



This work was partly funded by national funds through the FCT – Fundação para a Ciência e a Tecnologia, I.P., under the grant PTDC/EEI-EEE/31711/2017

Case Study C

Market splitting scenarios in MIBEL

Disclaimer: The statements and opinions expressed in this presentation do not bind the organizations participating in the study; LNEG, R&D NESTER or REN.

Workshop: 20th September 2022



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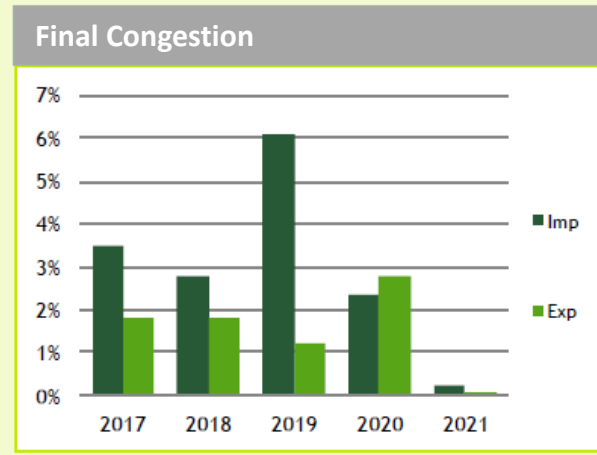
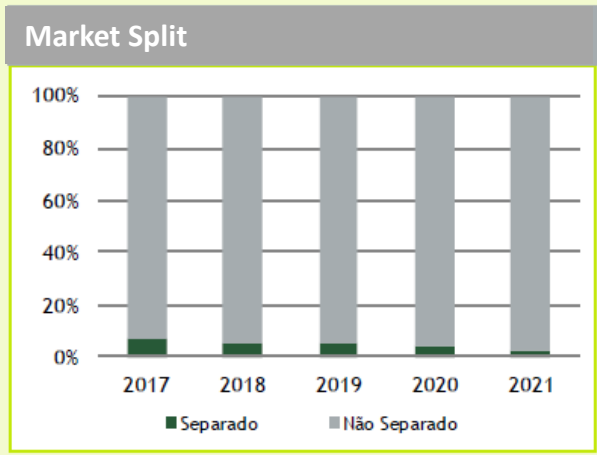
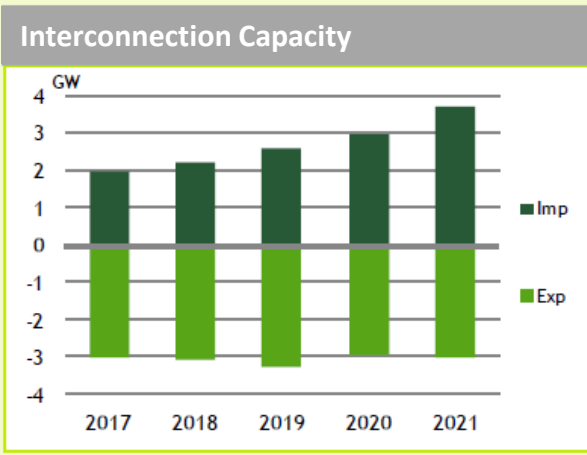
Case Study C

Market splitting scenarios in MIBEL

(R&D Nester)

