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Integrating renewables, energy markets and infrastructure

"Renewables – Policy and Market Design Challenges"

Workshop of IEA Renewable Energy Working Party & Renewable Industry Advisory Board (RIAB)

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RE-Shaping
Shaping an effective and efficient European renewable energy market

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The general challenge of RES-E expansion

Renewable electricity generation:

- creates fluctuating spatial and temporal generation patterns in the power system, resulting in
  - dynamically varying demand for conventional generation
  - complex congestion patterns in the transmission grid
- creates new challenges for the forecast of power generation resulting in new requirements for
  - flexible intraday dispatch
  - balancing products
- impacts hourly electricity prices, based on the merit-order-effect resulting in lower average prices and potentially increasing spreads

Market design

RES-E impact on electricity prices

Impact of RES-E generation on electricity prices in Germany based on hourly power system modeling

Year	Additonal RES-E generation	Effect	Reduction of Average market price
	TWh	billion €	Euro/MWh
2006	52.2	4.98(*)	5.82
2007	62.5	3.71	5.82
2008	69.3	3.58	5.83
2009	76.1	3.1	6.09

Source: Sensfuß et al ; Fraunhofer ISI

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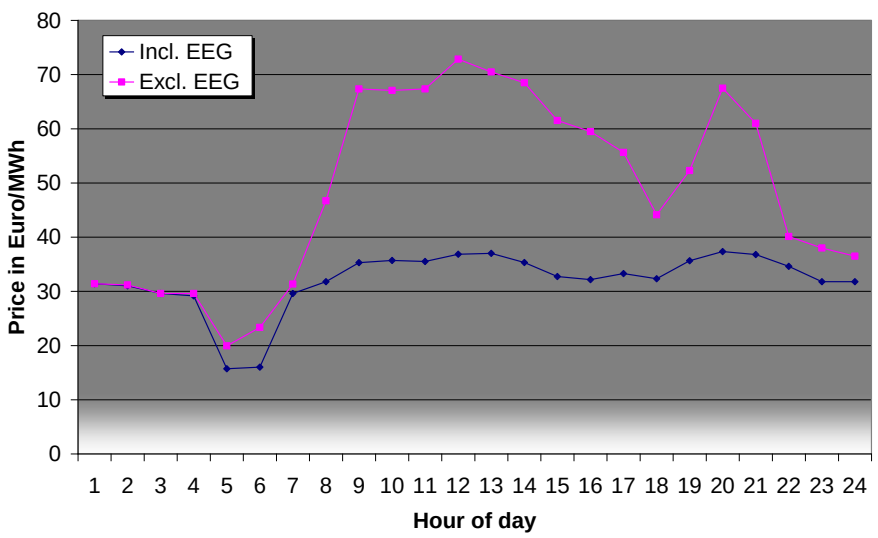
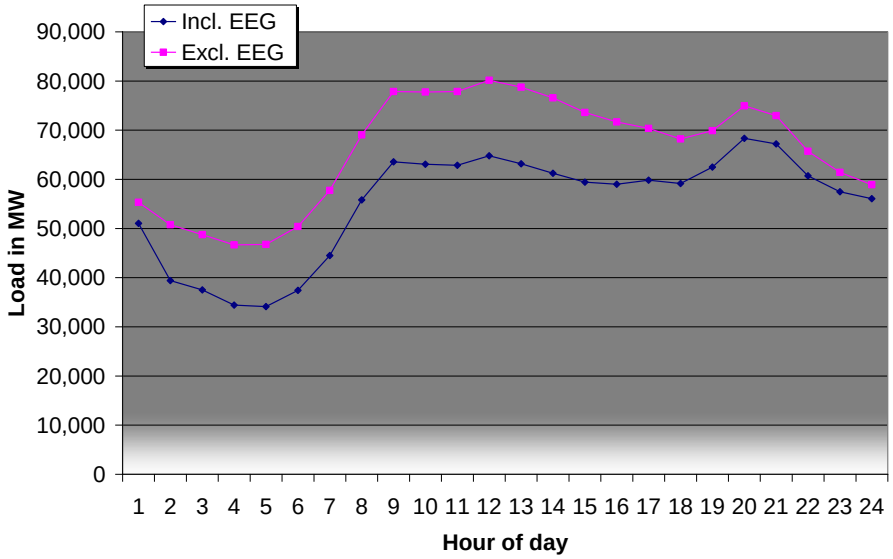
RES-E impact on electricity prices

Impact of RES-E generation on electricity prices in Germany based on hourly power system modeling





