



THEMA
CONSULTING GROUP

Arndt von Schemde

UTENLANDSHANDELEN I ET SAMFUNNSØKONOMISK PERSPEKTIV

NVE Energidagene

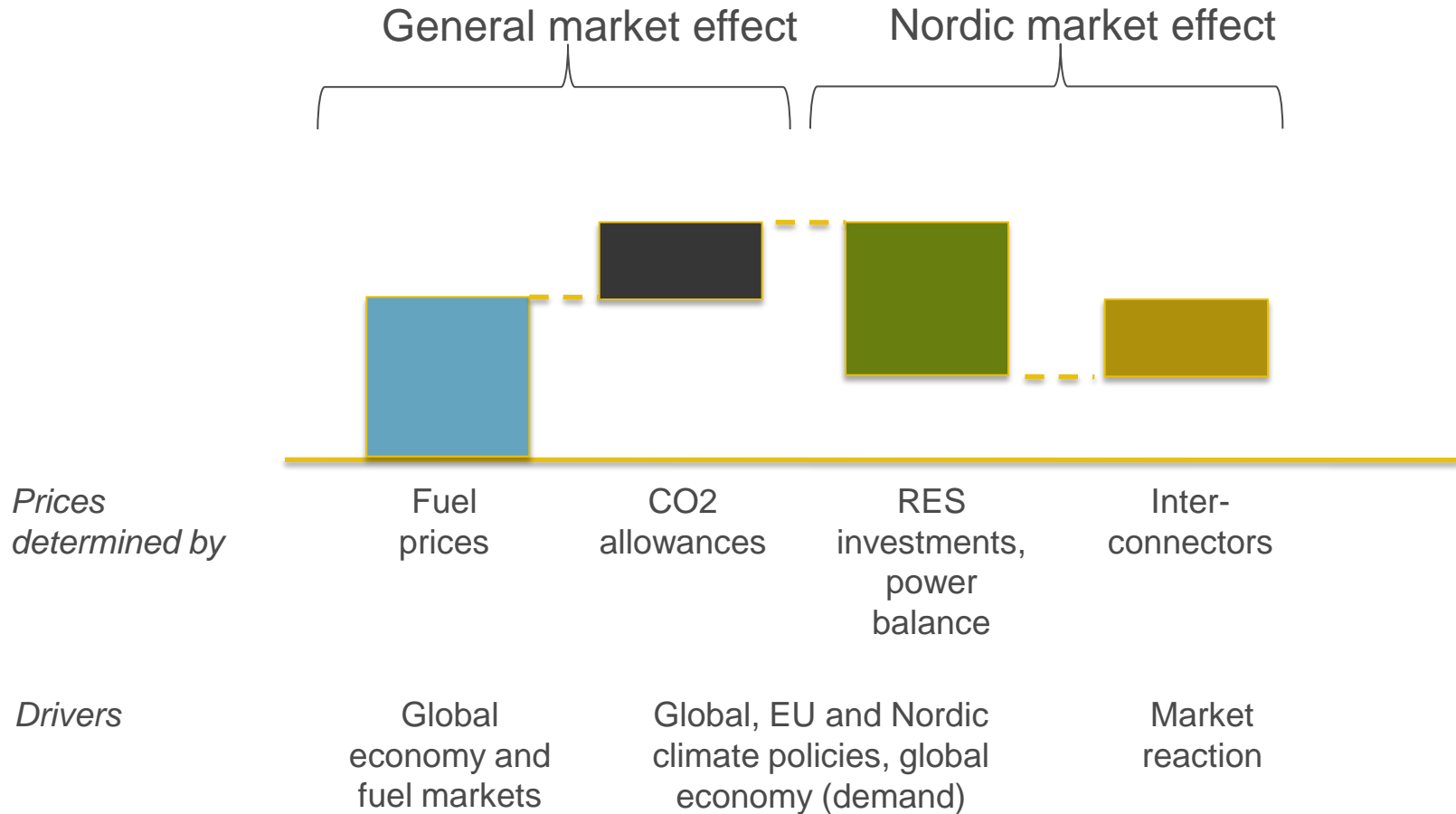
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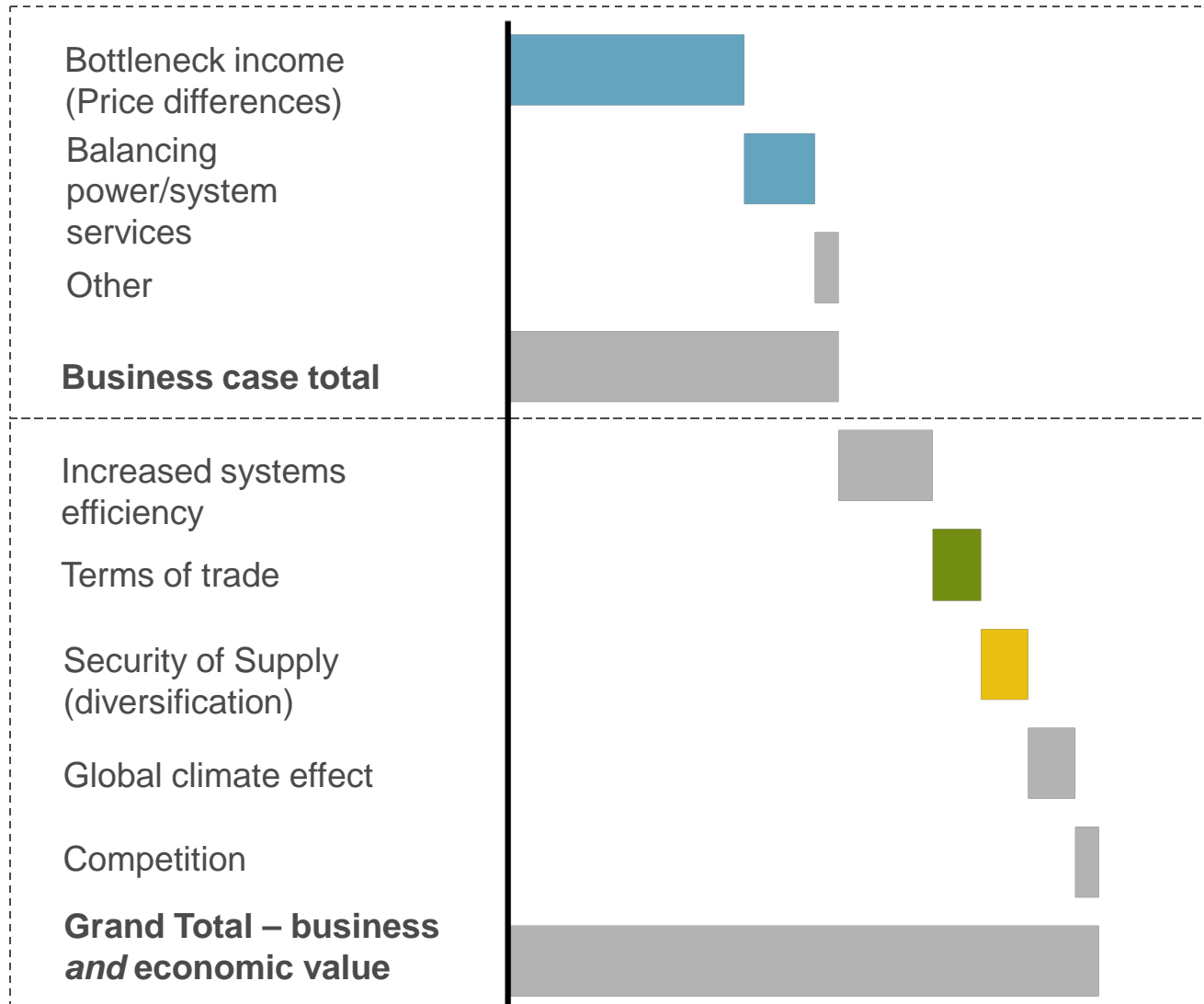
It is important to see the effect of cables in a larger context of price formation