Market splitting

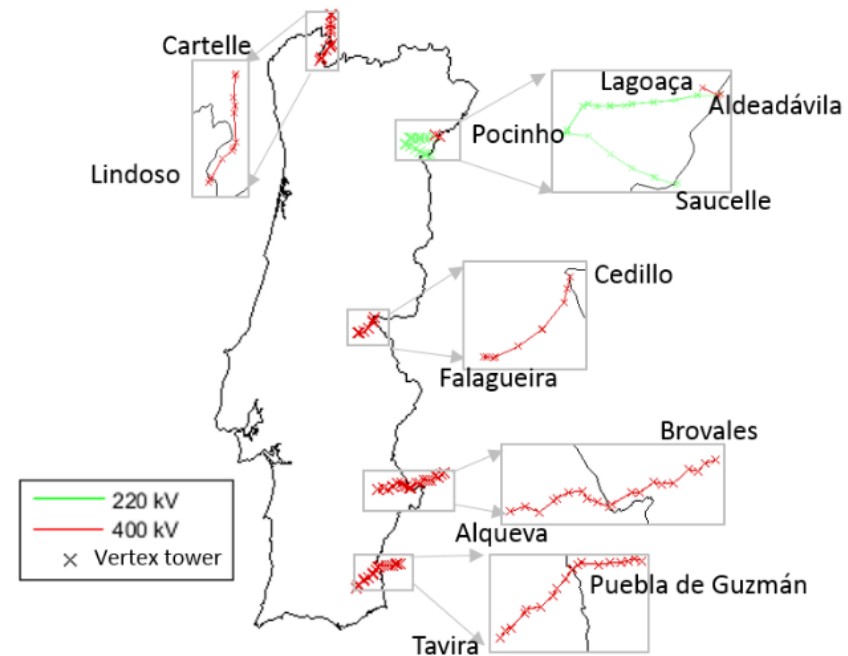
- Market split happens when there is not enough interchange capacity
 - The export capacity remains stable 3 GW,
 - The import capacity has increased from 2 GW to 3.7 GW.



	2017		2018		2019		2020		2021	
	IMP	EXP	IMP	EXP	IMP	EXP	IMP	EXP	IMP	EXP
Periods with Congestion [%]	3.5%	1.8%	2.8%	1.8%	6.1%	1.2%	2.4%	2.8%	0.2%	0.0%
Periods with Market Split DA [%]	6.7%		5.2%		5.2%		4.1%		2.6%	

Case Study C - MIBEL

- Case study that focus in the study of the congestion occurring in **interconnection lines** between Portugal and Spain.
- Takes advantage from using the **meteorological variables** from the operational wind and solar forecast tools, such as wind speed and direction, solar irradiation and ambient temperature, to predict the dynamic line rating capacity of overhead power lines.



- Portugal has 9 tie-lines with Spain:
 - The majority are 400 kV lines (#6) and only 3 are 220 kV,
 - The interconnected substation are near the border.

(2020 year)

Interconnection Line	Voltage	Length PT	Length ES	Total Length	Length PT %	Import	Export
	[kV]	[km]	[km]	[km]	%	[GWh]	[GWh]
Alto Lindoso-Cartelle 1	400	1,118	47,68	48,798	2,3	1604	510
Alto Lindoso-Cartelle 2	400	1,118	47,68	48,798	2,3	1586	509
Lagoaça-Aldeadavila 1	400	4,687	1,537	6,224	75,3	797	2518
Pocinho-Aldeadavila 1	220	41,129	0,378	41,507	99,1	273	202
Pocinho-Aldeadavila 2	220	41,31	0,378	41,688	99,1	277	204
Pocinho-Saucelle	220	30,222	0,1	30,322	99,7	287	91
Falagueira-Cedillo	400	26,151	0,245	26,396	99,1	812	934
Alqueva-Brovaes	400	39,899	40,97	80,869	49,3	1255	569
Tavira-Publa de Guzmán	400	33,806	25,17	58,976	57,3	663	460