→ The price effect depends heavily on the market situation

Source: Sensfuß et al ; Fraunhofer ISI

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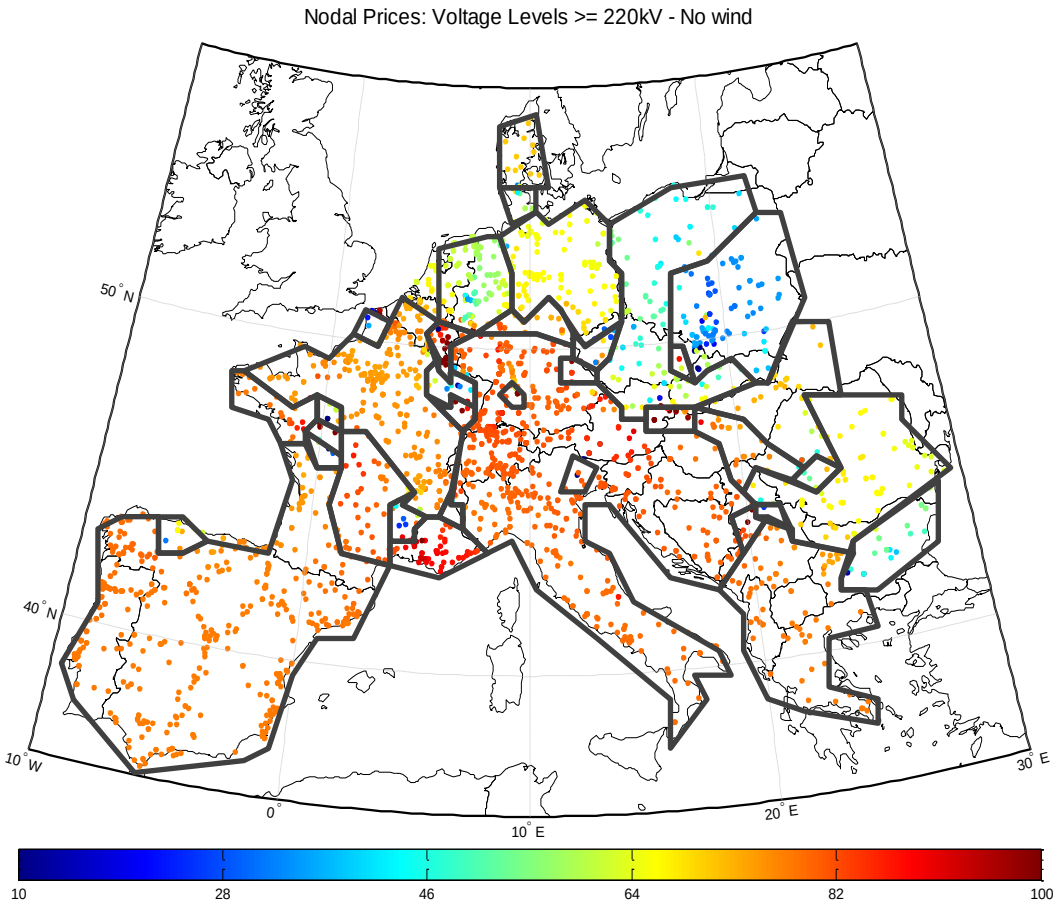
Zones with similar price change with wind output

No.wind



Source: Model results from project Re-shaping

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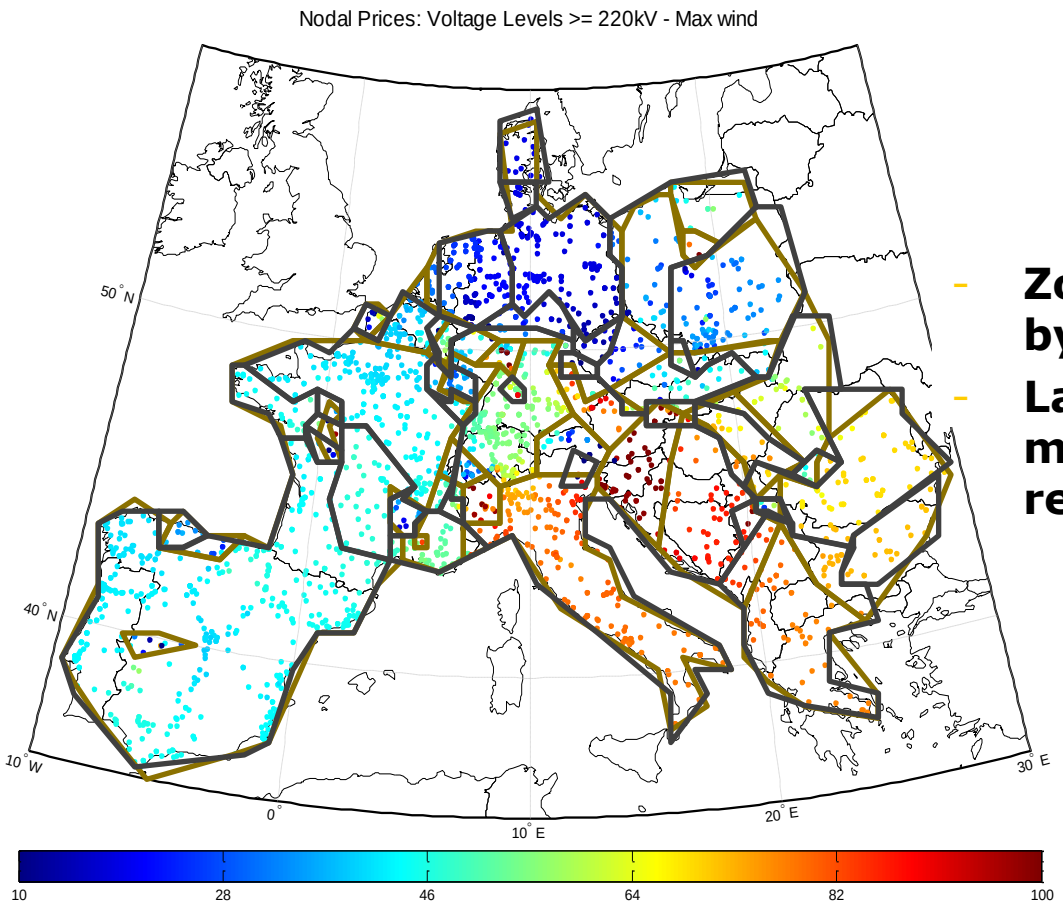
Zones with similar price change with wind output

Max wind.



