Impacts of RES policies on electricity markets – A first assessment

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Starting point for the analysis of market impacts by RES policies

- In the past priority has been on RES deployment. With a high RES share efficiency of wholesale electricity markets will become more important

- Development of market design (as well as major grid regulation issues) has mainly been driven by conventional and fossil generation capacity. In the future impacts of RES generation have to be taken into account.

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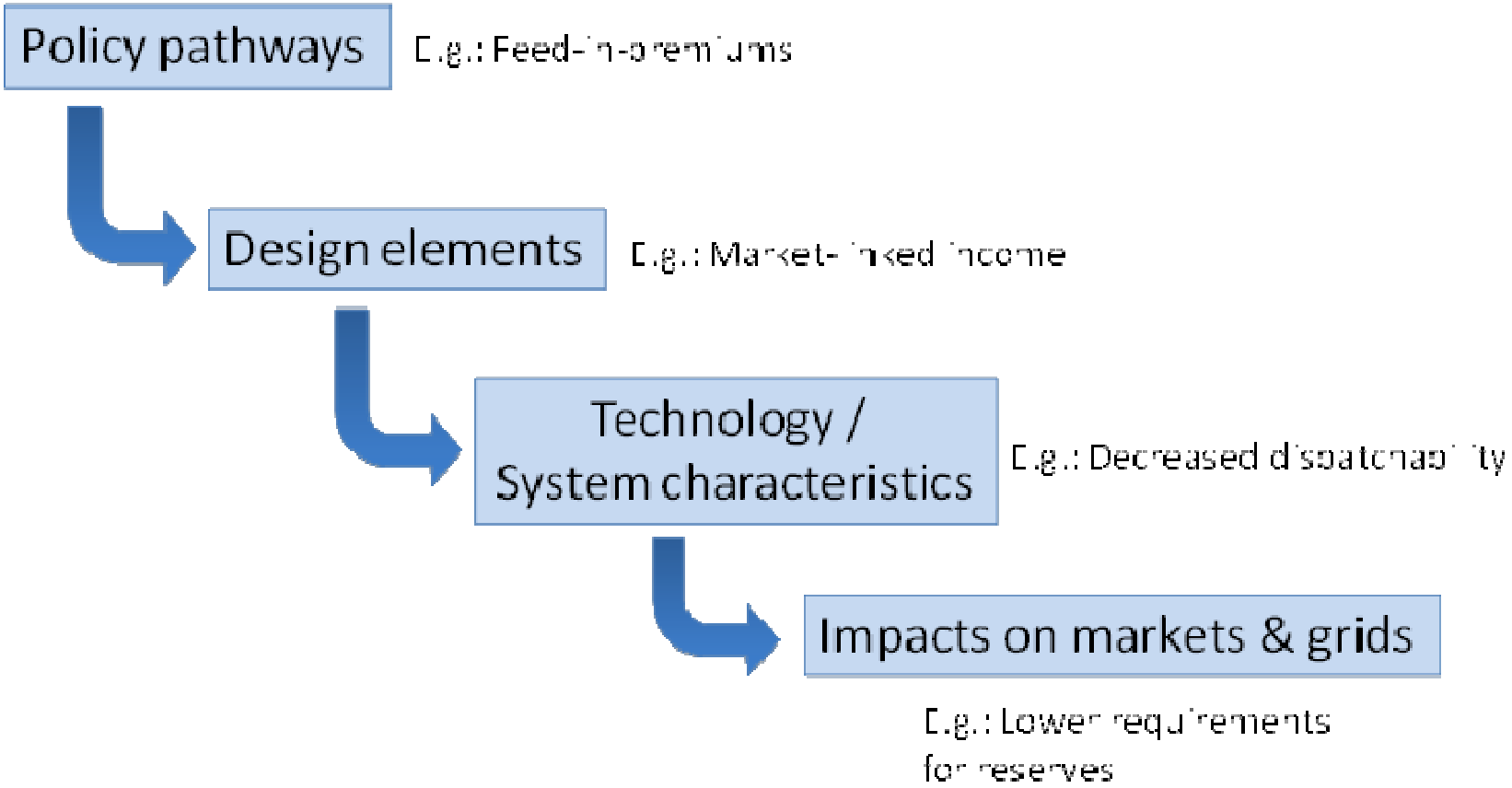
Decomposition of policy pathways to market (and gird) impacts



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Design elements of policy pathways

FIT	FIP	TEN	QUO banding	QUO	ETS
Fixed (Feed-in) tariff	Feed-in premium	Tendering for large-scale RES	Quota with banded TGC	Quota with TGC	no dedicated support for RES
Common design elements					
Duration of support					*No elements applicable*
Plant size limits					
Financial burden falling either on consumers or taxpayers					
Technologies eligible for support (all vs. only new plants)					
Instrument-specific design elements					
Flow of support*					*No elements applicable*
Cost-containment mechanisms		Timing of tendering rounds	Minimum TGC prices		
Support adjustments**		Recycling of proceeds	Guaranteed headroom		
Demand orientation	Cap / Floor	Deposit/ guarantee/penalty	Distribution of proceeds from penalty		
Technology-specific support level		Organisation of tender	Credit multipliers / Carve-outs		
Size-specific support level					
Location-specific support level					
Purchase obligation			Banking / Borrowing		
Forecast obligation					