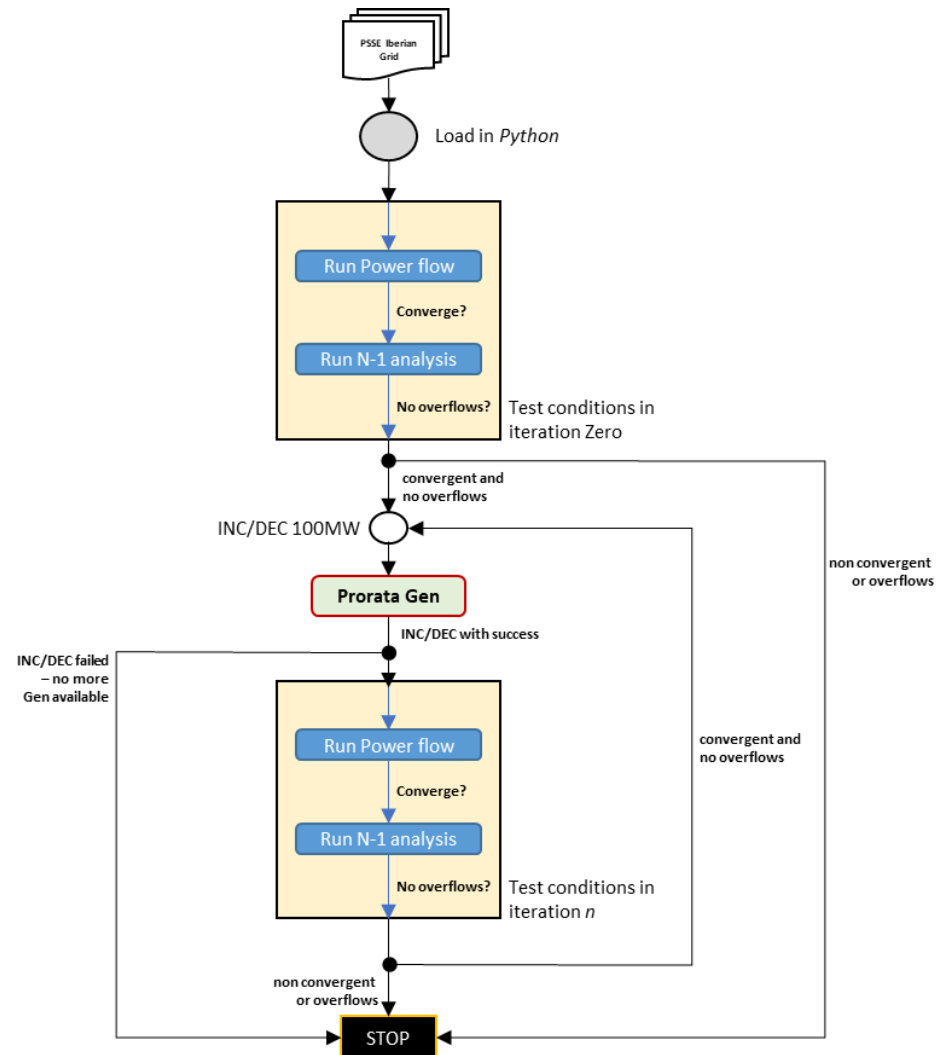
R&D NESTER Simulation Tool

- The developed tool runs an interchange capacity simulation between Portugal and Spain electricity grids for two cases:
 - i. **export** (energy flow from Portugal to Spain)
 - ii. **import** (energy flow from Spain to Portugal).
- Reference network cases were for 2029.
- The Iberian electricity grid used was modelled and the interchange capacity studies were conducted using *Python* environment.



R&D NESTER Simulation Tool

- 2029 Grid:
 - ✓ Export Grid
 - ✓ Import Grid
- Simplifications:
 - ✓ Machine Transformers
 - ✓ Some Spain Regions
 - ✓ First VHV (TSO), then HV (DSO)
- Power flow compliance
- N-1 analysis compliance
- Increases of 100 MW in generation (one side up, other side down)
- Pro-rata assumption



R&D NESTER Simulation Tool – Scenarios

- **Case C Baseline** – Reference Grids foreseen for 2029
- **Case C.I** – Baseline with an increment of 100 MW to Interconnection Lines Rating
- **Case C.II** – Baseline with an increment of 100 MW to all Lines Rating