Illustrative



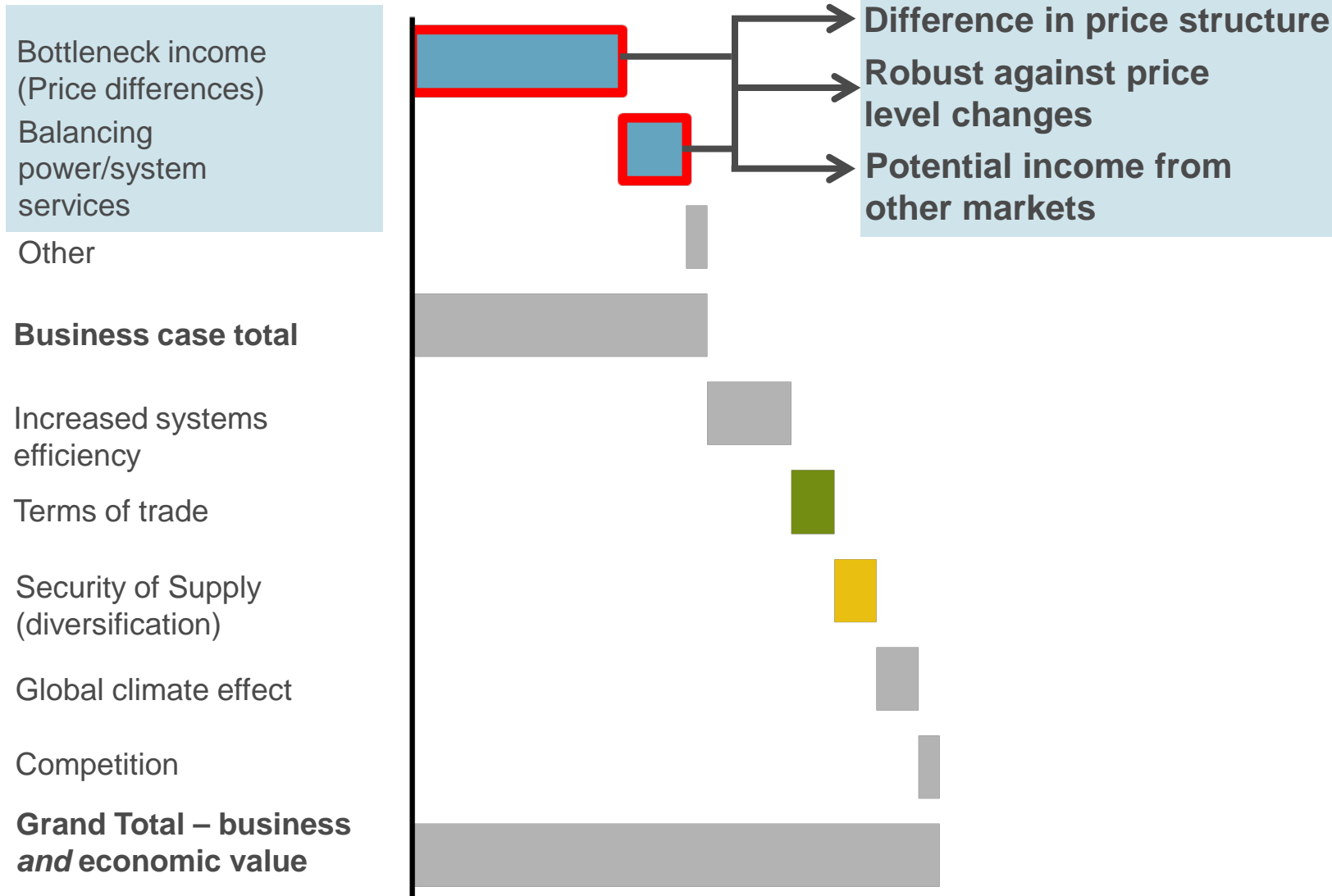
Overview: Sources of cable benefits

Illustrative

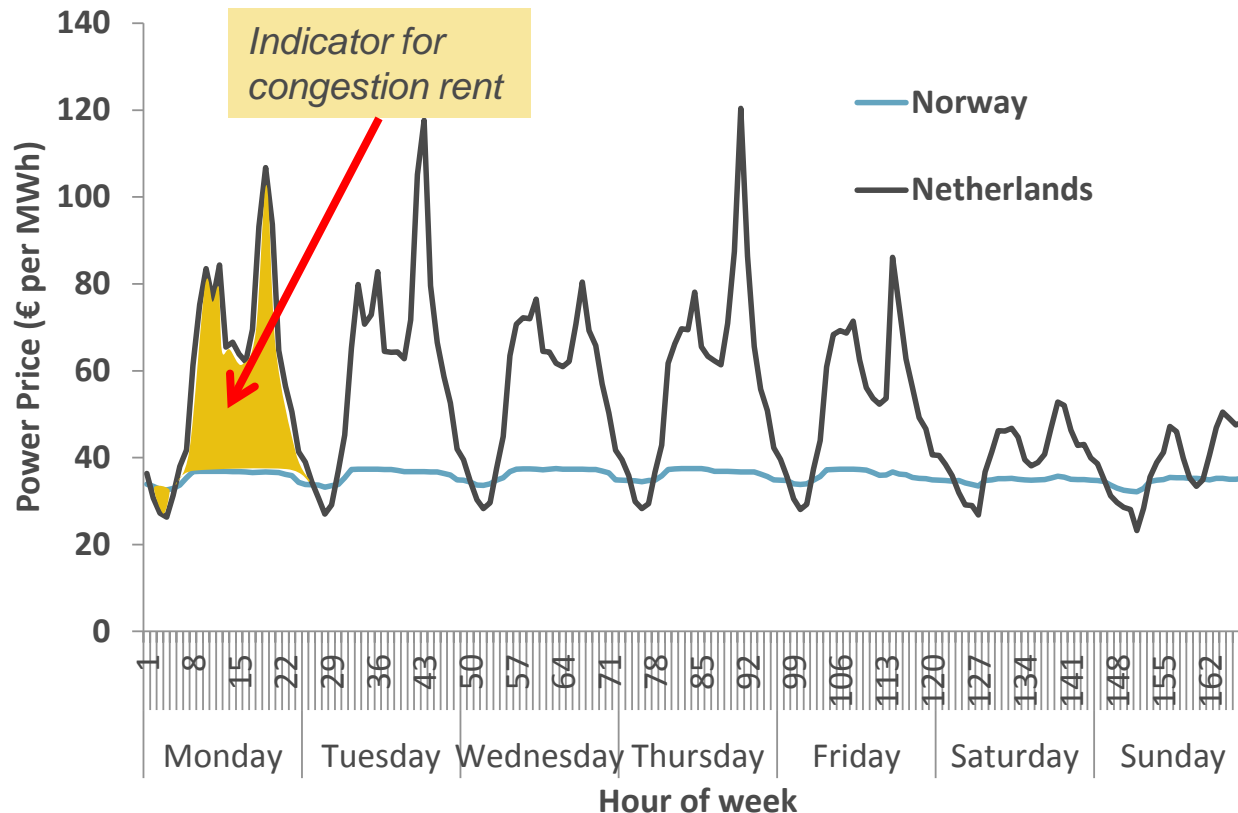


Overview: Sources of cable benefits

Illustrative



Cable income is the area between two price curves, driven by hourly price differences