* Constant or decreasing support levels over time for one explicit plant

** Includes approach (Periodic revisions; Degression; Cap-based adjustments) and frequency of adjustments

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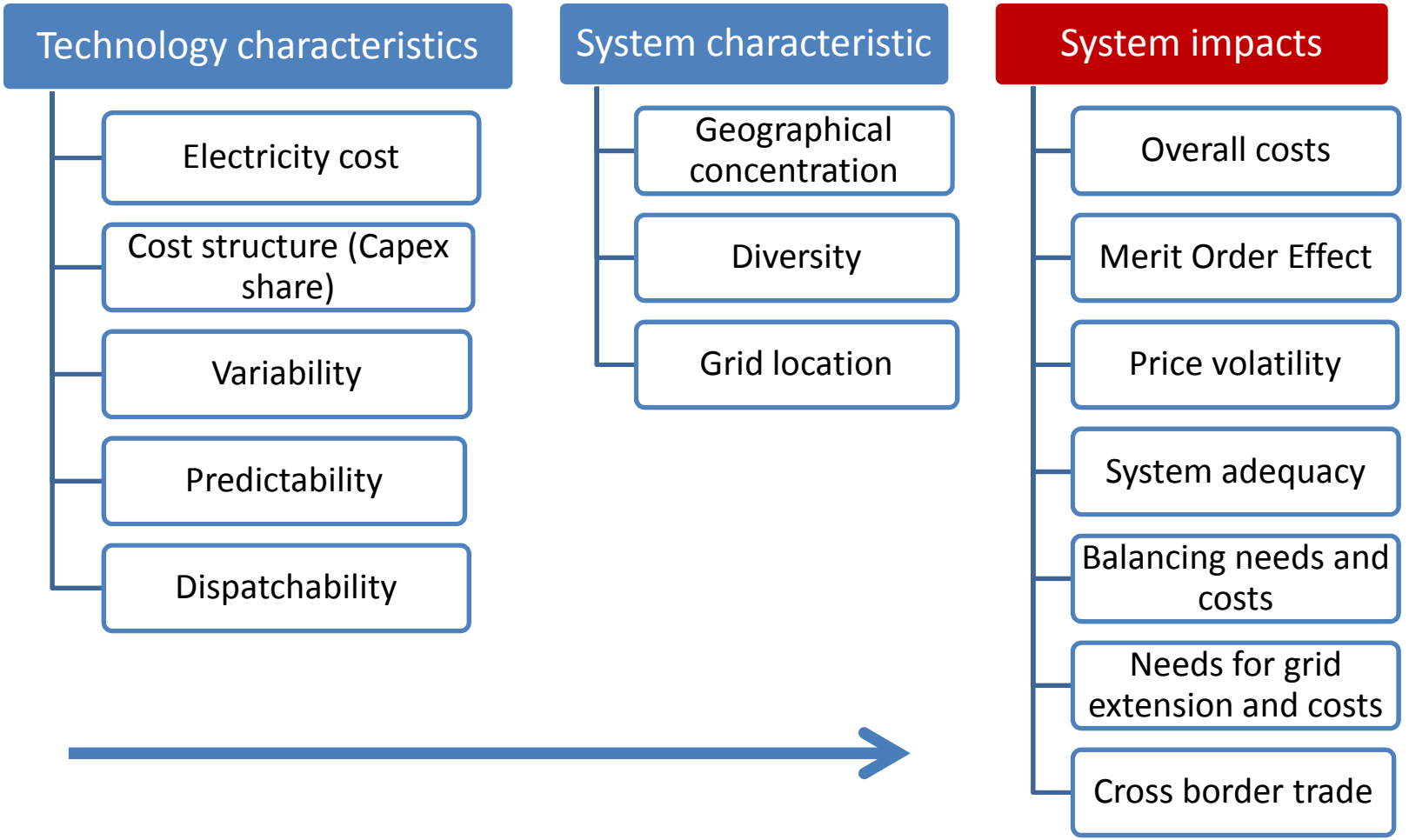
Impact of technology characteristics on the electricity system



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Variability of RES generation and flexibility of power plant operation

- Massive increase of short term variations
- Assessment of German system indicates 5 – 6 GW residual load change within 15 minute time scale (RES scenario 2020/2030 with >35 % resp. >60 %)
- Controllability and predictability will be key for future system operation

German electricity system	Year	Max. Variation (residual load) in GW		
		¼ h	1 h	4 h
With demand decrease	2020	4,9	11	32
	2030	5,4	14	37
Constant demand	2020	5,7	13	37
	2030	6,6	17	45