- **Zones change hour-by-hour**
- **Large zones do not match physical reality.**

Source: Model results from project Re-shaping

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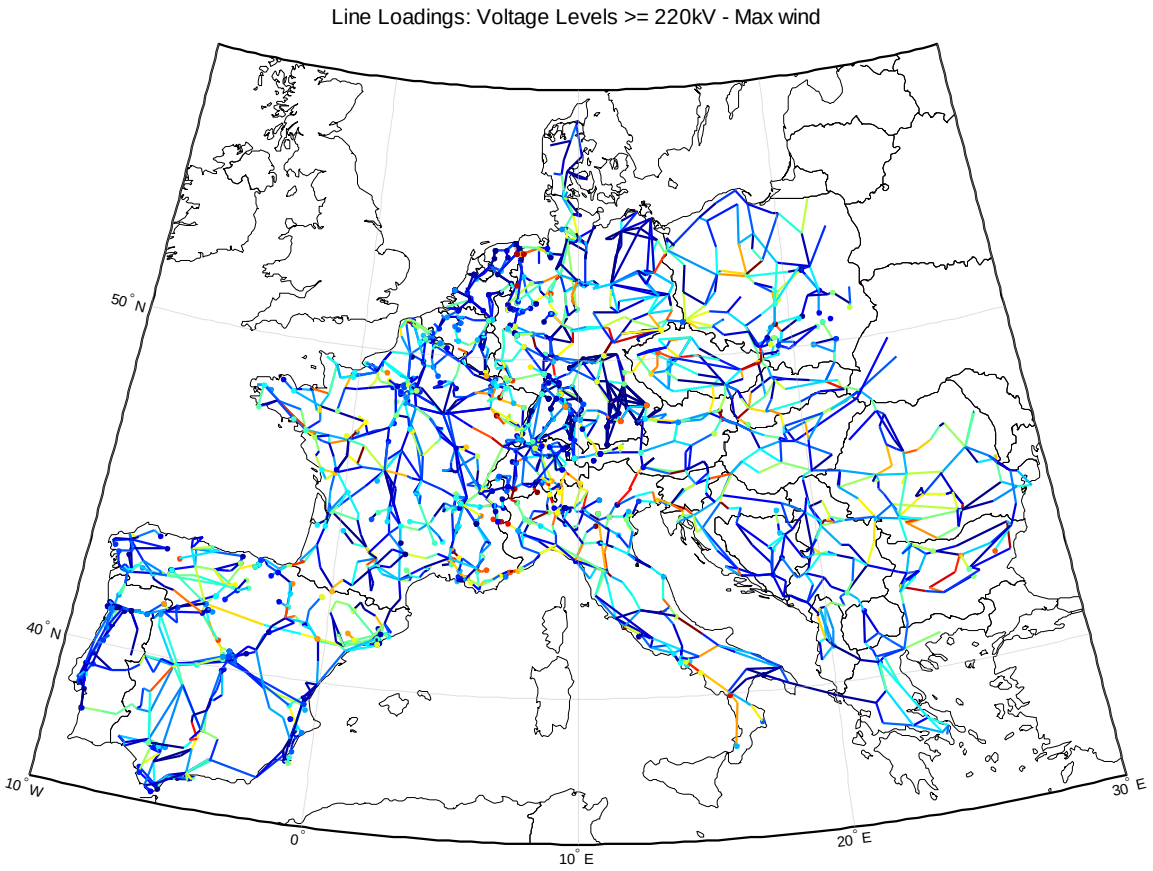
Transmission constraints exist between and within countries



Source: Model results from project Re-shaping;
congestions are indicated with red (range is from blue to red)