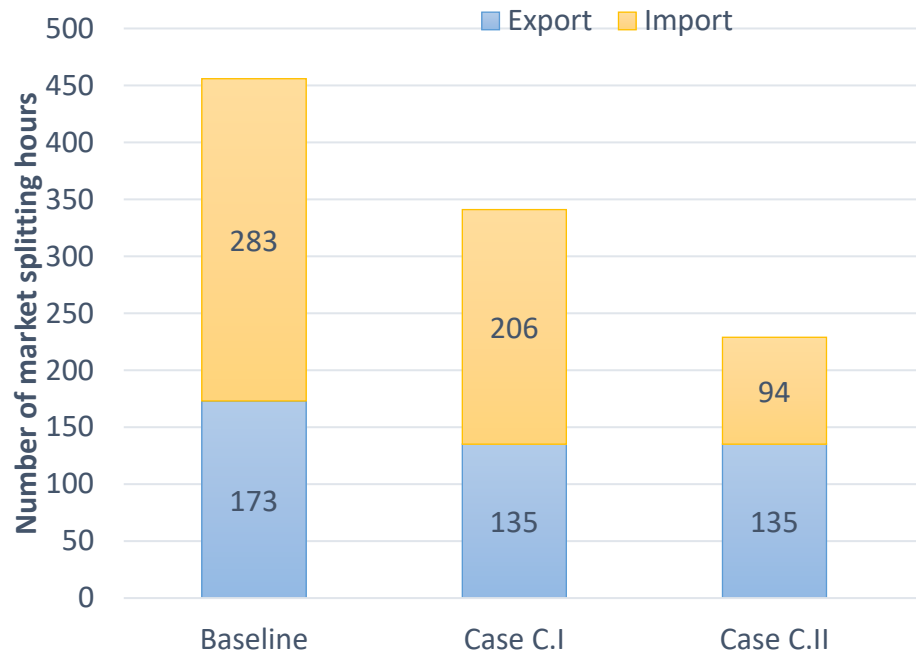
	Tavira-Guzmann	Alqueva-Brovaes	Falagueira-Cedillo	Lindoso-Cartelle 1-2	Lagoaca-Aldeadávila	Pocinho-Aldeadávila 1	Pocinho-Aldeadávila 2	Pocinho-Saucelle
Base Case	1386	1386	1386	1640	1706	435	435	430
Case C.I	1486	1486	1486	1740	1806	535	535	530
Case C.II	1486	1486	1486	1740	1806	535	535	530

R&D NESTER Simulation Tool – Results

	<u>EXP</u>	<u>IMP</u>	<u>diff EXP</u>	<u>diff IMP</u>
Base Case	5672 MW	6257 MW		
Case C.I	6064 MW	6257 MW	392 MW	100 MW
Case C.II	6064 MW	6979 MW	392 MW	722 MW

- Export (PT-SP):
 - ✓ Limitation was in a 400kV interconnection line
 - ✓ Improvements in all scenarios
- Import (SP-PT):
 - ✓ Improvements only when the DSO generation was changed

Market splitting results



Export (PT-SP):

- ✓ 100 MW additional lines' capacity leads to a small reduction in market splitting occurrences
- ✓ Using DLR on tie-lines (case C.III) strongly reduces the market splitting according with the applied tools.

Import (SP-PT):

- ✓ 100 MW additional in all internal lines' capacity (Case C.II) strongly decreases market splitting occurrences
- ✓ DLR on tie-lines also reduces market splitting occurrences