Source: Borggrefe & Neuhoff, 2011

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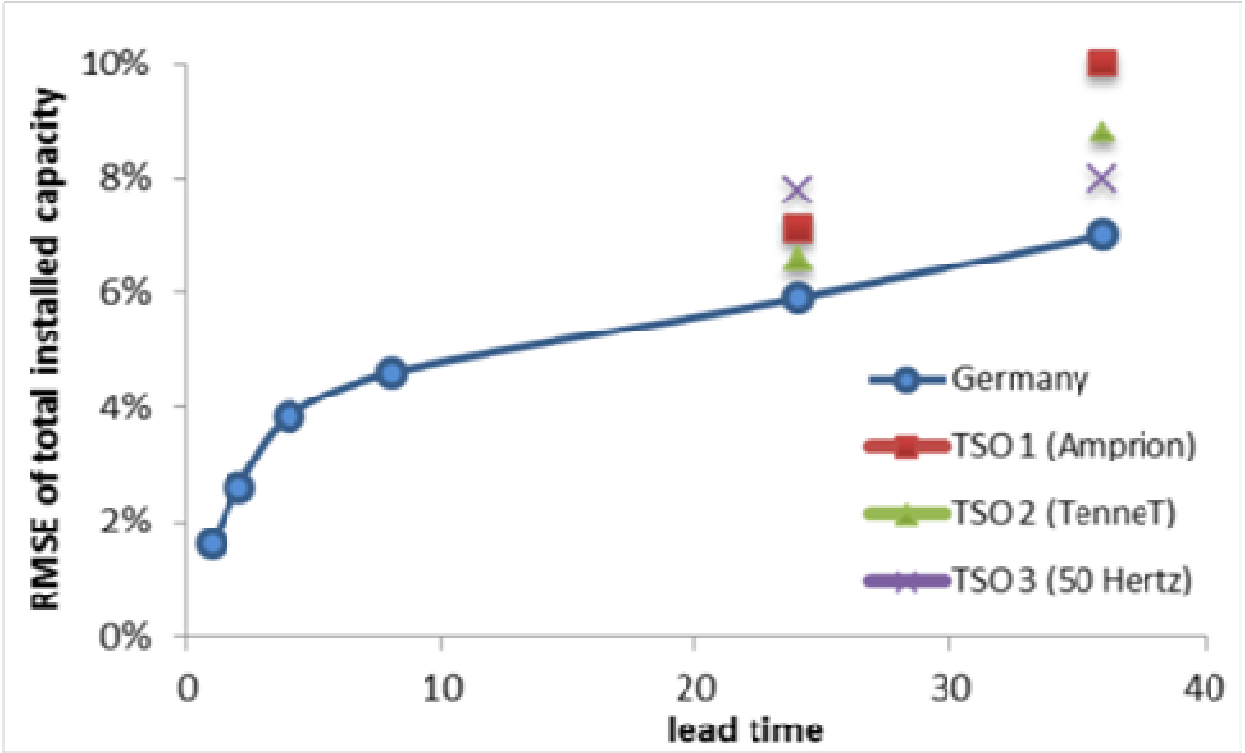
Requirements for operating reserves and ancillary services

Relevant measures:

- Coordinated and larger balancing zones
- Requirements for RES to support voltage control
- Integration of RES into frequency control
- Short term adaption to RES output

Improvement of wind forecast accuracy closer to real time
for Germany and three transmission zones



Source: Borggrefe & Neuhoff, 2011

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Negative market prices

- Negative market prices have been observed in power exchanges with high RES generation
- Two major reason can be identified:
  - For thermal units it is very costly or technically difficult to reduce its output for a short time period (1 – 2 hours). In this situations they can bid negative prices to avoid a shutdown
  - Generators (typically RES generators) receive productions tax credits, premiums, etc. on the generation sold. They are willing to bid negative prices until the negative value of their incentive
- Measures to avoid negative prices are e.g. price floors or more complex pricing schemes

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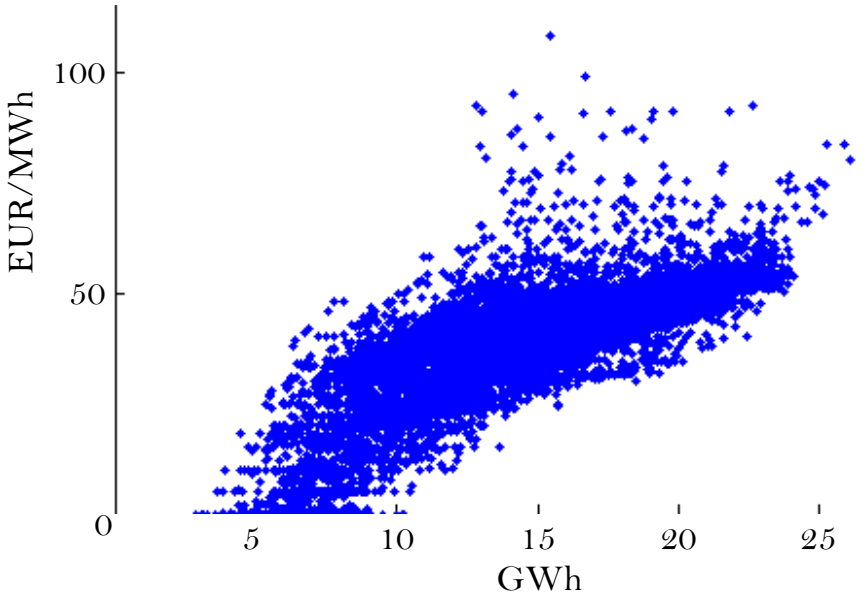
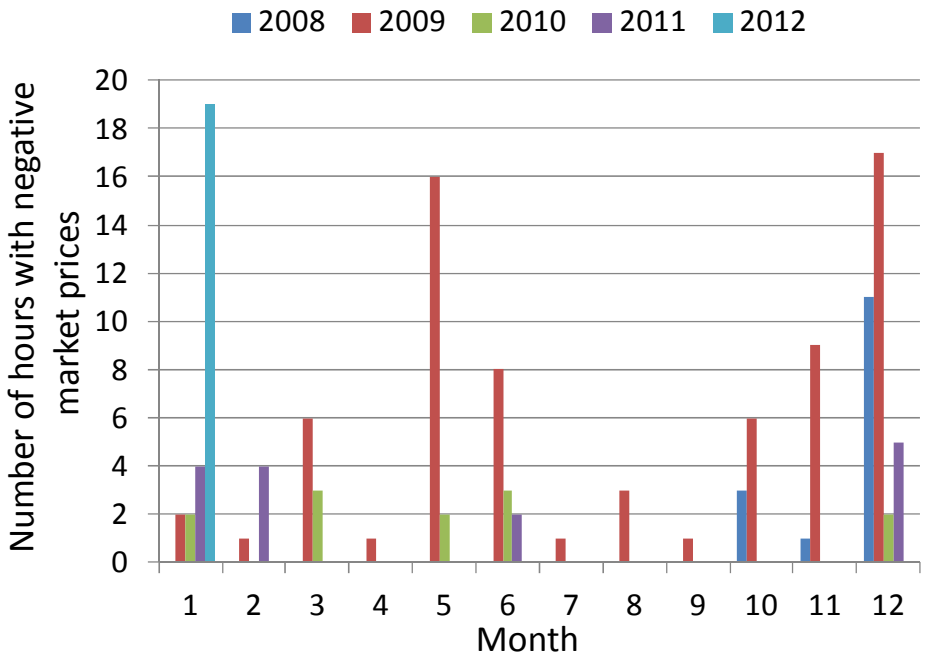
Market examples for market prices in Germany and Spain