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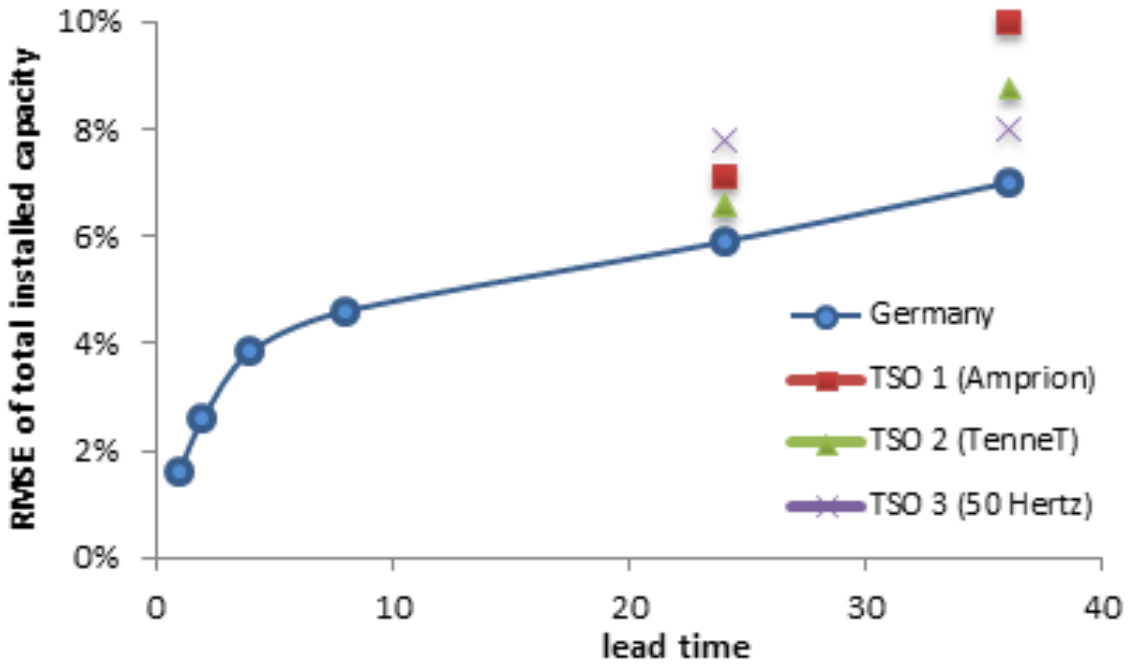
The time to trade

Wind forecasts improve substantially closer to real time



- Currently trading/transmission allocation focused day ahead
- Many power stations/grid can respond short time
- But power market design limits participation of actors

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Power market design

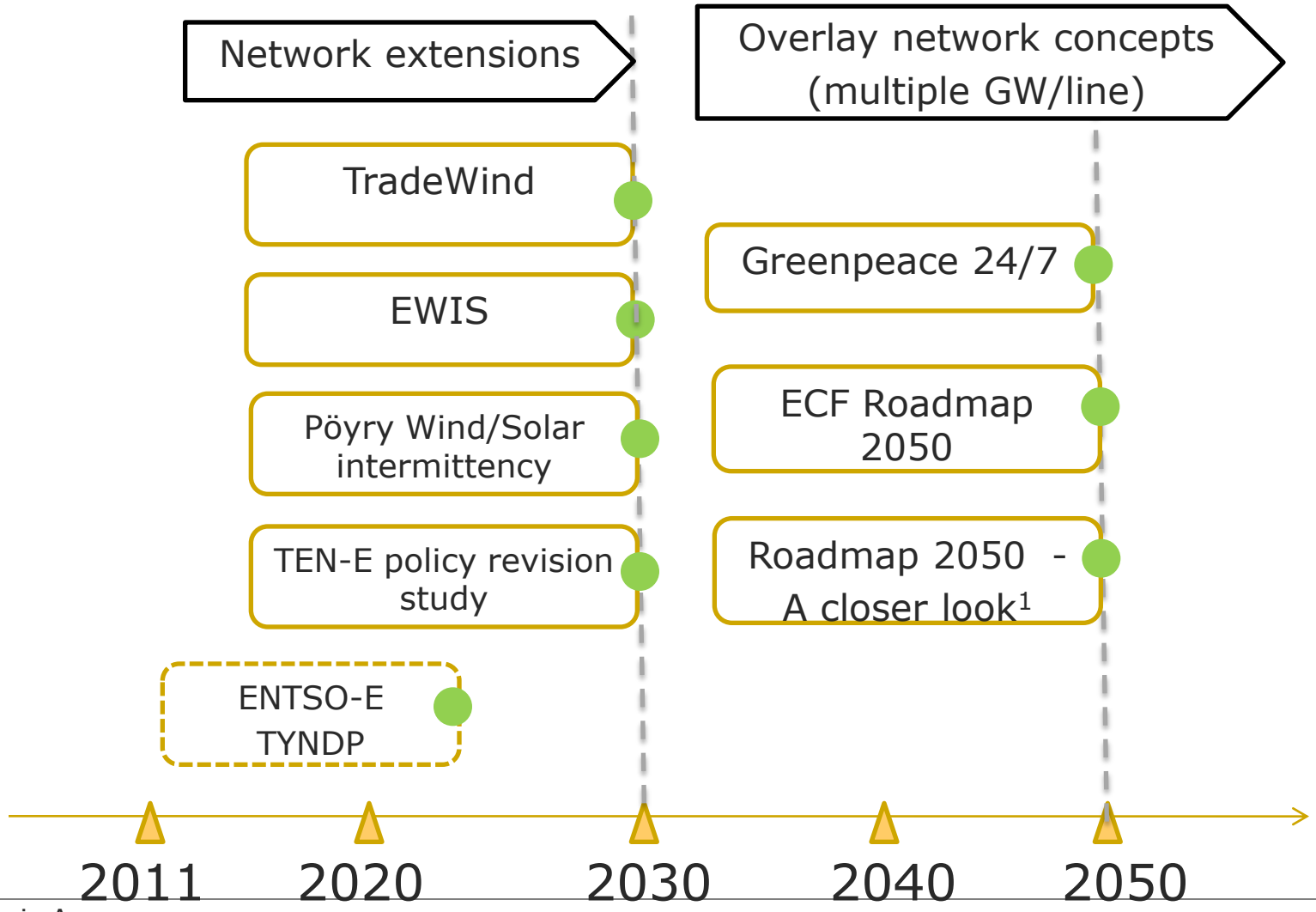
- Power markets need to accommodate the fact that wind and solar patterns vary across Europe and cause changing electricity flow-patterns and thus also a variety of different congestion patterns.
- Congestion management systems need to shift from heuristics to systematic approaches – and jointly address constraints within and between countries.
- An effective congestion management system can reduce, but not avoid, the necessity for grid investment. It also provides transparent data to inform grid expansion.