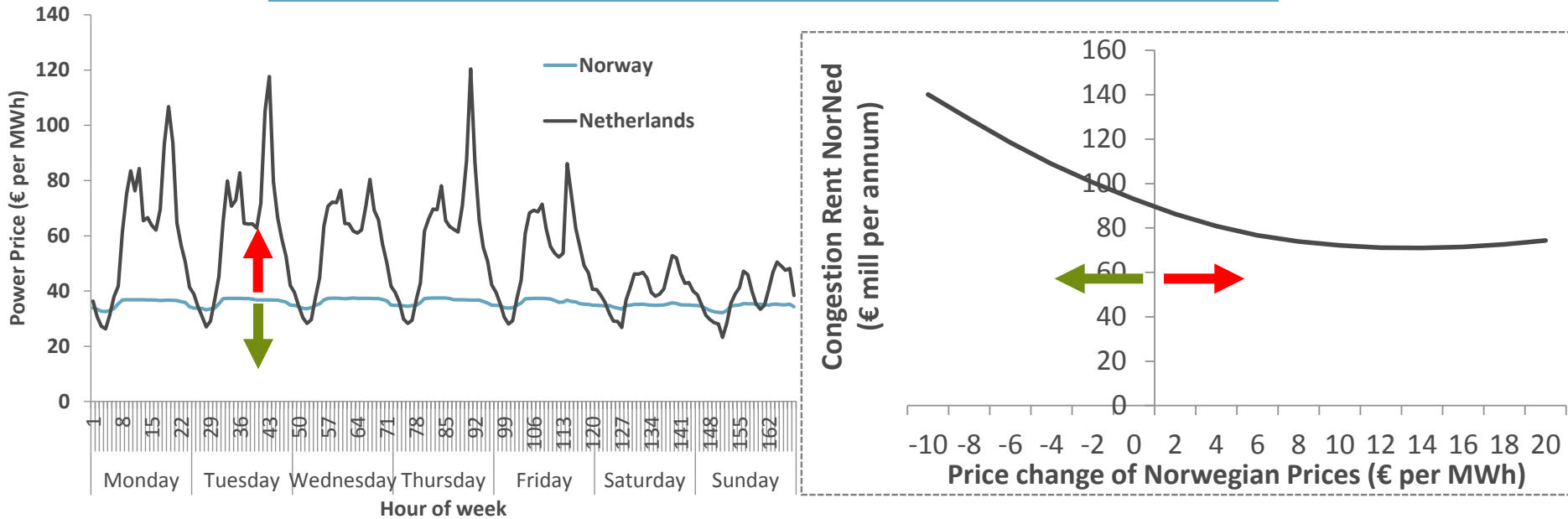


Source: THEMA Consulting, The-MA power market simulation model

- Cable income is driven by *hourly* price variations, not average price differences
- Characteristic of Nordic system: flat prices
 - Due to flexibility of water
- Characteristic of German prices: large price volatility
 - Due to wind and thermal generation

Income robust against changes in average prices as long as structures are preserved

Congestion rent income for alternative price levels



Source: THEMA Consulting Group, The-MA power market simulation model

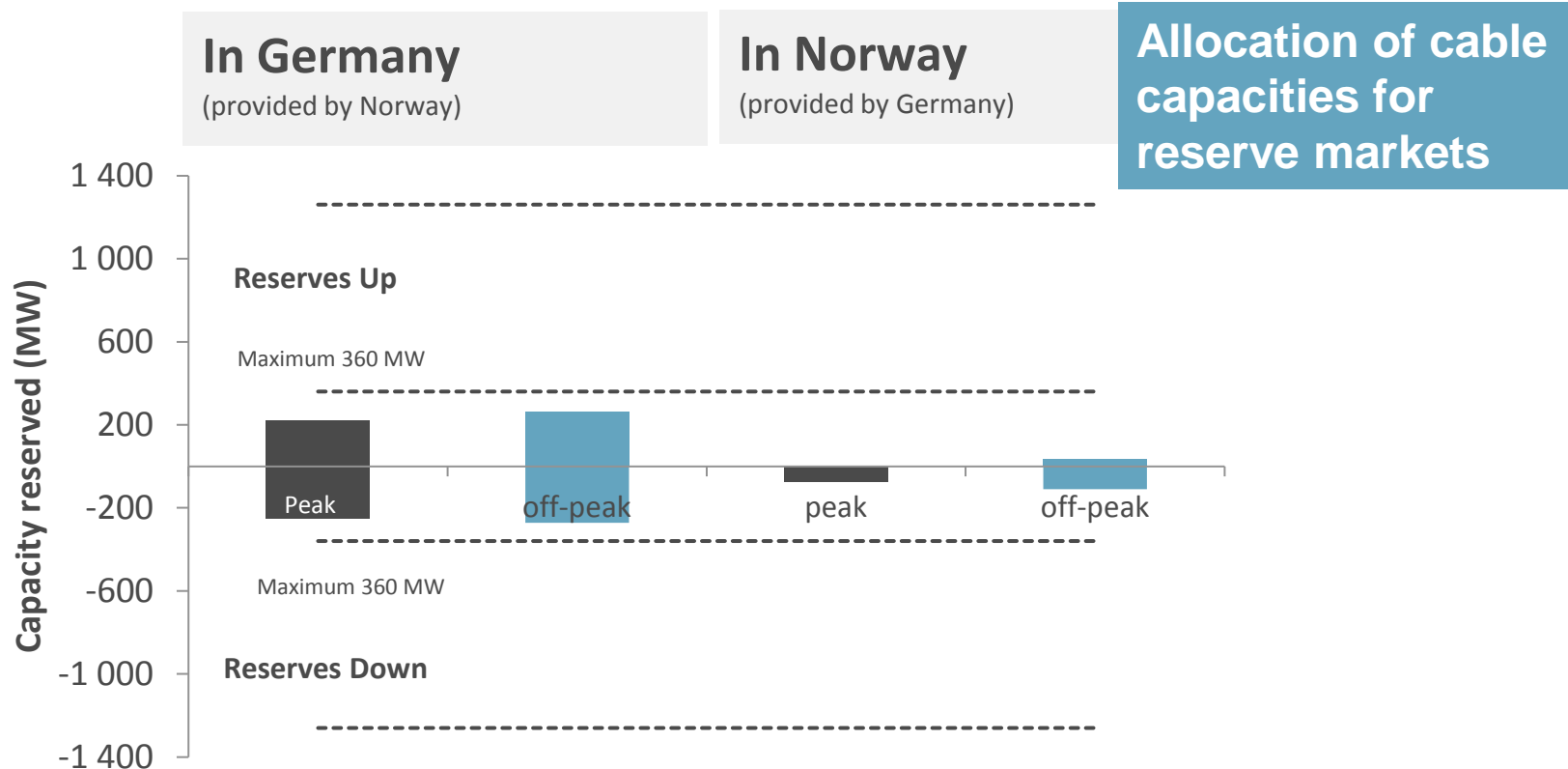
- Cable income is robust against changes in average price differences
- Note: New cables will impact both price levels and price structures
- Other elements that will impact price structures:
 - New RES (in particular wind and small RoR)
 - Demand
 - Other flexibility

Opportunities in other markets: Reserve markets and system services

Income

ToT

Risk



Source: THEMA Consulting Group, The-MA Reserve model

- Opportunities to employ cables in other markets
 - Secondary reserve markets
 - Tertiary reserve markets
 - Intraday
- Also increase welfare benefits of the cable

Overview: Sources of cable benefits

Illustrative

Bottleneck income
(Price differences)