- Occurrence of negative market price depends on market design
- In Germany: Regulatory regime to curtail RES generation at a specific level, since 2012 additionally direct marketing of RES with curtailment at minus the market premium

Spanish market price 2010



Negative market prices in Germany



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Market simulations with PowerACE

- First assessment of market development in Germany
- Scenario is based on **preliminary assumptions** on future development:
  - RES generation increase from 30 % in 2020 to 70 % in 2030 and to 80 % in 2050
  - Fuel prices increases until 2025 and decreases slightly afterwards
  - CO2-price stays below 50 €/t until 2030 and increases above 100 €/t after 2040

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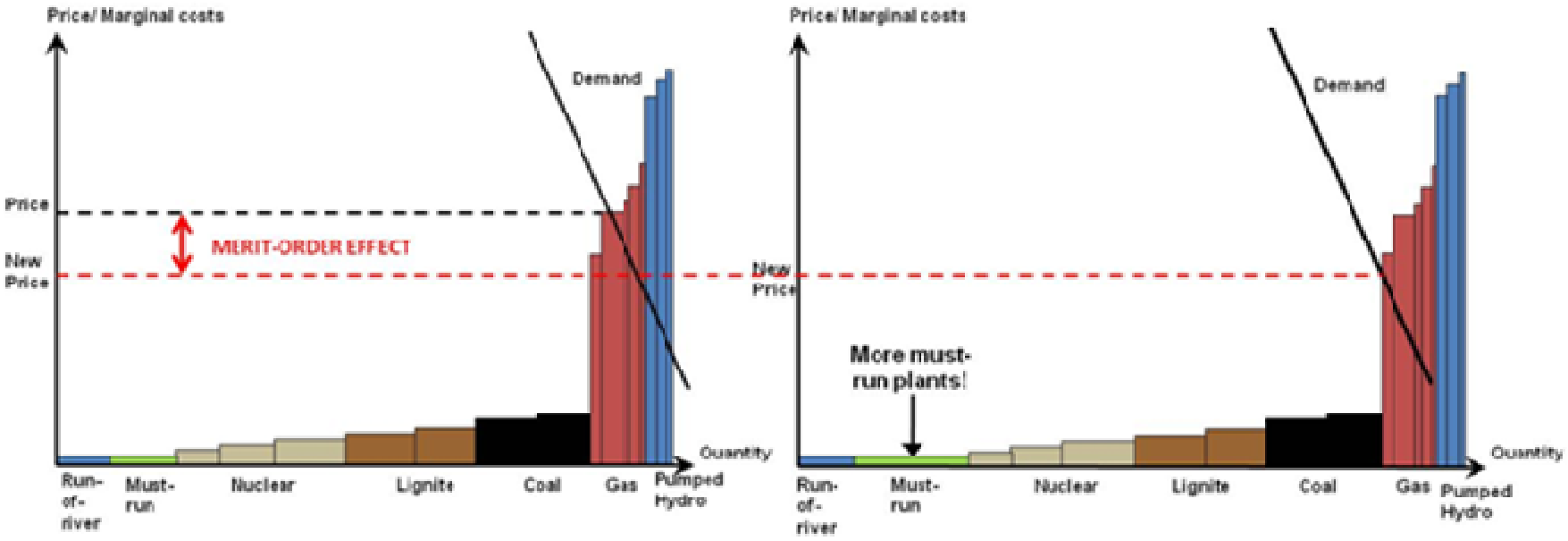
Market simulations for Germany – Merit order effect and price building



