



Merit Order Effect of Wind Power – Impact on EU 2020 Electricity Prices

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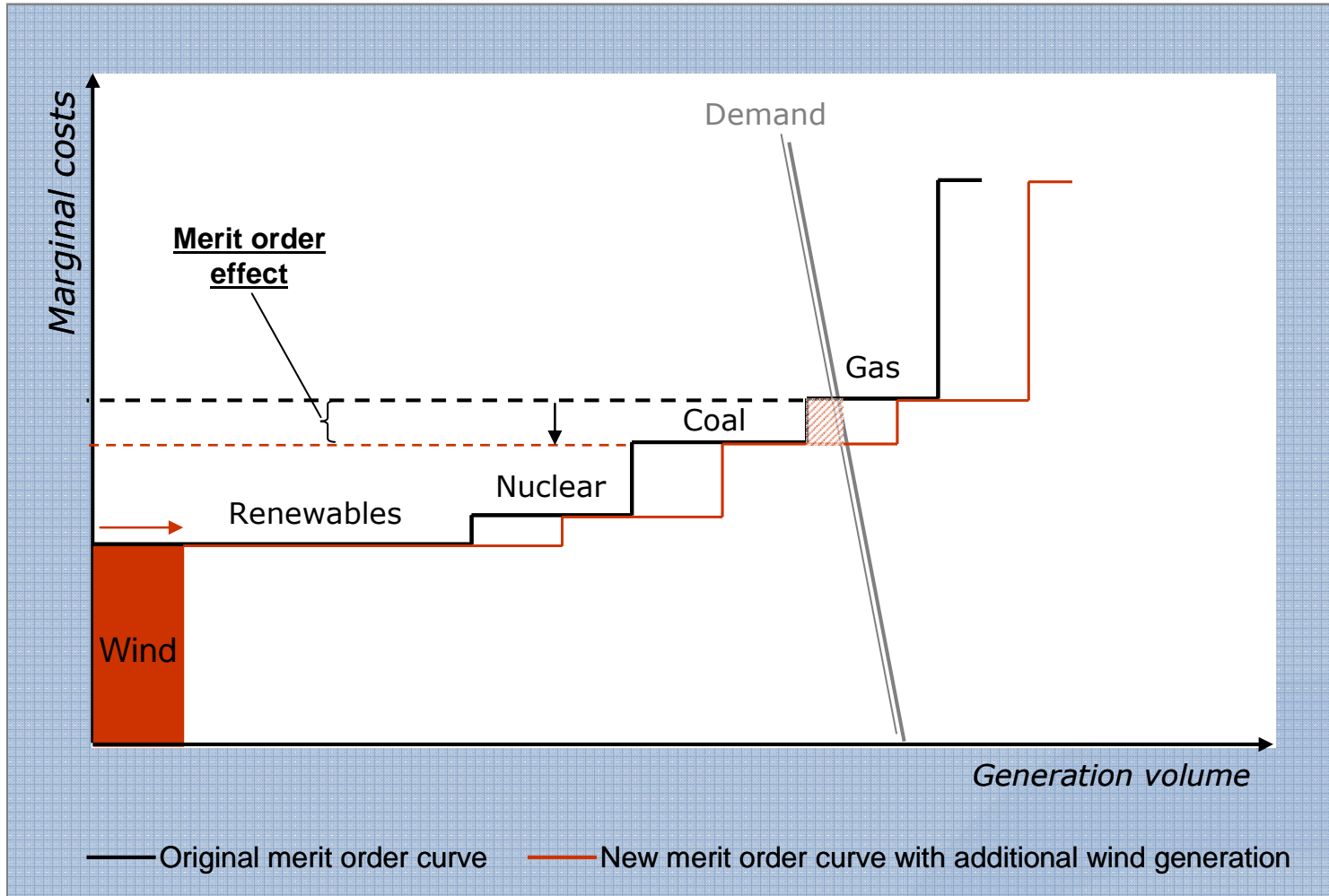
Agenda

- Background
- Literature review
- Modeling analysis
- Conclusions

Background

- By 2020 wind power will increase significantly
- Wind power will reduce average wholesale power price levels
- For EWEA we have analyzed the price impact when wind power replaces high cost thermal power plants in the “merit order curve”
- Study carried out in two phases:
 - I. Review of previous studies
 - II. Analyses made by Pöyry power market model

What is Merit Order Effect ?