Balancing
power/system
services

Other

Business case total

Increased systems
efficiency

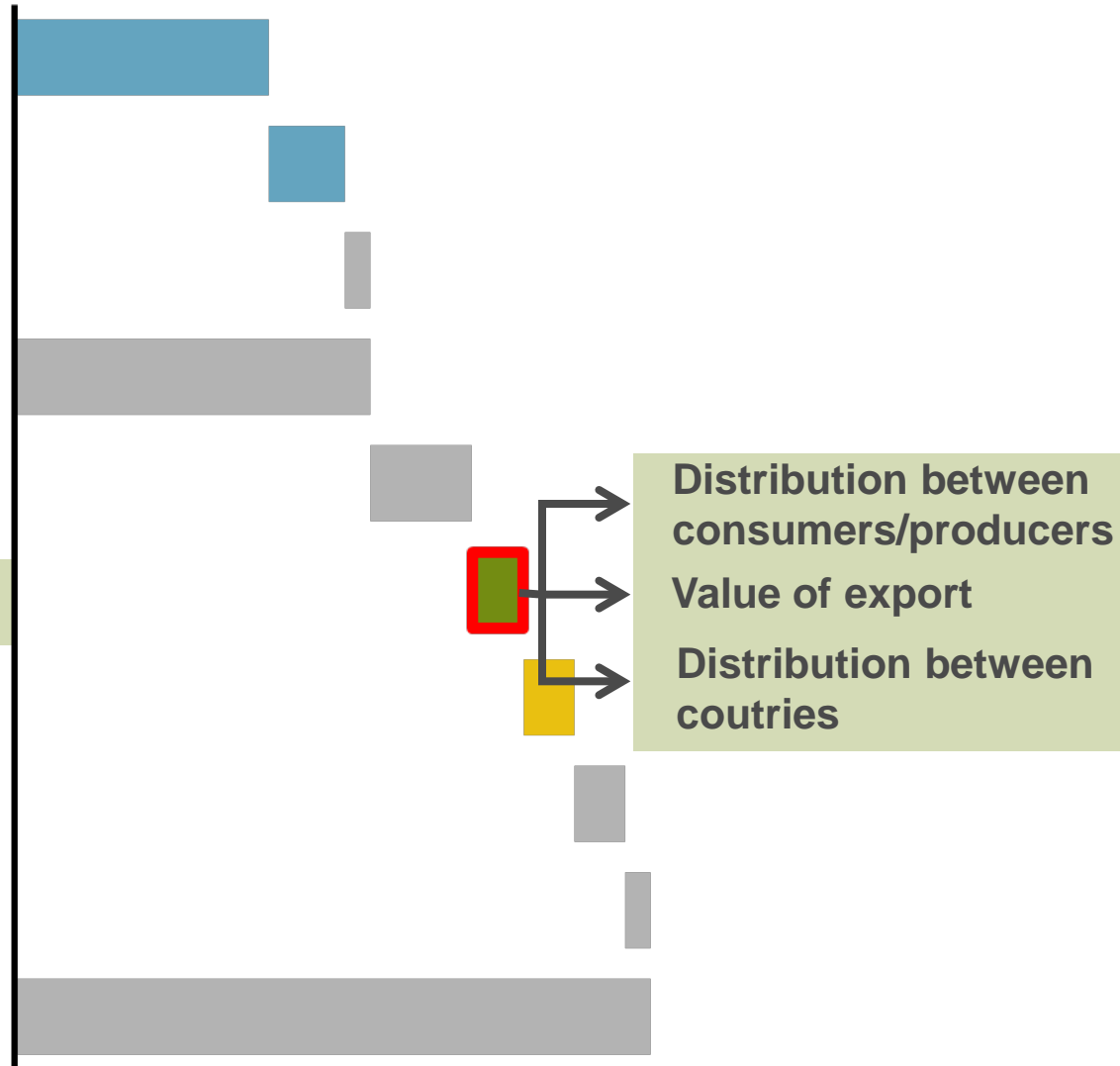
Terms of trade

Security of Supply
(diversification)

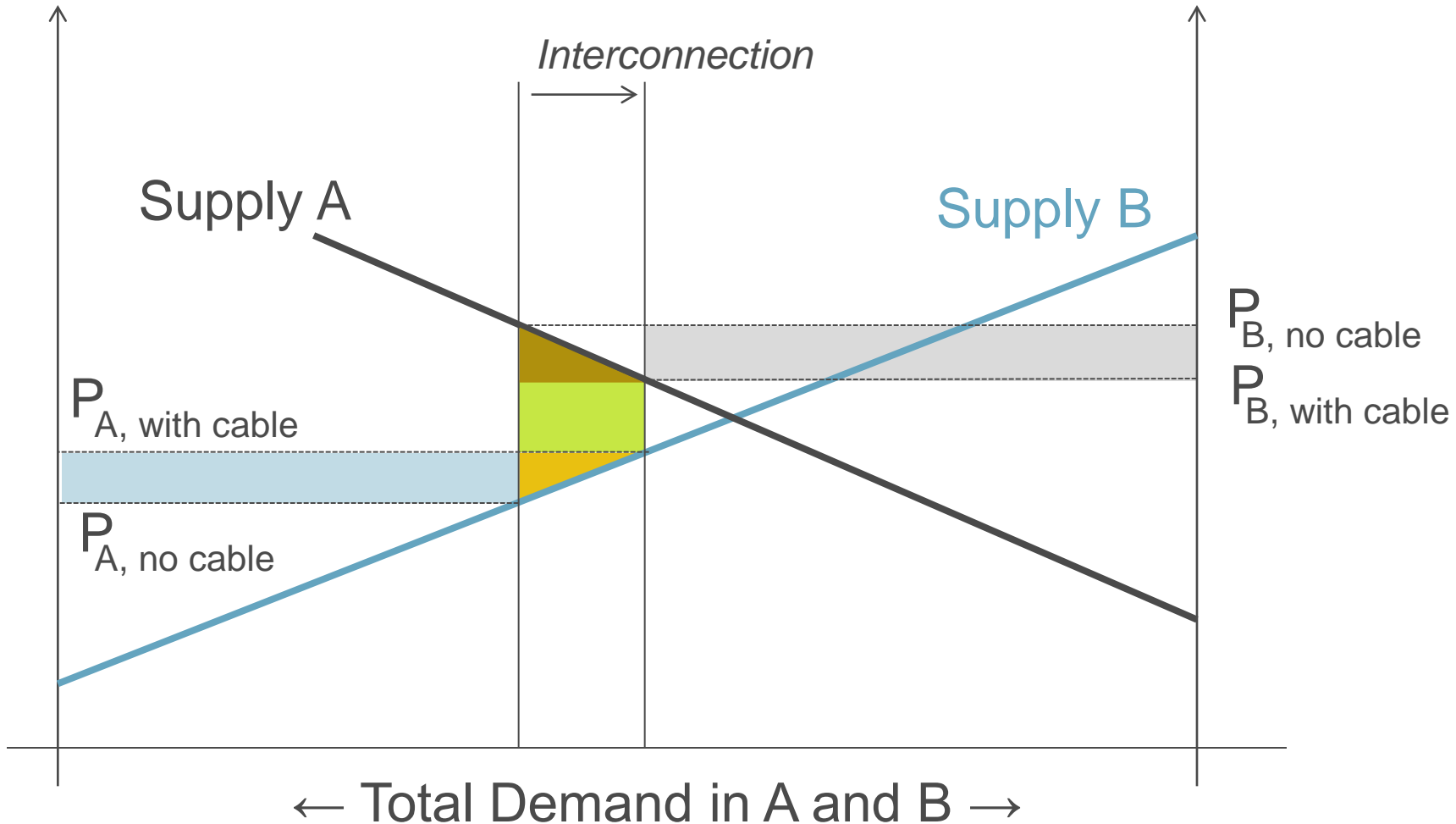
Global climate effect


Competition

**Grand Total – business
and economic value**



Distributional effects and value creation



- 

Shift from consumers to producers in A



Increase value of exports to producers in A
- 

Shift from producers to consumers in B



Effect of cheaper imports to consumers in B
- 

Congestion rent to TSOs

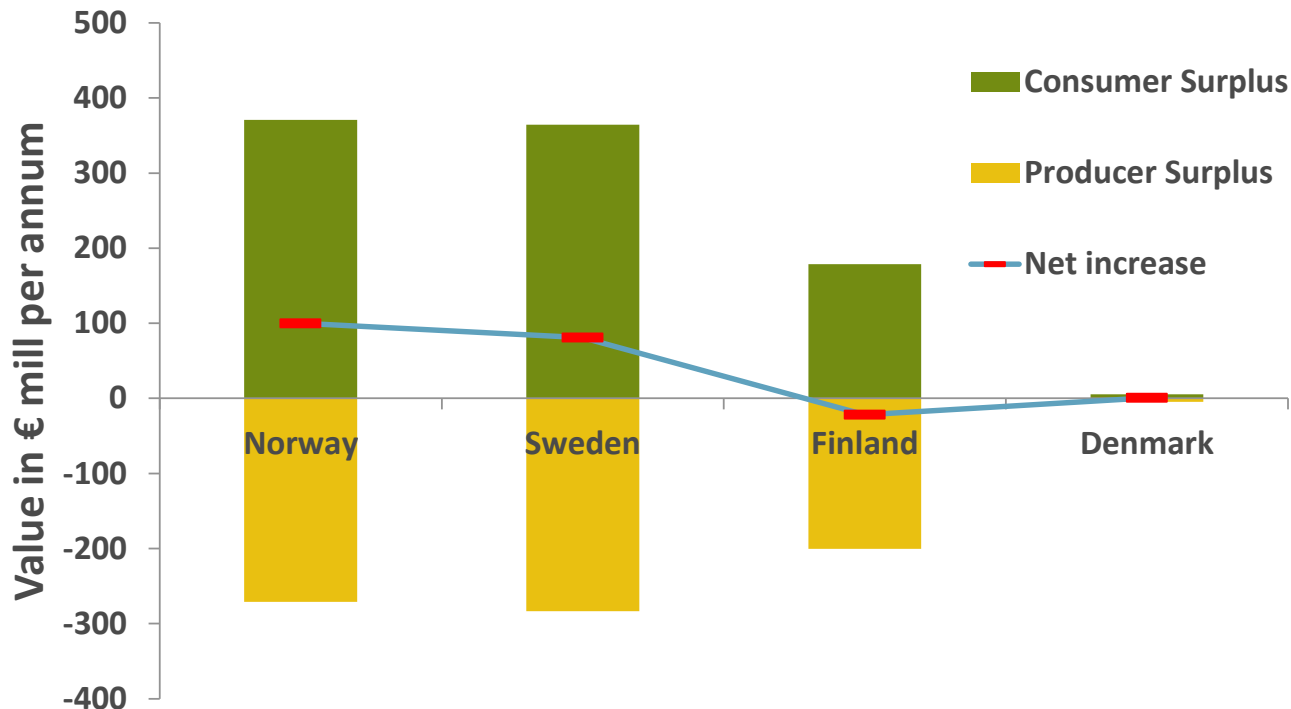
Thus, effect depends on power balance and price effect