Power market design

- Because wind and solar forecasts improve intraday, effective integration requires optimization of generation, system services and transmission in same time frame.
- For short-term optimization, market designs need to improve and integrate in a common platform the allocation of generation, transmission, and system services
- A market design with long-term viability provides framework to attract innovation and investment in long-term viable technologies and systems.
- Impact of RES-E on electricity prices needs to be taken into account for future investment decisions.

Infrastructure requirements

Review of existing European network expansion studies



1) Scenario A

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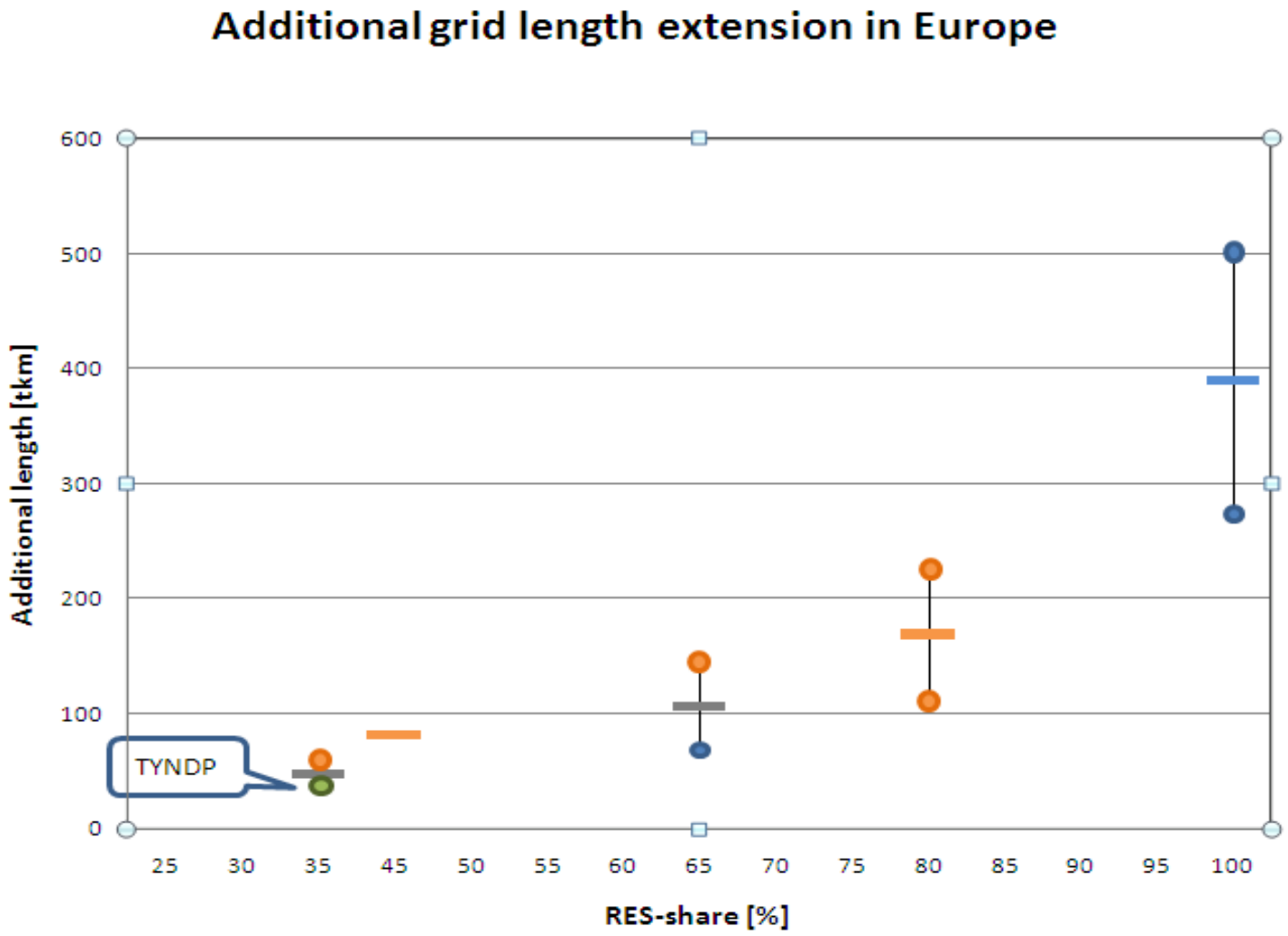
Review of existing European network expansion studies