Diapositiva 5

A1

I exchanged the picture with the latest one from the report where nuclear is included!

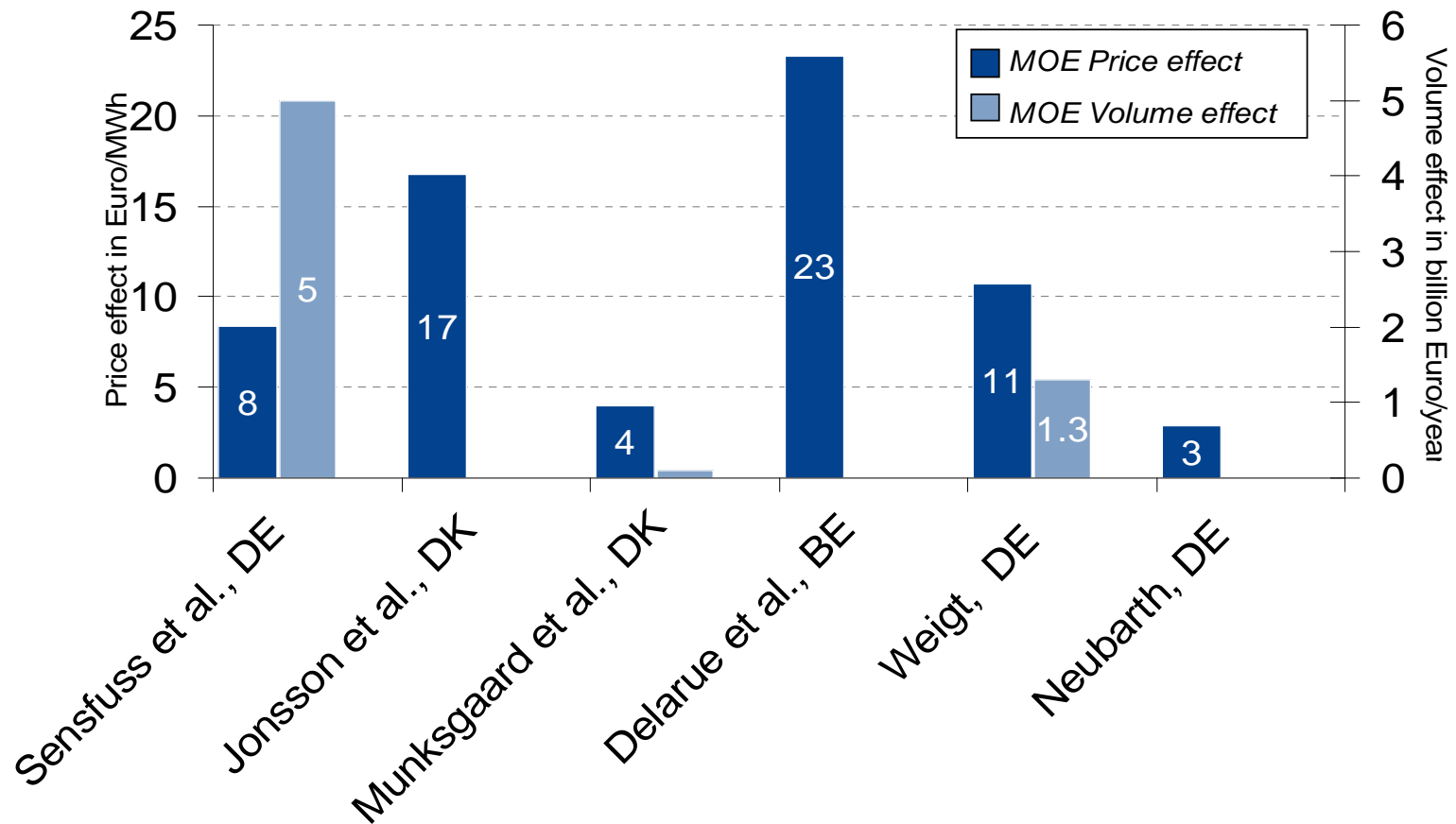
Administrator; 10/06/2010

Phase I: Literature Review

- 14 studies within three categories:
 - a) Impact of wind power on spot market prices in a single country
 - b) Costs and benefits of renewable energy support schemes
 - analyze costs and benefits of support schemes from an end-user point of view
 - c) Wind power and the power grid infrastructure
 - i.e. transmission capacities and dispatch mechanisms