Income

ToT

Risk

Simulated consumer and producer surplus Δ (2020; NordLink and NN2)



Source: THEMA Consulting Group, The-MA power market simulation model

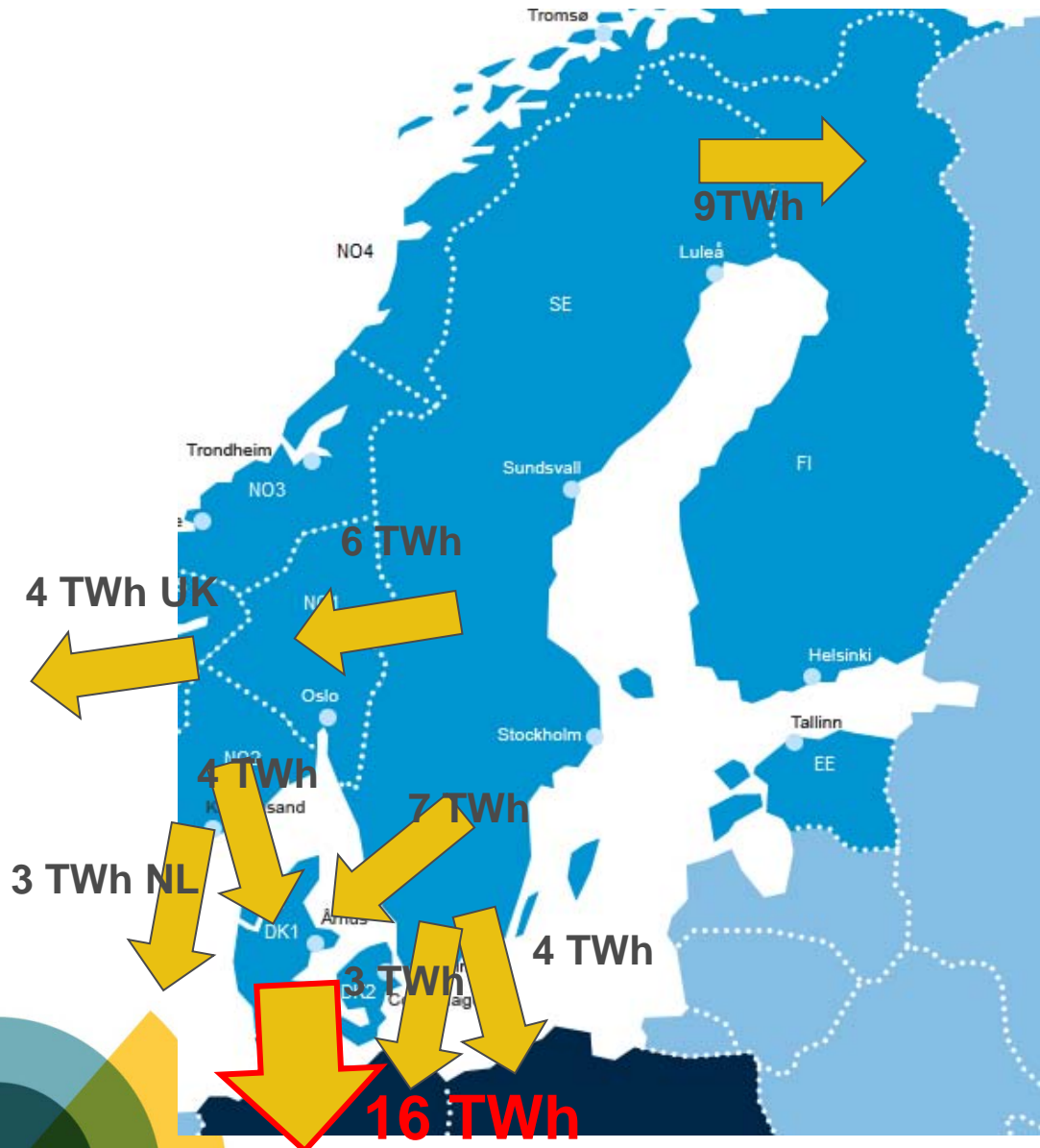
- Cables do not only re-distribute, but create values
- Effect depends on effect on prices and price structure
 - To what extent may producers shift generation to hours with higher prices?

Cables change import/export patterns, thus they influence trade and congestion rent of other countries

Income

ToT

Risk



- Cable ambitions 2010 revised
 - Cable to Germany **X postponed**
 - 2nd cable to Netherland **X postponed**
 - Cable to UK **X reduced size**
 - Cable to Denmark **✓**
- This implies that by 2020, Denmark's role as transit country will be increased
 - Large exports via Denmark
 - Norway becomes transit for exports to Denmark
 - Substantial congestion on all export lines via Denmark and from Denmark
- In addition: price effect in other countries as well

Overview: Sources of cable benefits

Illustrative

Bottleneck income
(Price differences)