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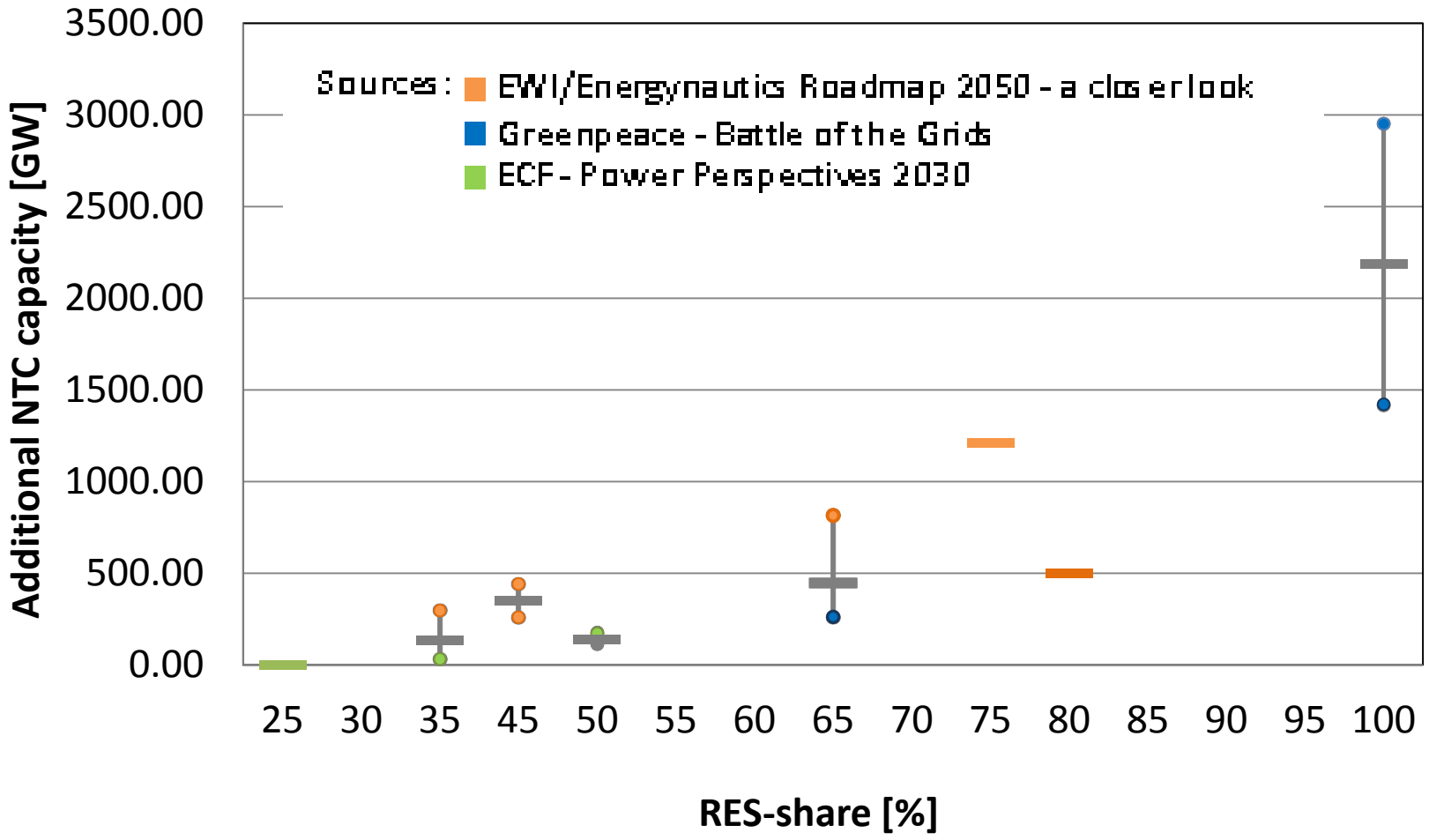
Review of existing European network expansion studies