Merit Order Effect in € per MWh and billion € per year

MOE Price and Volume Effect in 2009 Prices

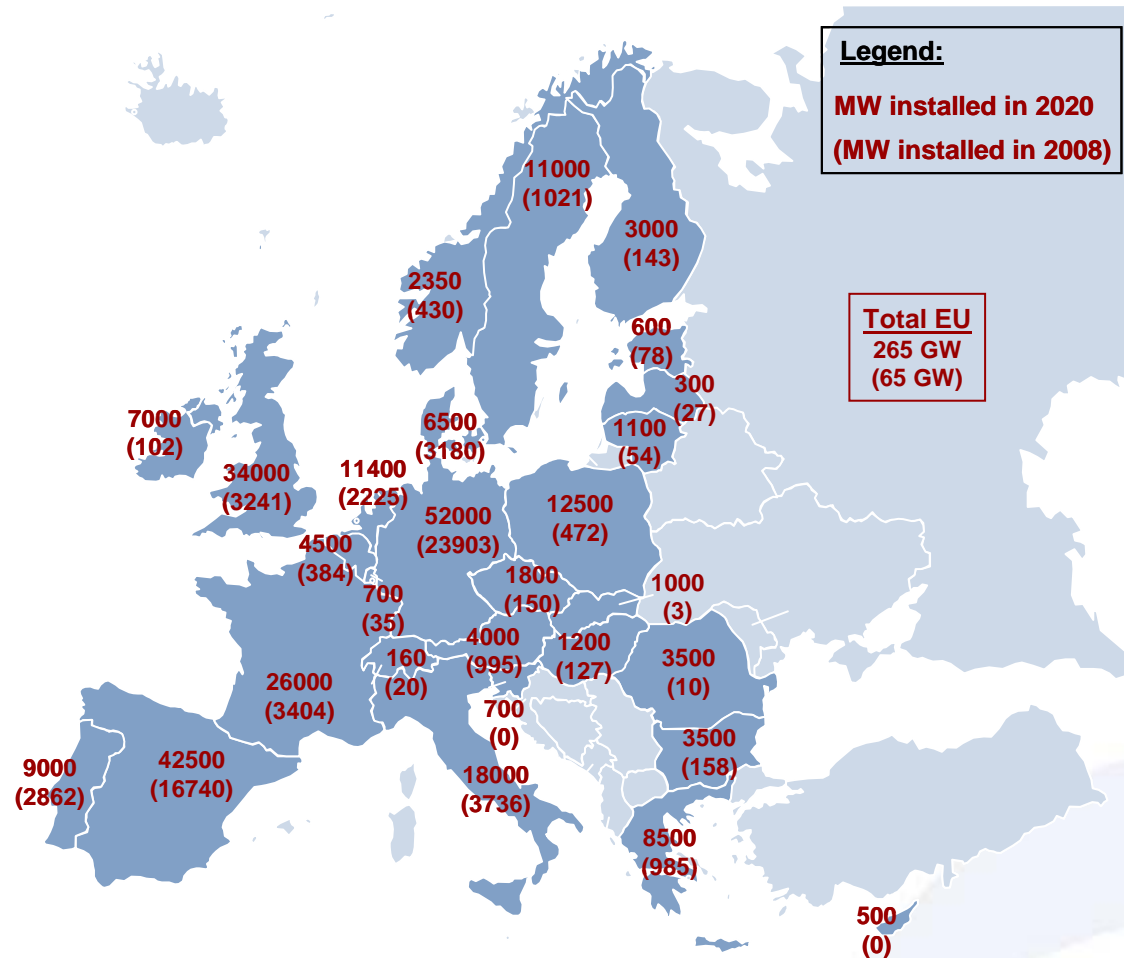


Phase II: Pöyry's Modeling Analysis

- Aim:
 - To quantify merit order effect from wind power in Europe in 2020
- Methodology:
 - Scenario analysis: Compare a Reference to a Wind scenario
 - Marginal cost curves (short term) assuming a long term market equilibrium
 - Grid investments are not considered
- Pöyry applied The Classic Carbon Model
 - A power and carbon market model for the European power market
 - Conventional investments are determined by the model
 - Model results include wholesale and end-user prices for each market area, trade flows, generation, demand, fuel use, CO2 emissions and the carbon (EUA) price

Coverage of the analysis

- EU 27 plus Norway and Switzerland



The figure indicate assumed installed wind capacities in accordance to EWEAs Pure Power Scenario!

Modeling Analyses for 2020

- Two scenarios defined by EWEA:
 - **Reference Scenario:** Renewable power generation mix in 2020 equals in shares the actual mix of 2008. No further wind and other RES investments are assumed
 - **Wind Scenario:** Wind power capacities increased by 300% from 2008 until 2020 (~200 GW)
- The merit order effect is estimated as difference in market prices between the two scenarios

Input Parameter	Reference Scenario	Wind Scenario
Fuel prices	Forecast from IEA Coal: 10.5 €/MWh, Gas: 28 €/MWh, Oil: 110 \$/boe	
Wind capacities	As 2008	High growth compared to 2008
Carbon policies/targets	EU target: -20% to 1990 CO2 price: 48 €/ton	EU target: -20% to 1990 CO2 price: 30 €/ton
Conventional investments	According to long run marginal costs	According to long run marginal costs
Capacities of RES other than wind	As base year 2008	Share as base year 2008

For the same "Input Parameter", blue marked cells represent the same value. Red marked cells are representing a different input value compared to the other scenario.

Results: Merit Order and Volume Merit Order Effect

- Wind generation displaces conventional gas and coal generation
- Average power market price in Europe is thereby reduced in Europe
- The Wind Scenario reduce wholesale market revenue by nearly **42 billion € per annum**

	Wind generation volume	Merit order effect	Volume order effect	Merit order effect per wind MWh
Year	TWh/a	€/MWh	bio €/a	€/MWh
2020	648	10.8	41.7	64.4