Source: Linares et al. 2012

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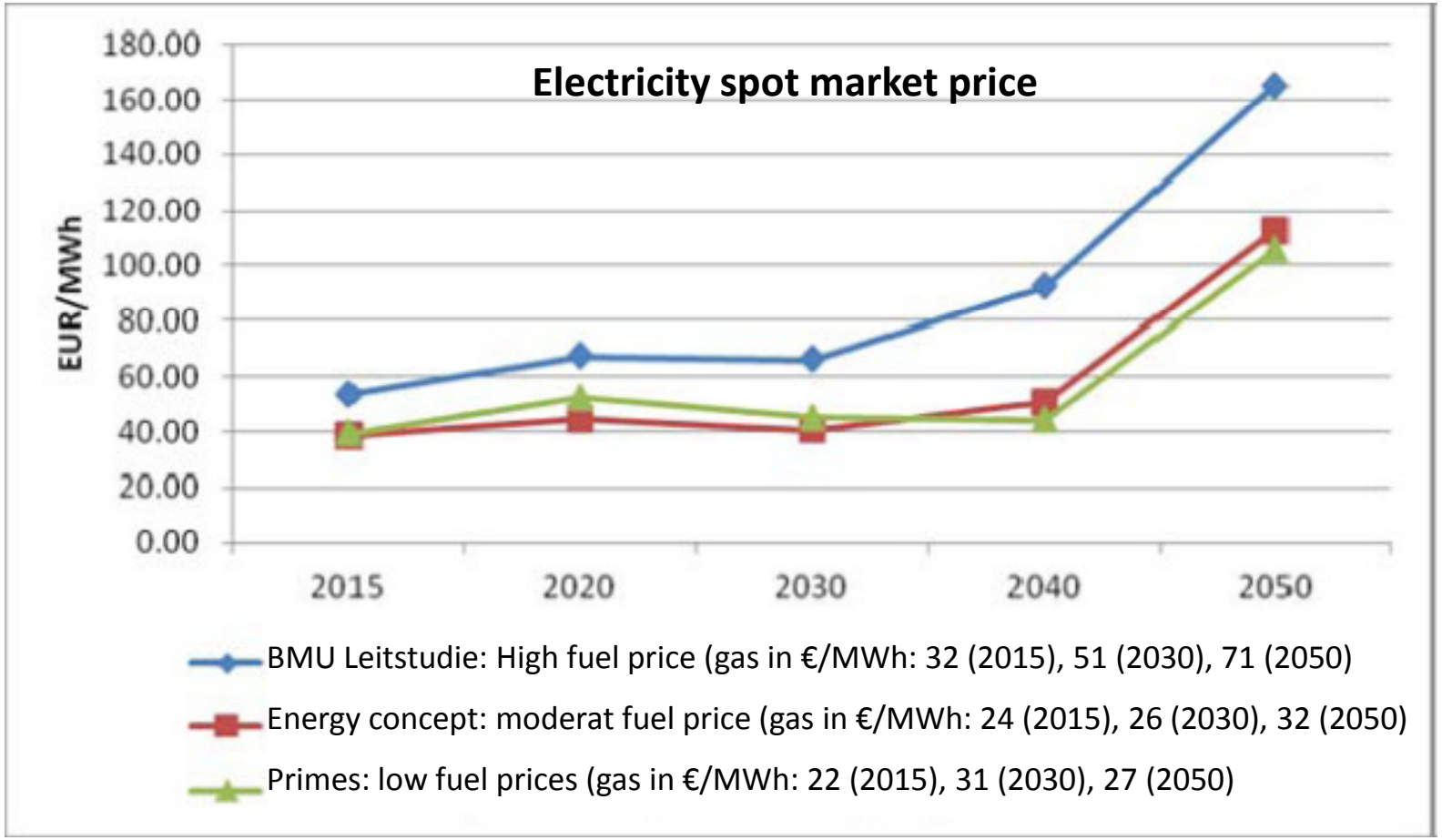
Market simulations for Germany – Preliminary results



Source: PowerACE Simulation results

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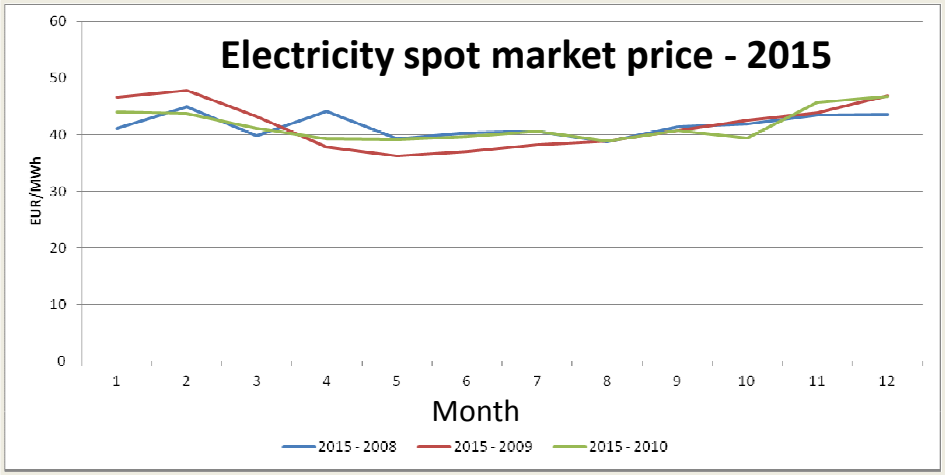
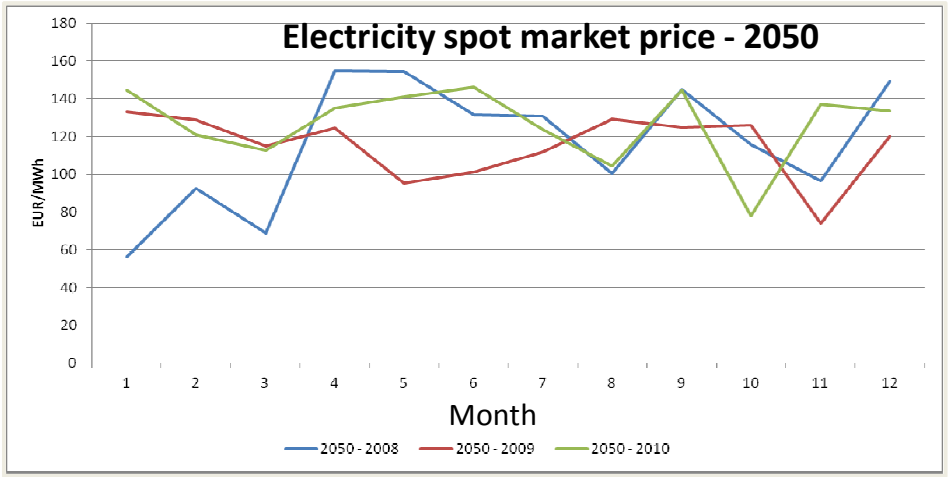
Preliminary results on market simulations for Germany