Balancing
power/system
services

Other

Business case total

Increased systems
efficiency

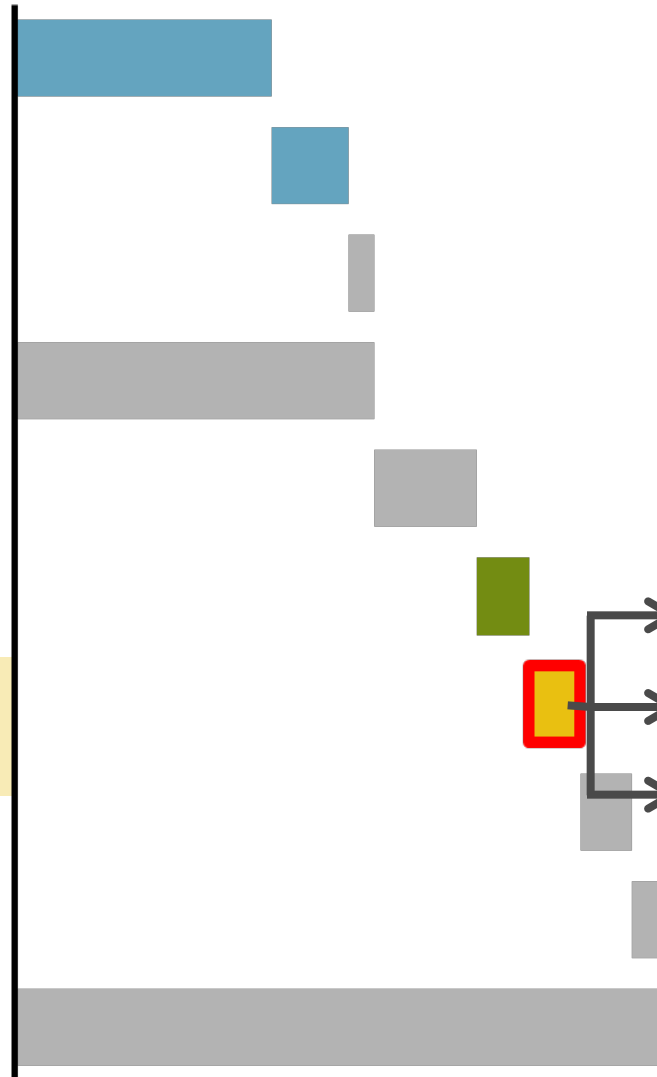
Terms of trade

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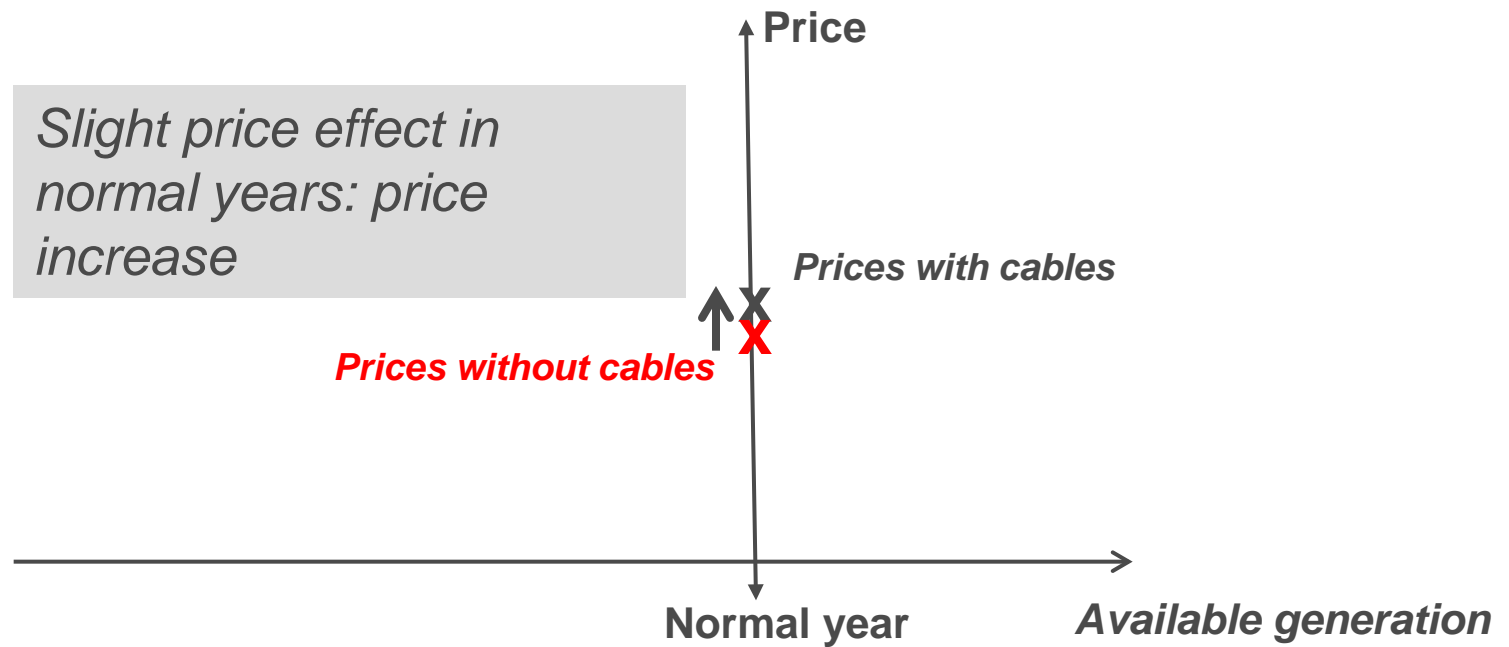
**Grand Total – business
and economic value**