MOE has been estimated at 10.8 €/MWh

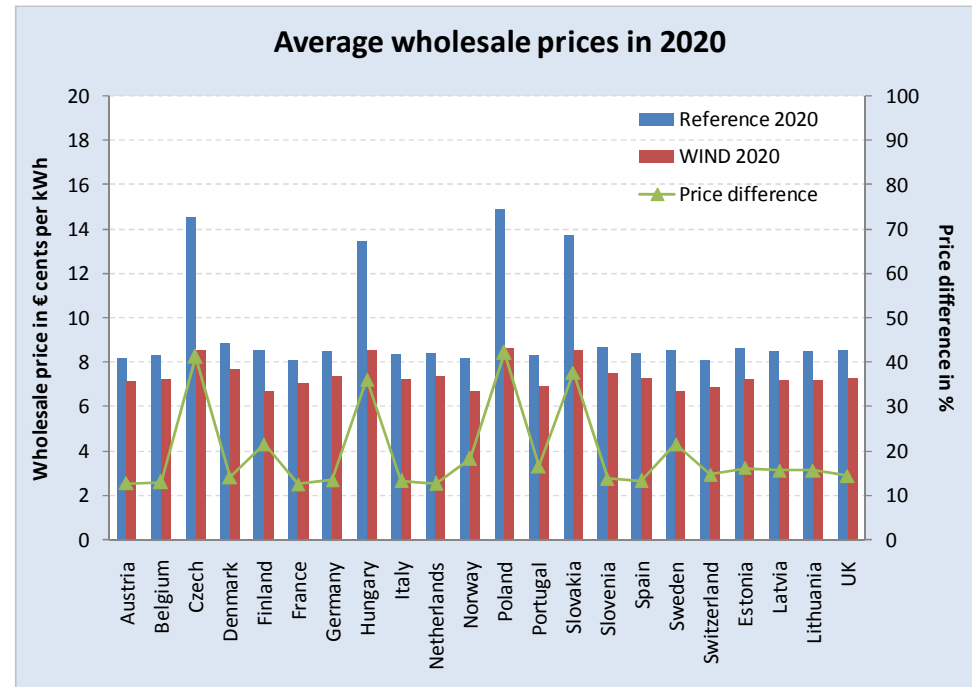
Wholesale Prices in Europe in 2020

- **Reference Scenario**

In Czech, Poland, Hungary and Slovakia average prices are about 50% higher than EU average

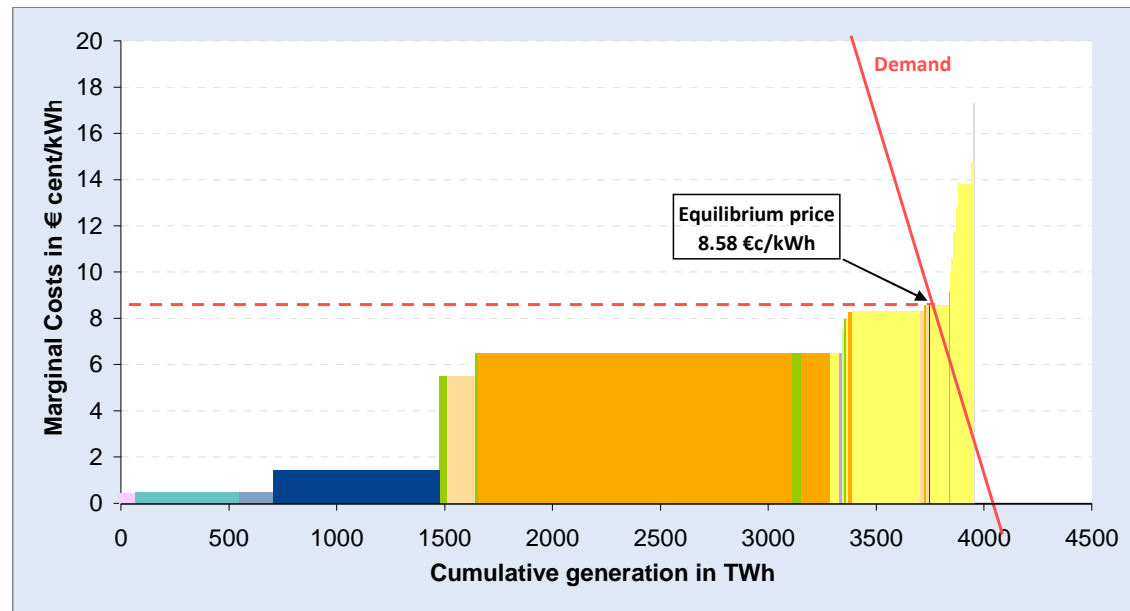
- **Wind Scenario**

In Czech, Poland, Hungary and Slovakia the price level is about 15% higher than the EU average