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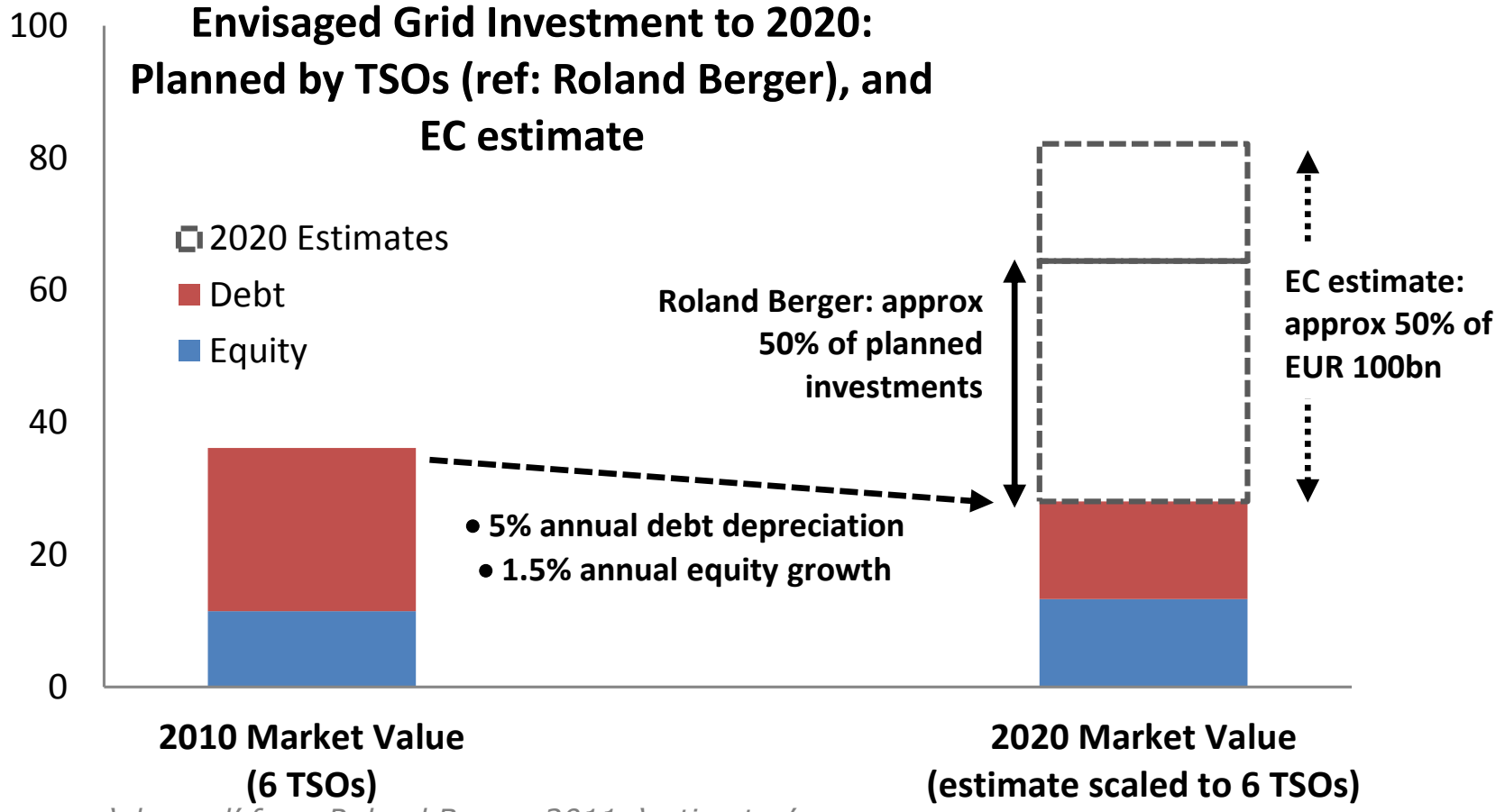
Grid 2020 – Financing Needs

6 TSOs - represent approx. 50% of current EU installed capacity: UK, FR, ES, DE (2), IT



Sources: 'planned' from Roland Berger 2011, 'estimates' from EC, 2011

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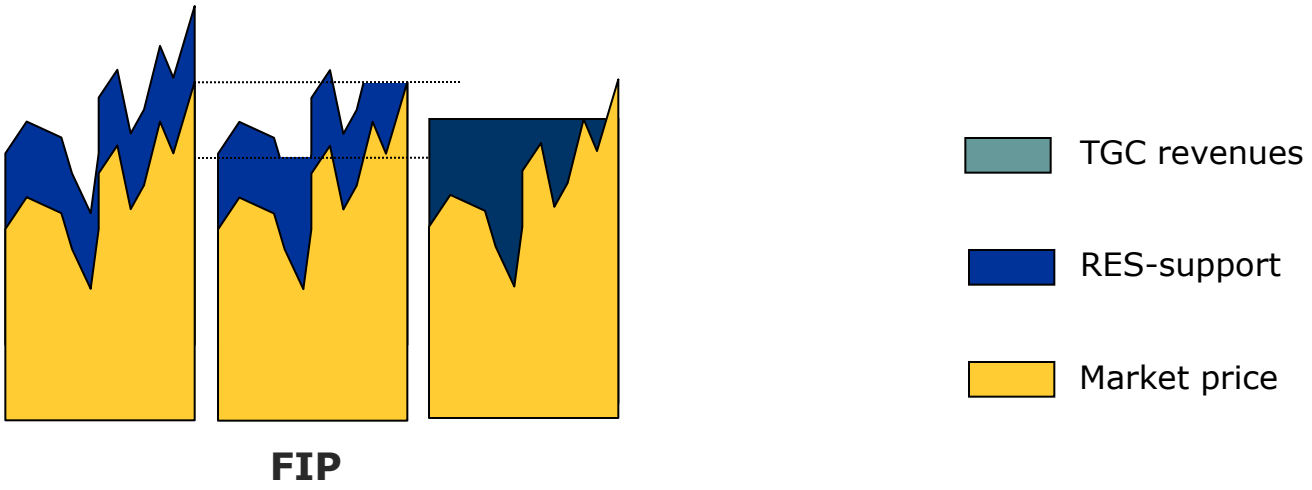
RES policy

Main RES-E support scheme options

- Fixed premium / Cap and floor / Sliding versus fixed FIT and Quota sytem based on TGC



