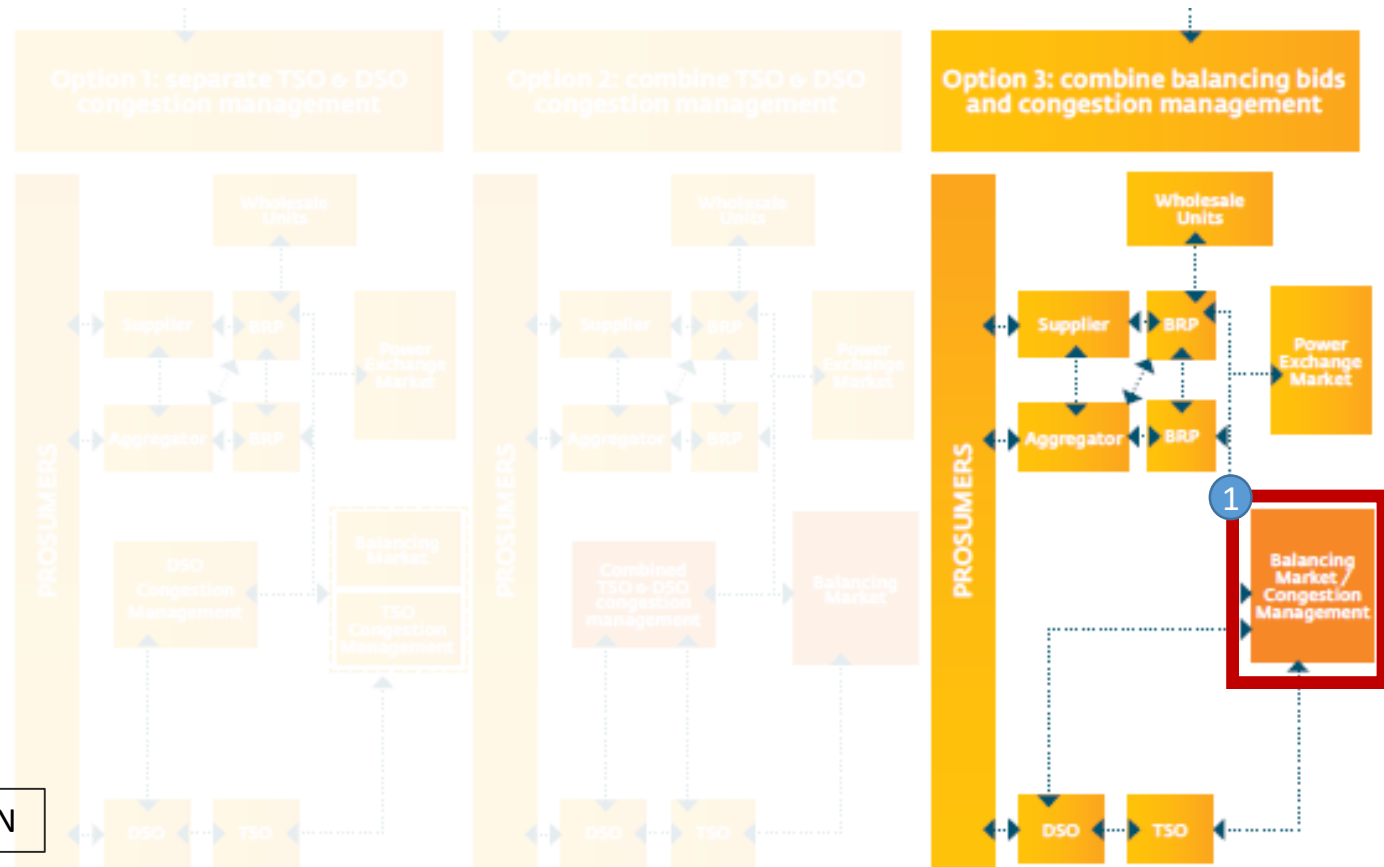
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3 Coordination Schemes