Reference Scenario 2020 – Merit Order Curve

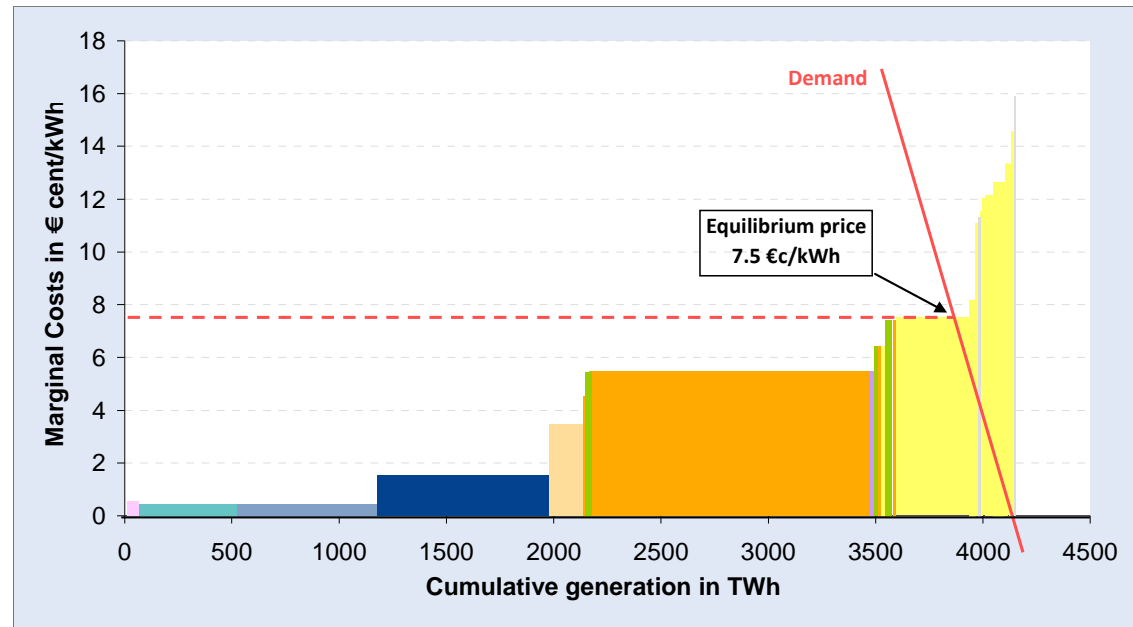
- European power demand is first served by waste, hydro and wind technologies with low short term marginal costs
- Nuclear provide 780 TWh at marginal costs of on average 1.5 €cent/kWh
- Major share of Europe's demand is supplied at cost levels between 5 and 7 €cent/kWh, mainly by hard coal technologies
- At higher cost levels, gas technologies are dominating



Fuel	Wind	Hydro	Nuclear	Lignite	Coal	Peat	Biomass	HFO	Oil	Gas	Waste
Colour	Blue	Teal	Dark Blue	Orange	Light Orange	Light Green	Green	Grey	Purple	Yellow	Pink