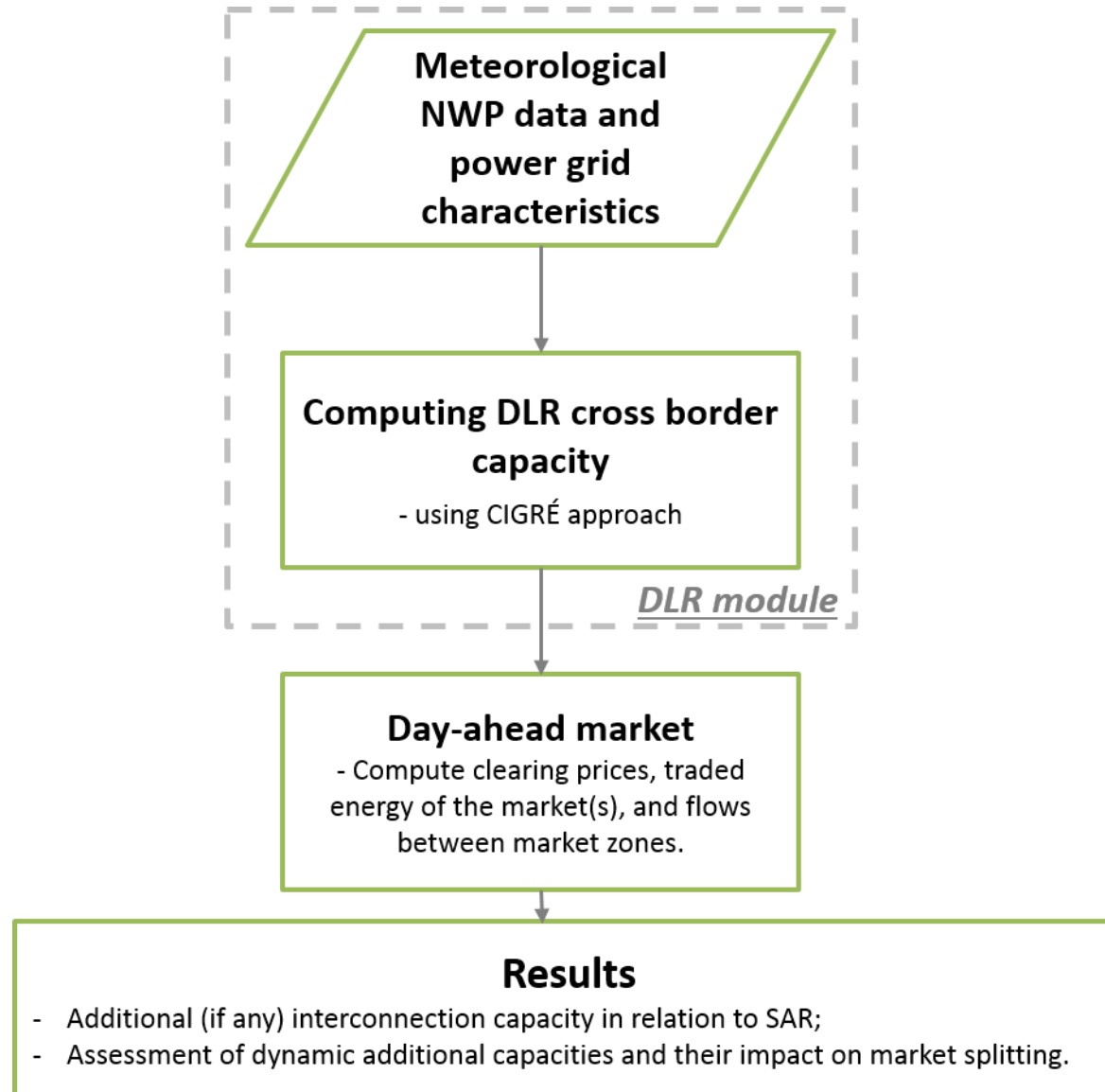


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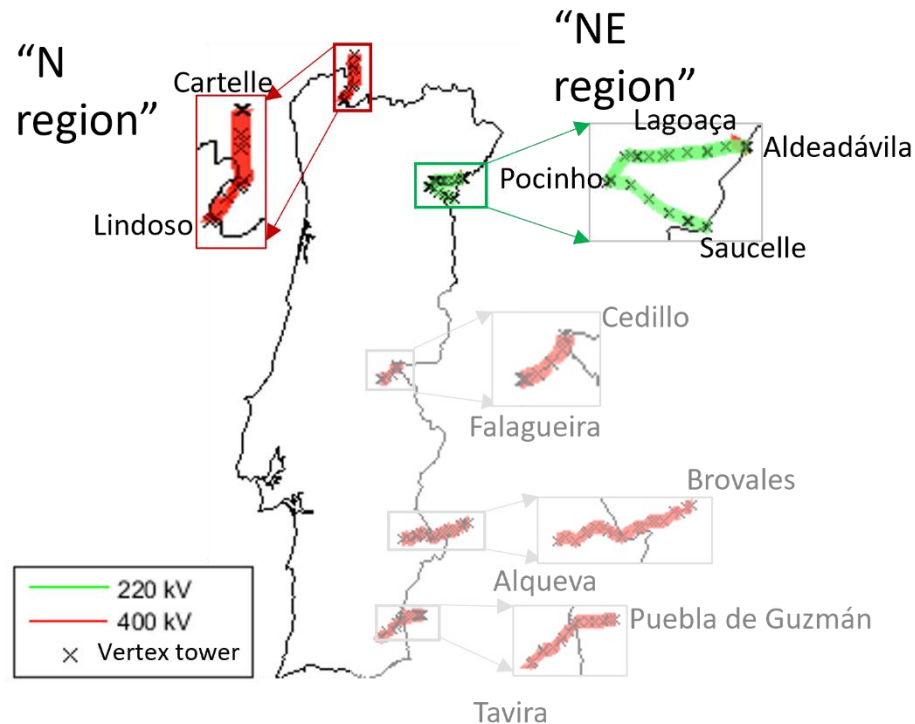
Case Study C