Price risks between
years
Price variation within
year
Risk of rationing

Effect of cables varies with power balance

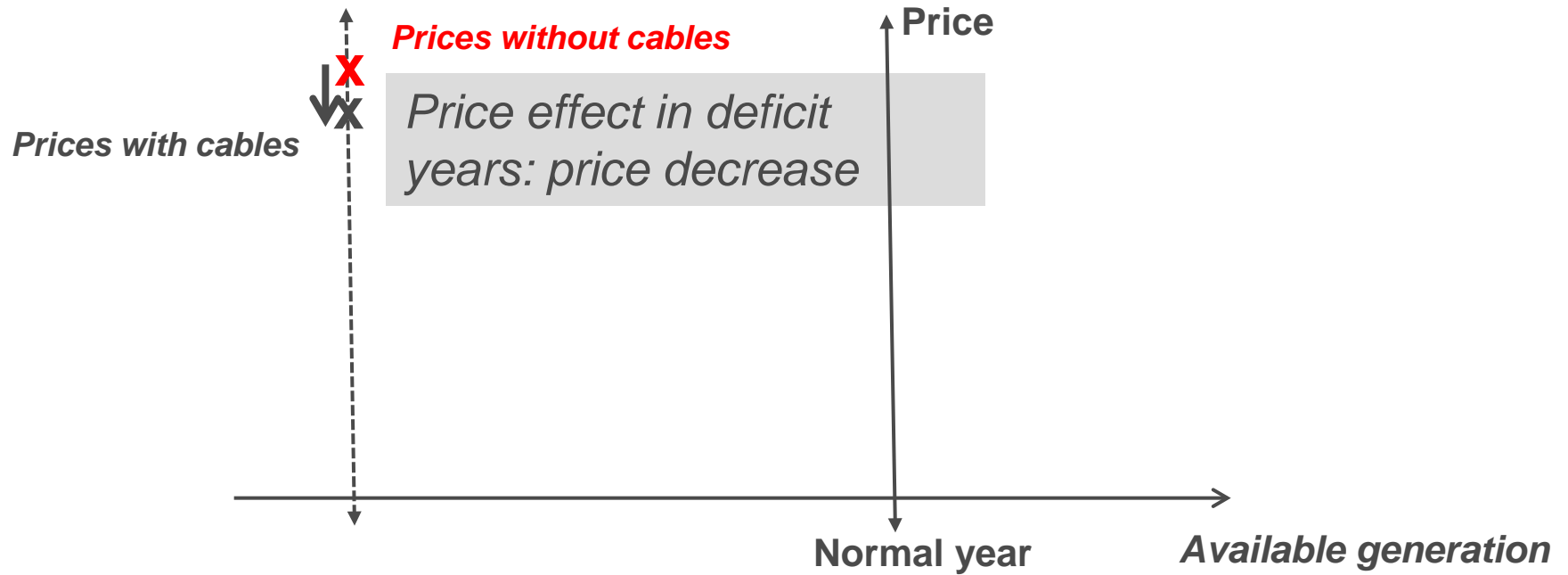
Illustrative



Effect of cables varies with power balance

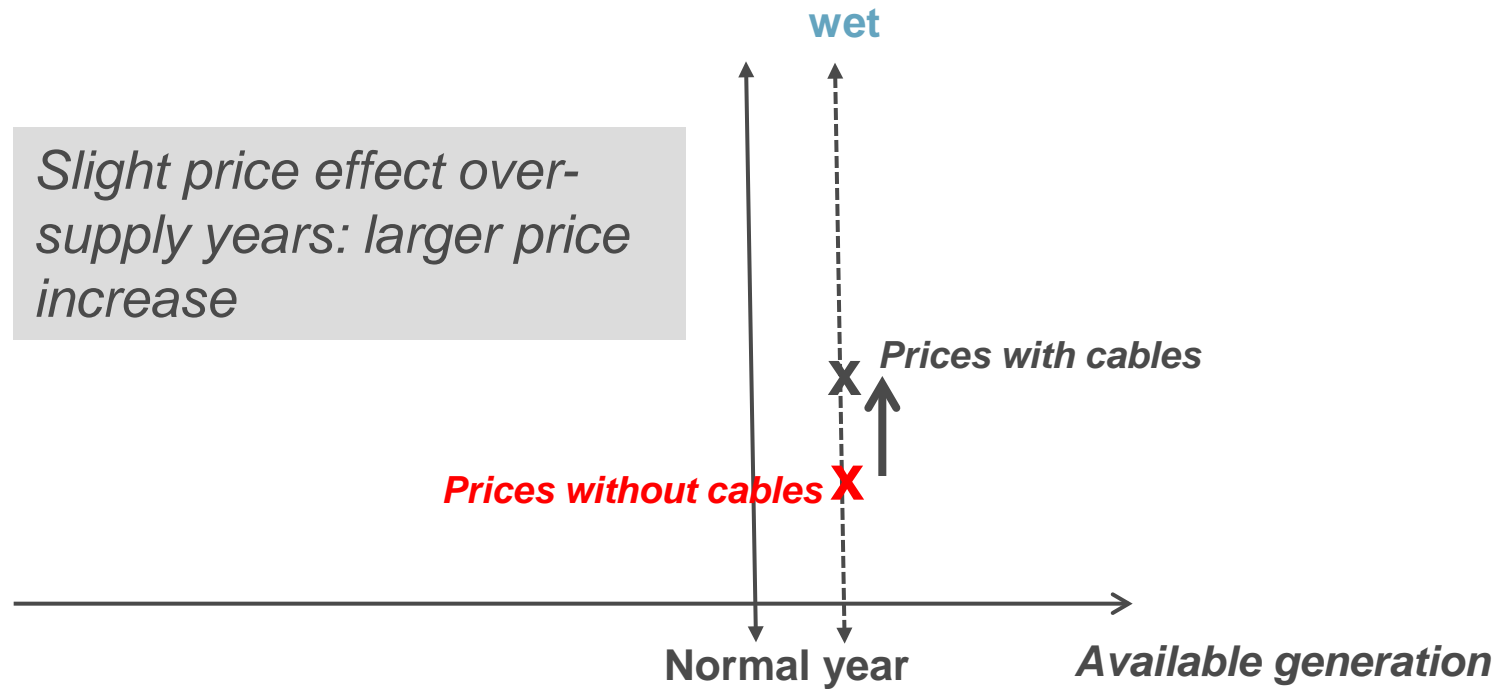
Illustrative

Dry year and nuclear trouble



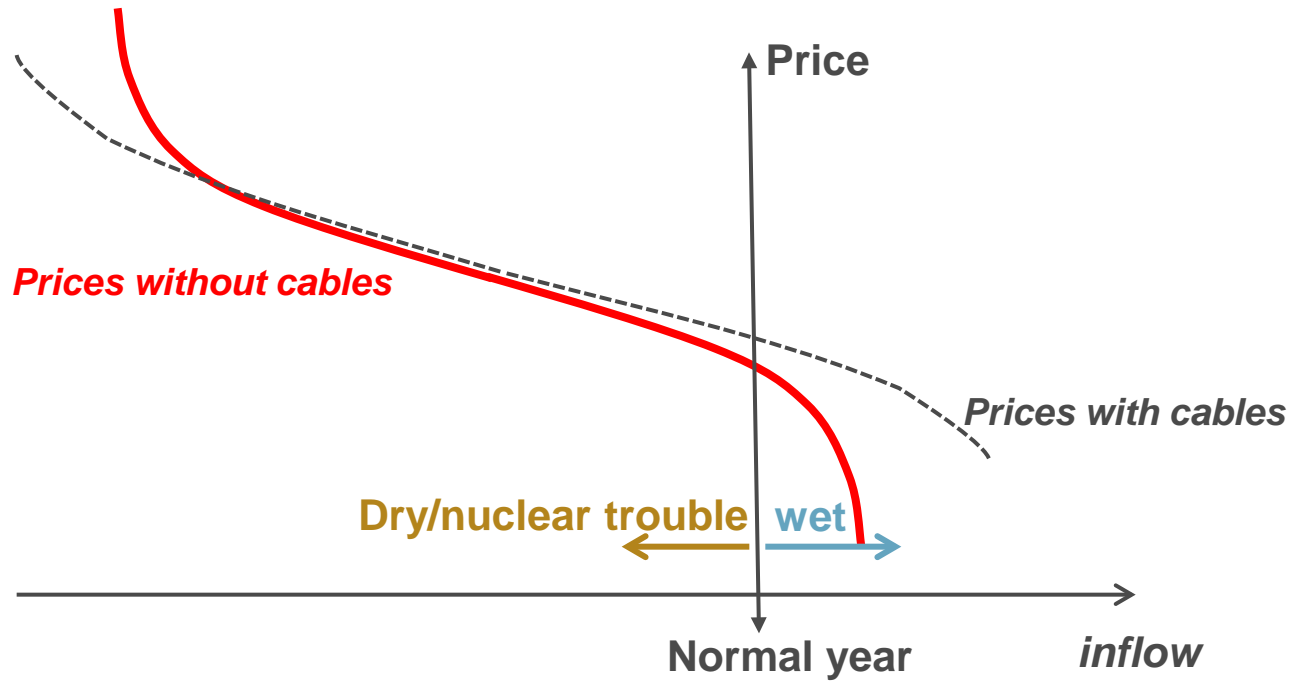
Effect of cables varies with power balance