Source: PowerACE Simulation results

- Monthly market price in 2015
- Yearly average:
  - 2015_08: 39 EUR/MWh
  - 2015_09: 39 EUR/MWh
  - 2015_10: 39 EUR/MWh

- Monthly market price in 2050
- Yearly average:
  - 2050_08: 108 EUR/MWh
  - 2050_09: 106 EUR/MWh
  - 2050_10: 116 EUR/MWh



Source: PowerACE Simulation results

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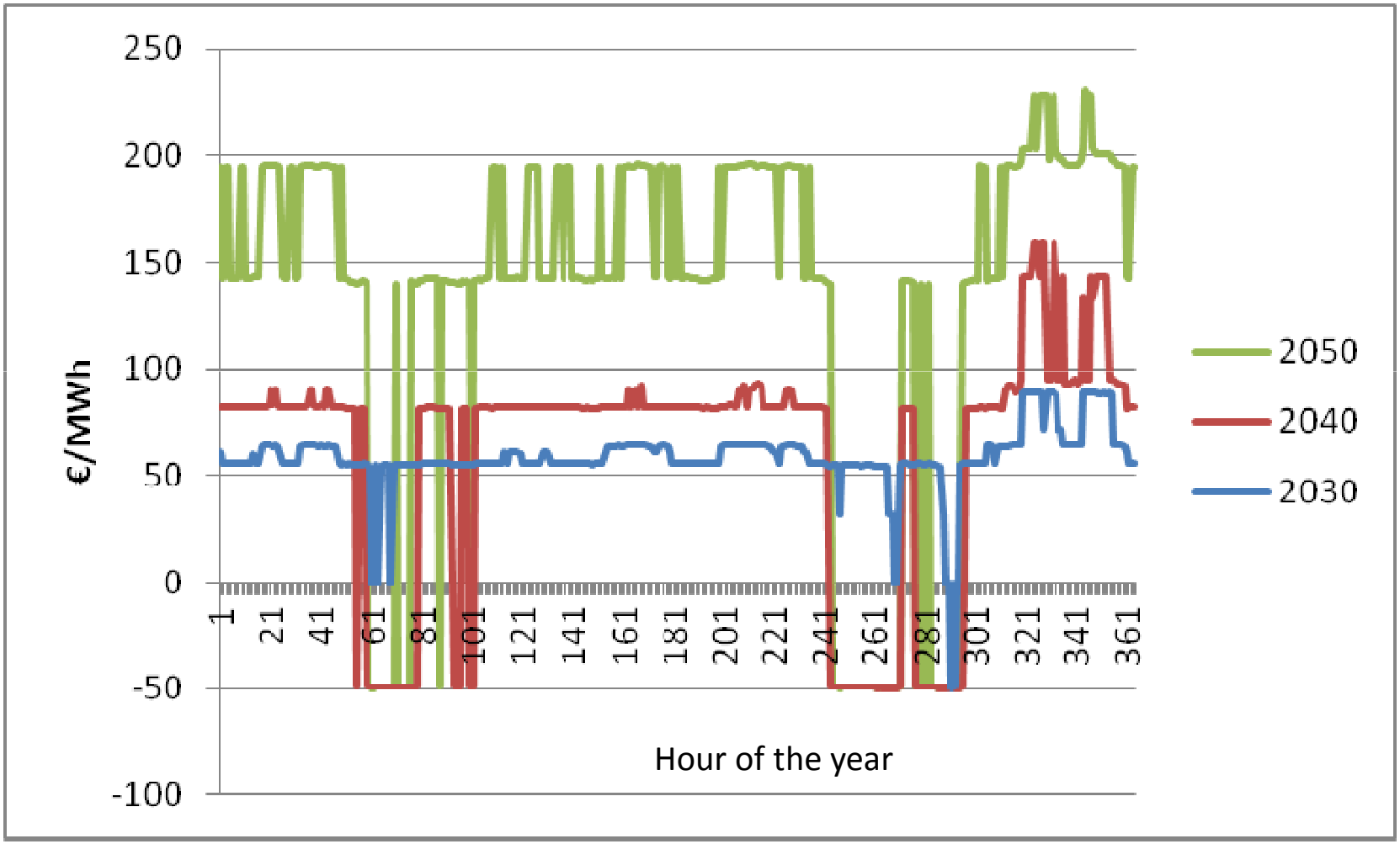
Simulations of spot market price for Germany