Market splitting scenarios in MIBEL (LNEG)

Flowchart of the DLR methodology



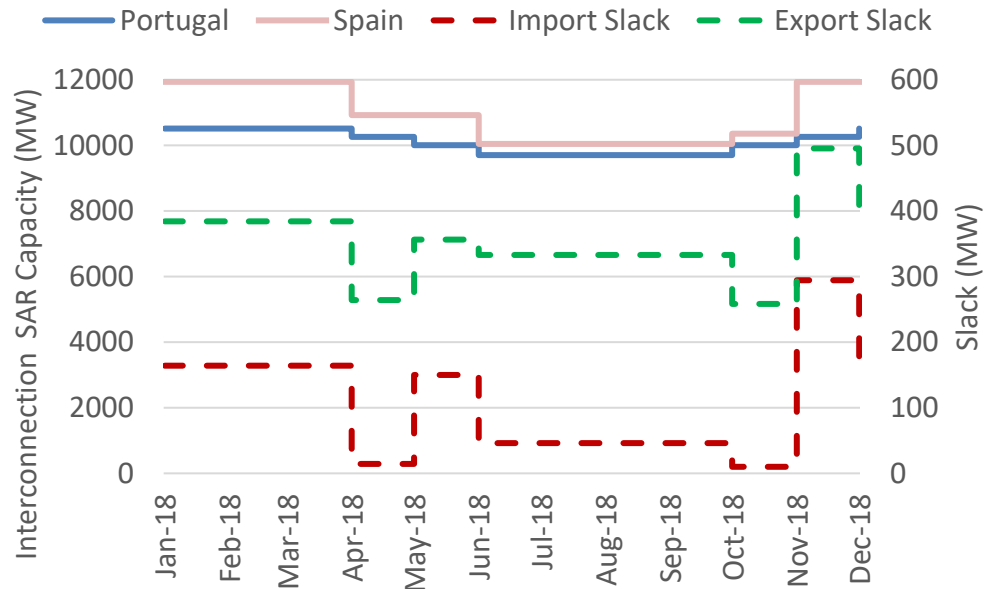
2018 market splitting case study



- 456 hours of Market Splitting (MS) were observed during 2018:
 1. "North(N) region" congested during importing hours (Spain -> Portugal power flow) – 283 hours
 2. "NorthEastern (NE) region" congested during exporting hours (Portugal -> Spain power flow) – 173 hours

2018 scenarios

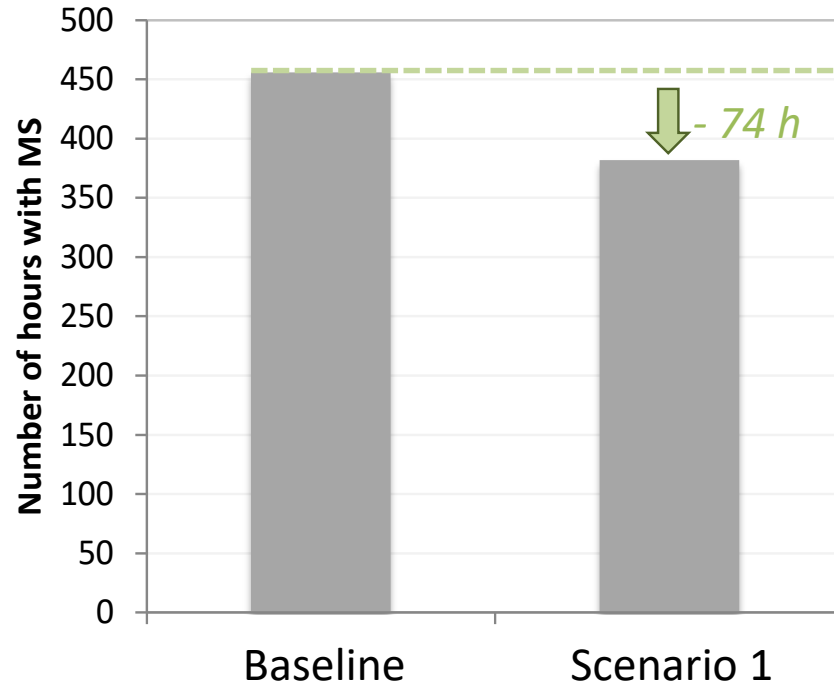
Available thermal capacity :



Baseline scenario: 2018 data for cross border capacity of lines was used.