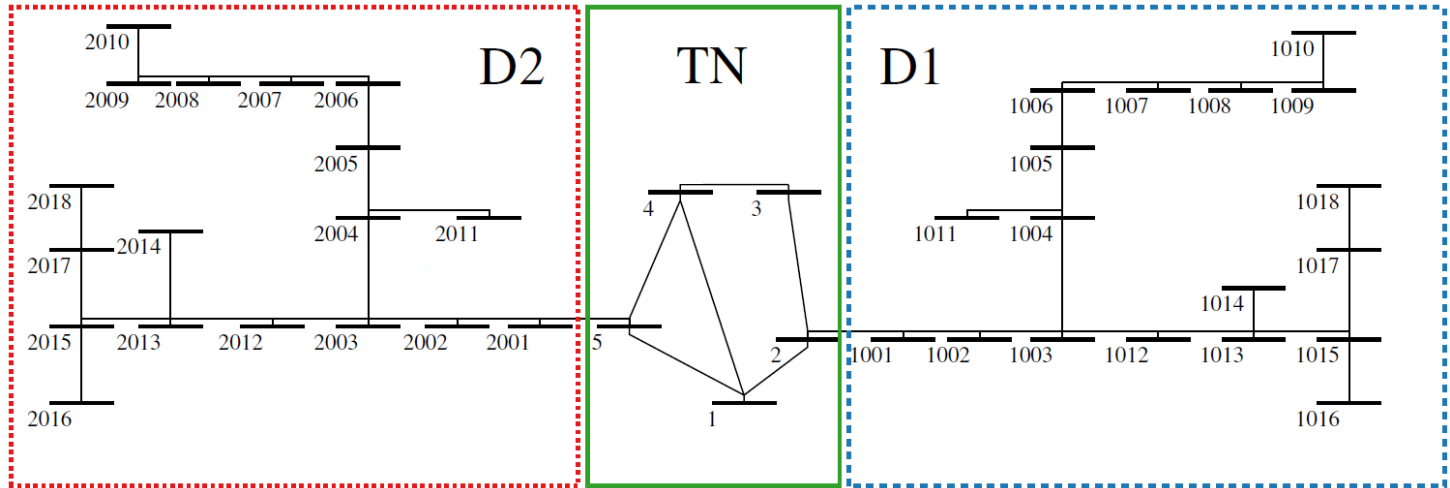
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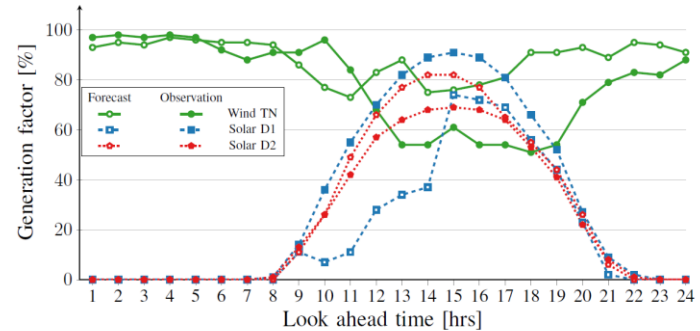
Network Data

Based on: Savvopoulos, N., Konstantinou, T., & Hatziaargyriou, N. (2019). TSO-DSO Coordination in Decentralized Ancillary Services Markets. 2019 *International Conference on Smart Energy Systems and Technologies (SEST)*, 1–6. <https://doi.org/10.1109/SEST.2019.8849142>



Imbalances for 24h:

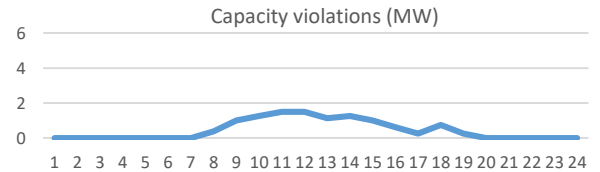
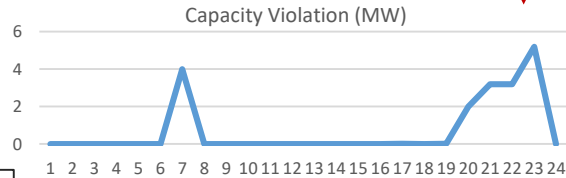
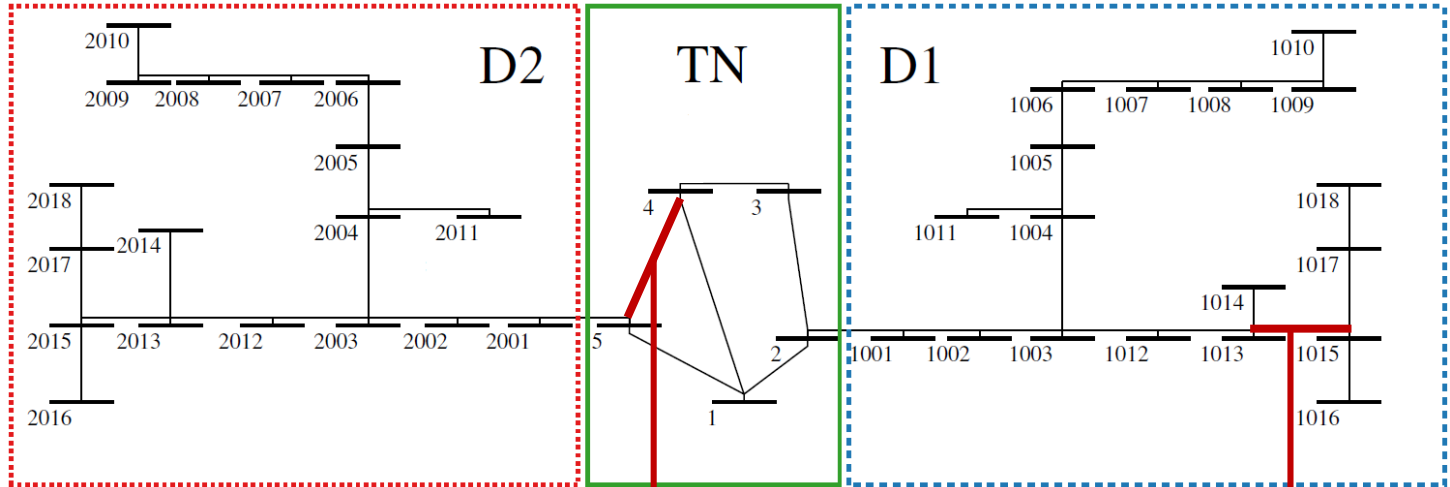
Source:
(Savvopoulos et al., 2019)



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Case Study: Results

Depreciation and return on asset
(annuity method)

	€/km	Km	Total
Line	€ 75,000.00	1.6	€ 120,000.00
WACC			5.58%
Asset Life			40 y
Annual Depreciation + Return on Asset			€ 7,557.00

<i>Cost of activation for 24h in €</i>	Option 1: Separate TSO and DSO Congestion Management		Option 2: Combined TSO and DSO Congestion Management		Option 3: Combined Balancing Bids and Congestion Management
	Congestion Management	Balancing	Congestion Management	Balancing	
1-TSO	1,872.99	487.32	1,972.53	487.32	2,395.41
2-DSO 1	43.50				
3-DSO 2					
Total		2,403.81		2,459.85	2,395.41

After distribution line reinforcement					
1-TSO	1,872.99	476.77	1,872.99	476.77	2,349.76
2-DSO 1					
3-DSO 2					
Total		2,349.76		2,349.76	2,349.76

Savings in 24h		54.05		110.09	45.65
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Savings in one year (days with congestion)	10 days	540.50		1,100.94	456.50
	50 days	2,702.50		5,504.68	2,282.50
	100 days	5,405.00		11,009.36	4,565.00

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EU Regulation

L 158/134

EN

Official Journal of the European Union

14.6.2019

- (61) Distribution system operators have to cost-efficiently integrate new electricity generation, especially installations generating electricity from renewable sources, and new loads such as loads that result from heat pumps and electric vehicles. For that purpose, distribution system operators should be enabled, and provided with incentives, to use services from distributed energy resources such as demand response and energy storage, based on market procedures, in order to efficiently operate their networks and to avoid costly network expansions. Member States should put in place appropriate measures such as national network codes and market rules, and should provide incentives to distribution system operators through network tariffs which do not create obstacles to flexibility or to the improvement of energy efficiency in the grid. Member States should also introduce network development plans for distribution systems in order to support the integration of installations generating electricity from renewable energy sources, facilitate the development of energy storage facilities and the electrification of the transport sector, and provide to system users adequate information regarding the anticipated expansions or upgrades of the network, as currently such procedures do not exist in the majority of Member States.

DIRECTIVE (EU) 2019/944 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 5 June 2019

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DSO Landscape



(1 DSO)



(1 DSO)



(~880 DSOs)



(354 DSOs)



(170 DSOs)

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Thank you

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