Source: PowerACE Simulation results

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Market simulations for Germany (preliminary results)

		2015	2030	2040	2050
RES share	%	25	68	80	81
Mean spot market price	€/MWh	39,34	44,89	44,22	105,68
Spot market price Standard deviation	€/MWh	11,14	33,79	61,39	97,60
Prices below zero	h	0	865	2587	2376
Surplus generation	TWh	0	3,4	11,5	11,8
RES market value related to mean spot market price	%	1,00	0,82	0,58	0,71

Source: PowerACE Simulation results

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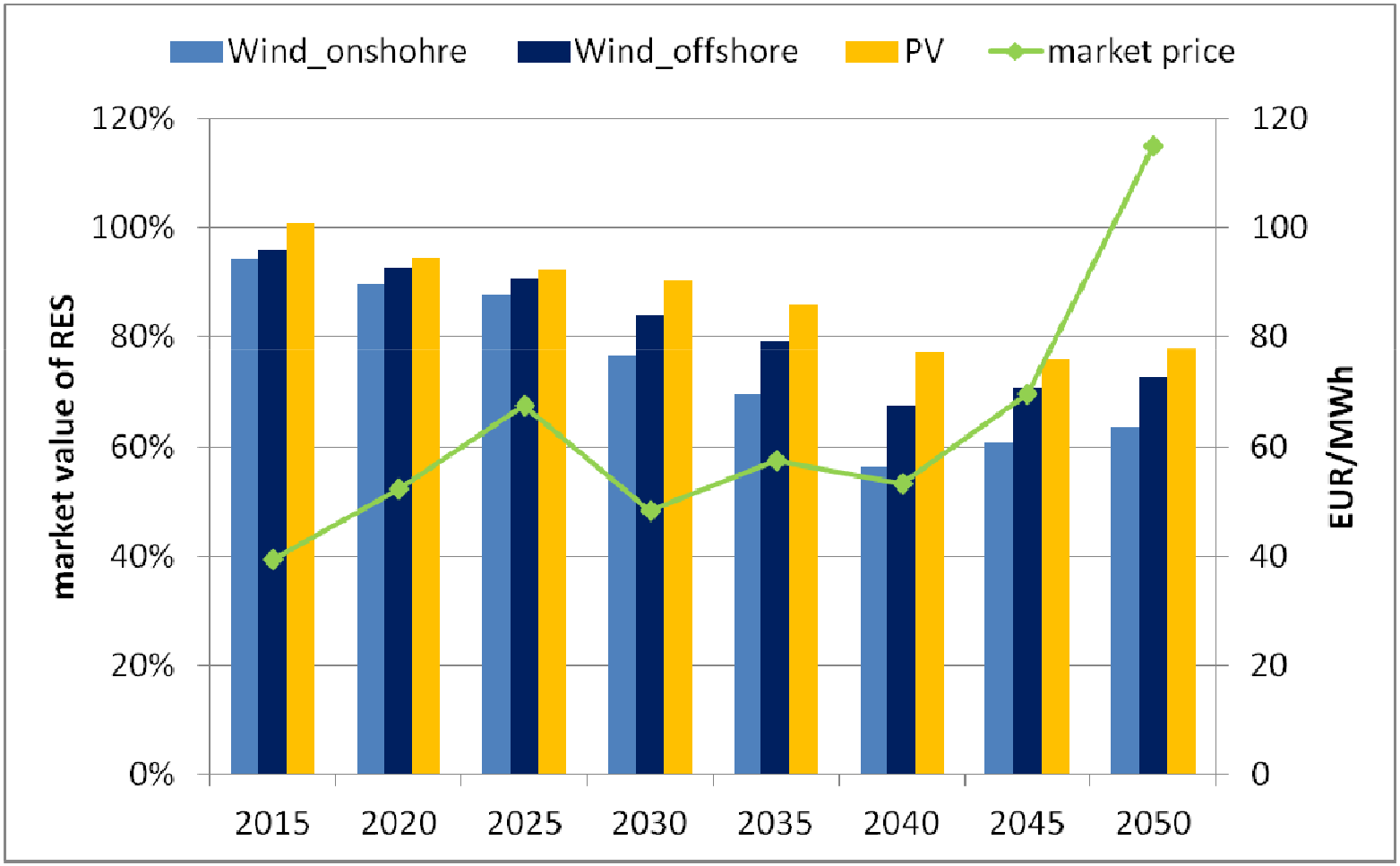
Market value of RES technologies (preliminary results)