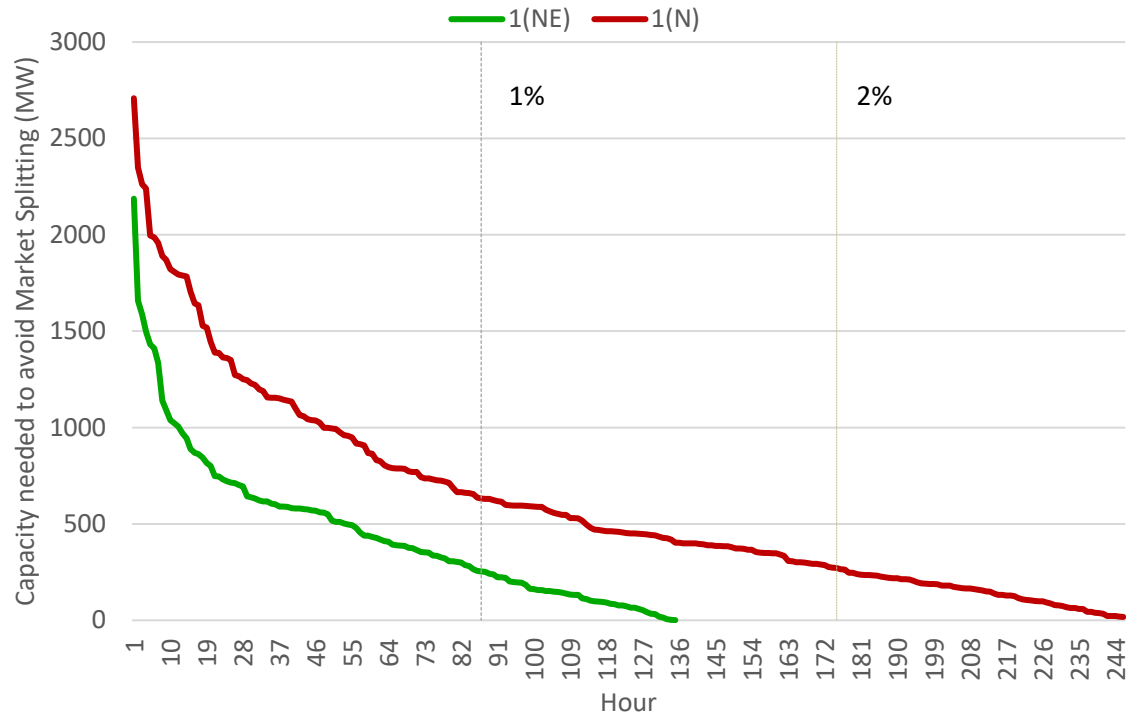
Scenario 1: Portugal uses its capacity slack in relation to Spanish SAR limited to the DLR outputs.

Case C - results (2018)



DLR enables to reduce the periods of Market Splitting from 456 hours (SAR) to:

1. 382 hours in *scenario 1* → DLR application to Portuguese transmission lines



- To reduce the Market Splitting threshold occurrence to 1% (max. of 87 hours yearly) an additional transmission capacity is needed - 715 MW in North and 536 MW in North-Eastern regions.
- Using DLR to validate the Spanish SAR, those capacities are reduced to:
 - scenario 1 – 631 MW in North region and 253 MW in North-Eastern region;

Further study considering the application of DLR in both Portugal and Spain:

H. Algarvio et al. Increase cross-border capacity to reduce market splitting of day-ahead electricity markets-A dynamic line rating approach. In: 2022 IEEE/PES Transmission and Distribution Conference and Exposition. IEEE, 2022. p. 1-5.



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Case Study C

Market splitting scenarios in MIBEL

(Synthesis)

Synthesis



- DLR can also provide additional interchange capacity, and reduce the number of hours with market split.
- For this case C the DLR meteorological area is the entire country.
- Preliminary studies shows that DLR brings more export capacity (+wind) than import capacity (-wind).



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Further information available at: <https://optigrd.lneg.pt>

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