FIP

fixed premium - cap & floor - sliding/Cfd

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Motivation for using FIP systems

Nine MS use (or plan to use) FIP systems as support scheme for RES-E

The following reasons for use of FIP were identified:

- Higher investment security as compared to TGC system
- Improved compatibility with electricity market as compared to FIT → RES generators react to market signals
- All different market places for selling RES power may be used, which may increase the value of RES
- Creativity of RES generators for creating better forecasts, new balancing products, use of storage options, optimising plant design and operation etc. can be activated

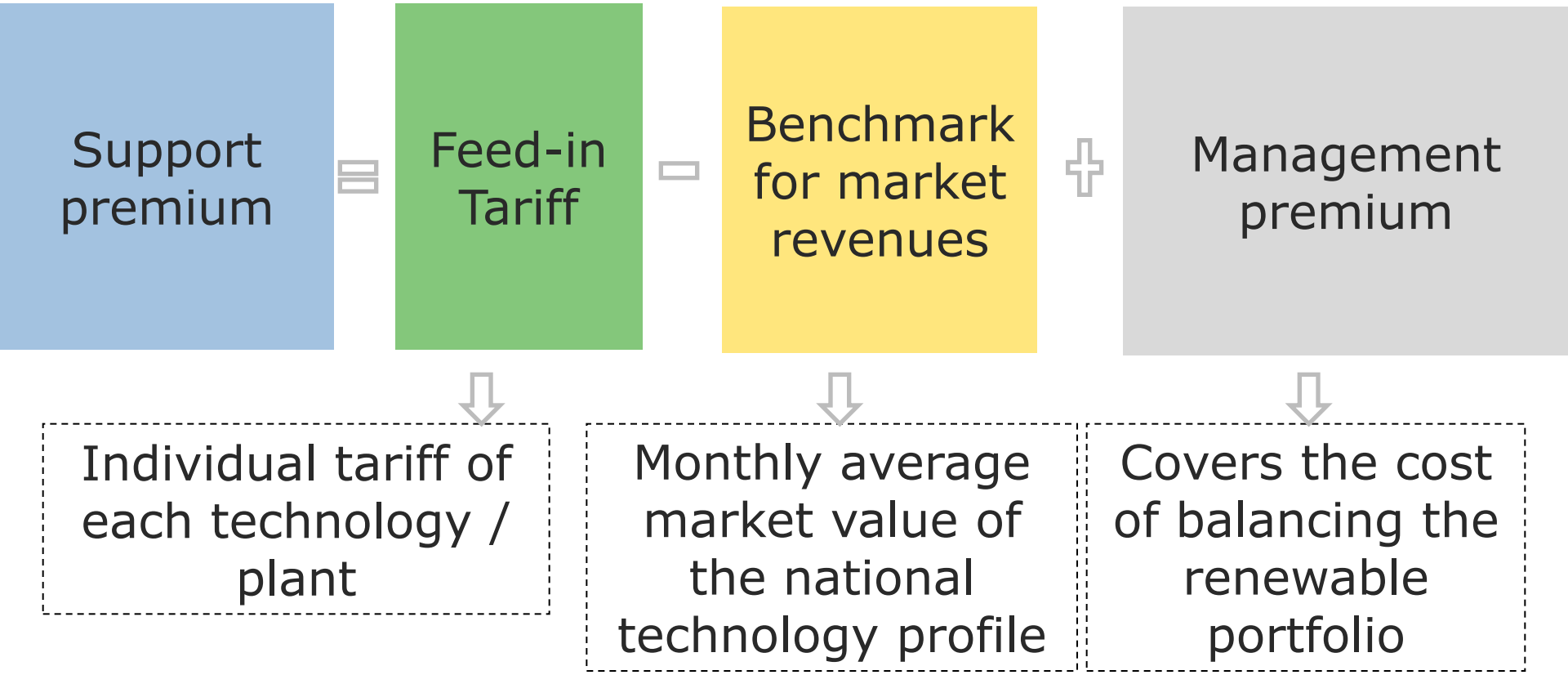
Differences in FIP design

FIP systems differ regarding:

- Mandatory or optional introduction of FIP model
  - Intervals to change between premium and alternative system
- Type of premium: fixed, cap and floor, sliding
- Methodology to determine (technology specific) reference prices
  - Period for averaging reference prices: hourly, monthly, annually
  - Consideration of value of wind / solar hourly generation at spot markets → profile factor
- Methodology to determine balancing costs
- Consideration of other fixed costs, e.g. trading platform, etc.

Floating / sliding feed-in premium in Germany

Income=Market revenues + support premium



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Conclusion

Integrating renewables, energy markets and infrastructure requires:

- **Power markets** to accommodate the natural characteristics of wind and solar resources by a more flexible and integrated design → improve design and integrate in a common platform for the allocation of generation, transmission, and system services
- **RES policy** to offer flexibility and responsiveness to market signals for RES plants by incentivising RES generators to participate in all relevant markets
- **Grid regulation** to match network extension and renewable energy deployment → all investments need to be coordinated, both from a long- and short-term planning perspective in a transparent manner

Thank you for your attention!

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RE-Shaping reports available at
www.reshaping-res-policy.eu

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