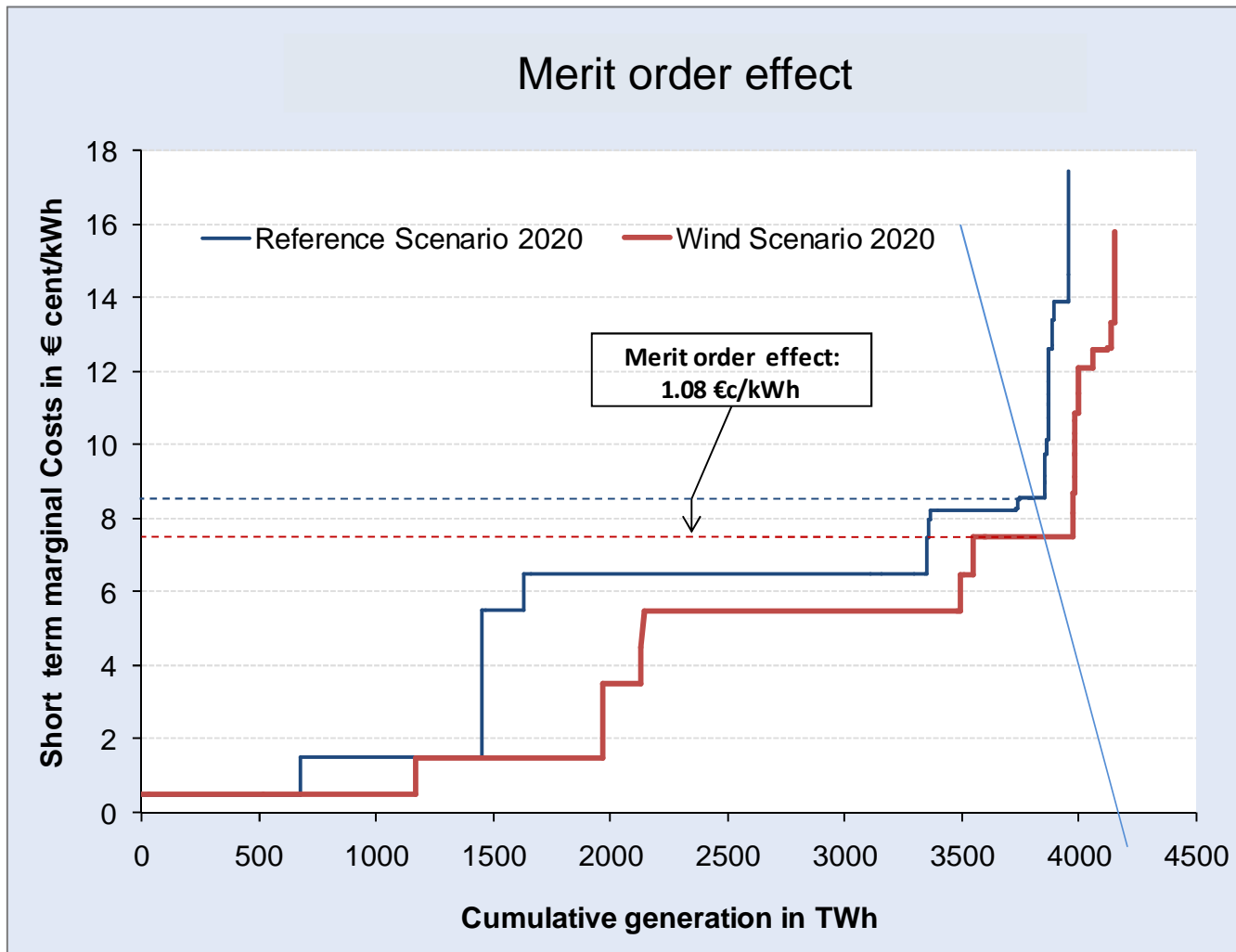
Wind Scenario 2020 – Merit Order Curve

- Merit order curve and its technology mix and sequence very much resembles the Reference Scenario
- Wind power mainly replaces coal and gas power as compared with the Reference Scenario
- Marginal cost levels for the conventional technologies vary in the two scenarios mainly due to the resulting difference in the CO2 price