Illustrative

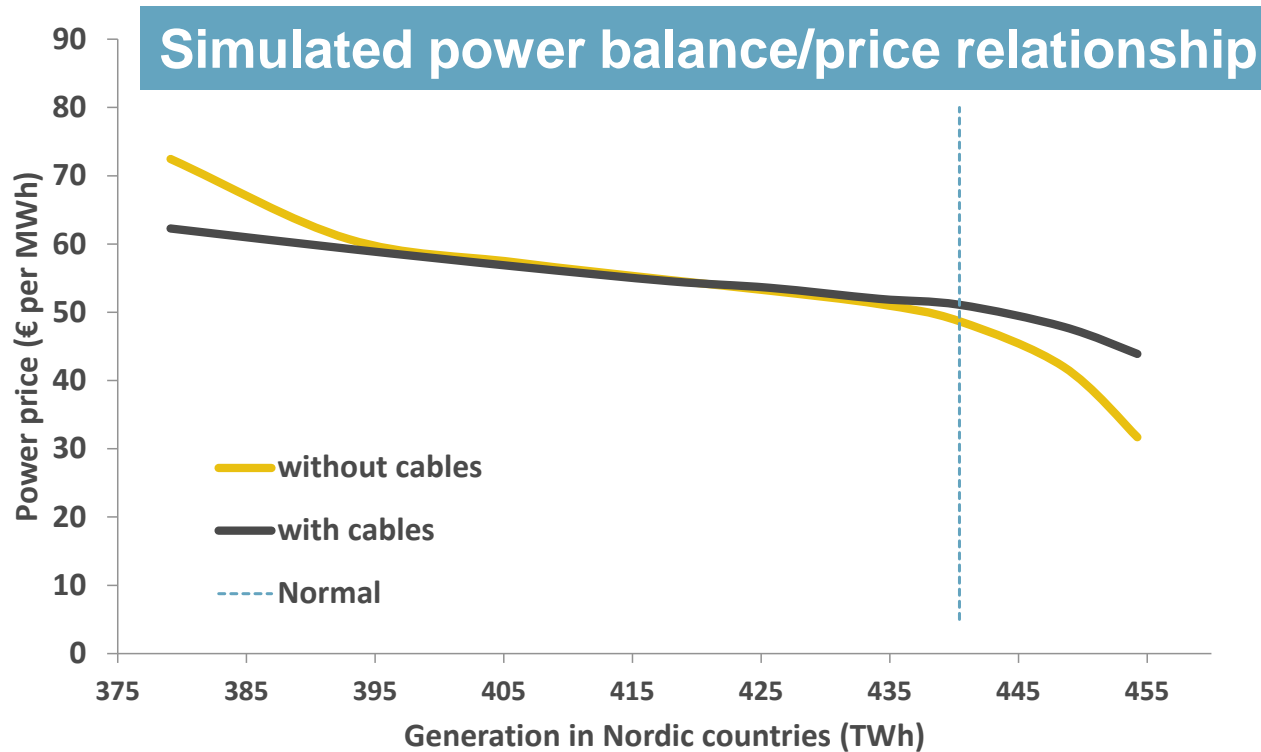


Effect of cables varies with power balance

Illustrative



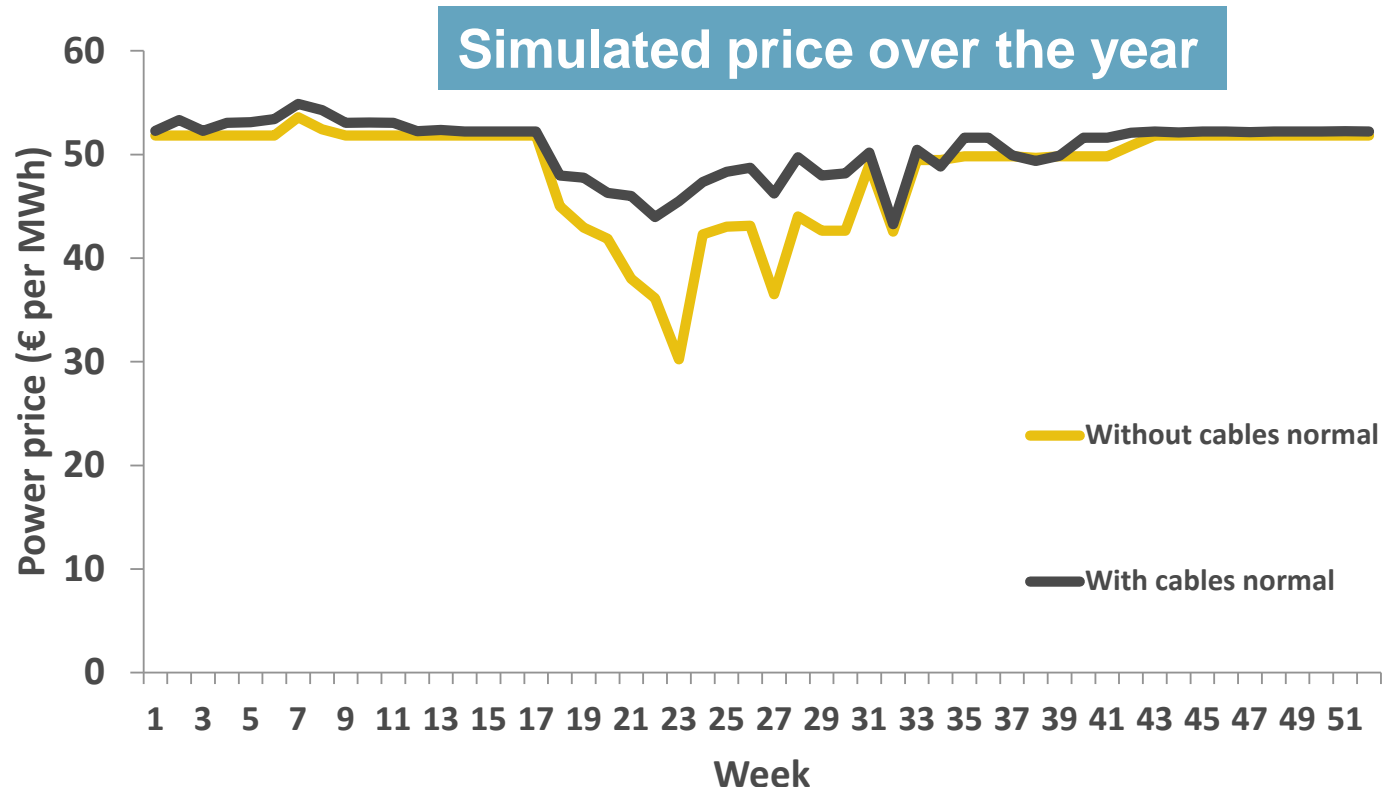
Cables significantly reduce price risk between years related to power balance uncertainty



Source: THEMA Consulting Group, The-MA power market simulation model

- Much flatter price relationship against power balance
- Note: power balance not only related to inflow, but also nuclear and other generation
 - Inflow: symmetric (both up/down)
 - Other generation: only negative risk (down)

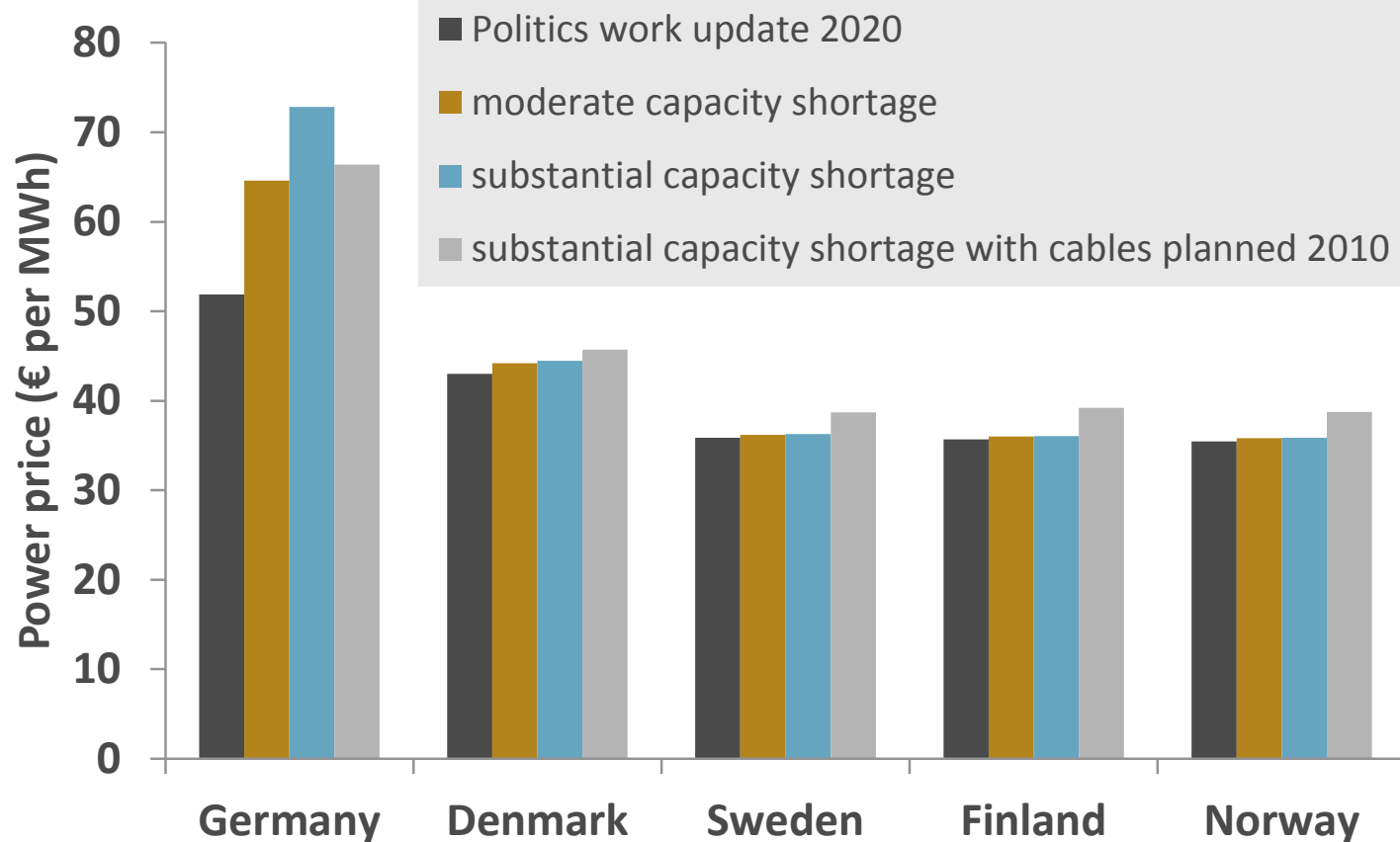
Also much less price variation within a year



Source: THEMA Consulting Group, The-MA power market simulation model

- Cables stabilize price over the year
- In summer time: export opportunities prevent low prices
- In winter time: only slight or no increase (due to increase in water values)
 - In extreme winters, prices would lower with cables than without

Import of other price risks is limited



Source: THEMA Consulting Group, The-MA power market simulation model

- Nuclear phase out in Germany could lead to capacity shortages in Germany, resulting in high prices
- But, even with direct cables to Germany, the price impact in Norway is limited
- Also: Indirect diversification of supply increases with cables to Continent
 - Continent gas/coal thermal vs. Nordic coal thermal



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THEMA's new power market model The-MA

- Newly developed, state of the art fundamental power market simulation model
- Hourly time resolution, with detailed thermal and hydro modeling
- Wind and solar modeled with observed volatility
- Start-up costs, minimum stable load and part-load efficiencies accounted for