Source: PowerACE Simulation results

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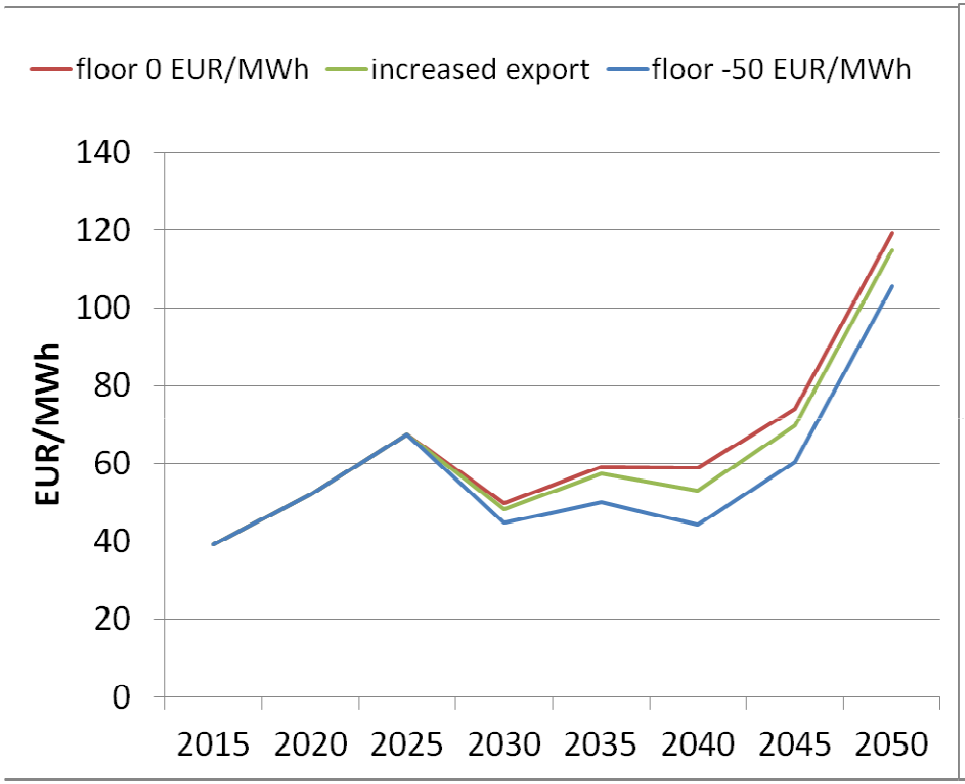
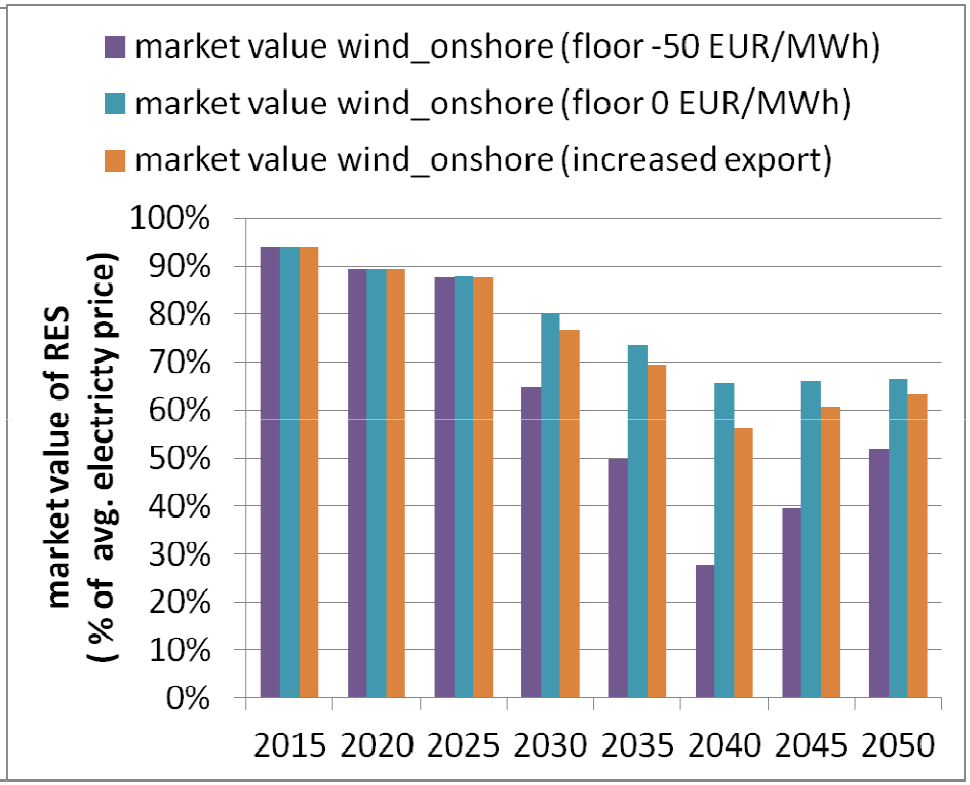
Impact of increased exports or different floor prices





- Increased export
- Generation surplus:
  - 2050: reduction of 11 TWh
  - 2040: reduction of 11 TWh
  - 2030: reduction of 3 TWh

- Increased export
- Hours with negative prices:
  - 2050: reduction of 1600 h
  - 2040: reduction of 1550 h
  - 2030: reduction of 610 h

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Conclusion and next steps

- High share of RES will impact market functioning substantially (especially with higher shares than 50 %)
- Integration of RES into balancing mechanisms is of high importance
- Market design and market coupling have a strong impact on market prices and furthermore on investment conditions for generation capacity

- Next steps:
  - Model analysis: Evaluation of major impacts of different policy paths
  - Recommendation on RES policy framework related to electricity markets

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Thanks for your attention

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