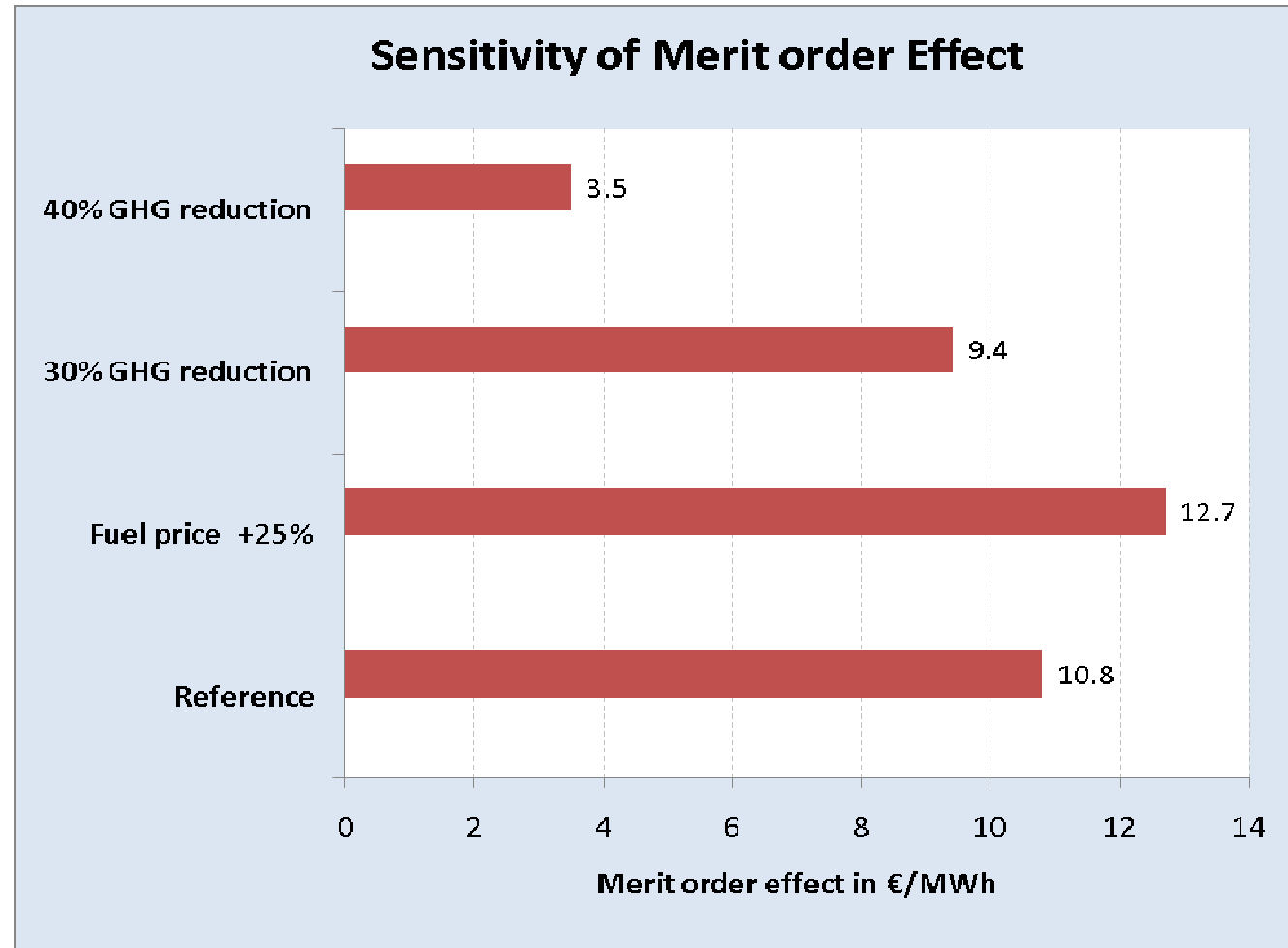
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Comparison of the two scenarios' merit order curve



Merit order effect of different sensitivity cases

The sensitivity analysis included the increase of the EU GHG reduction target from -20% to -30% and -40% as well as the increase of fuel prices by 25%.



Conclusions

- Wind power will have a strong impact on future spot market prices in European power market
- Previous studies find merit order effects in range 3-23 € per MWh
- Pöyry's analyses find merit order effect of nearly 42 billion € per year on European level
- Wind power reduces EU carbon price level by one third in 2020

