

**Transmission challenges (and other
challenges) related to balancing power
from hydro power in Norway**

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- **Statnett, interconnections today and in 2020**
- **Profitability of interconnectors**
- **Challenges related to more ambitious development of interconnectors and hydro flexibility (**Big Blue Battery**)**
 - Two important questions:
 - How much is economically efficient and possible?
 - How can it be achieved?
 - R&D perspective. Understand to achieve

Statnett, current situation and plans

- ❖ Statnett operates and build the national power grid and interconnectors (TSO)
 - Has promoted interconnectors for more than a decade

- ❖ Today: 5000 – 5500 MW transmission capacity out of Norway
 - 2/3 to Sweden, 1000 MW to Denmark and 700 MW to the Netherlands (NorNed)

- ❖ Will double the capacity by 2020
 - Denmark + 700 MW
 - Germany 1400 MW
 - UK 1400 MW
 - Sweden 1400 MW

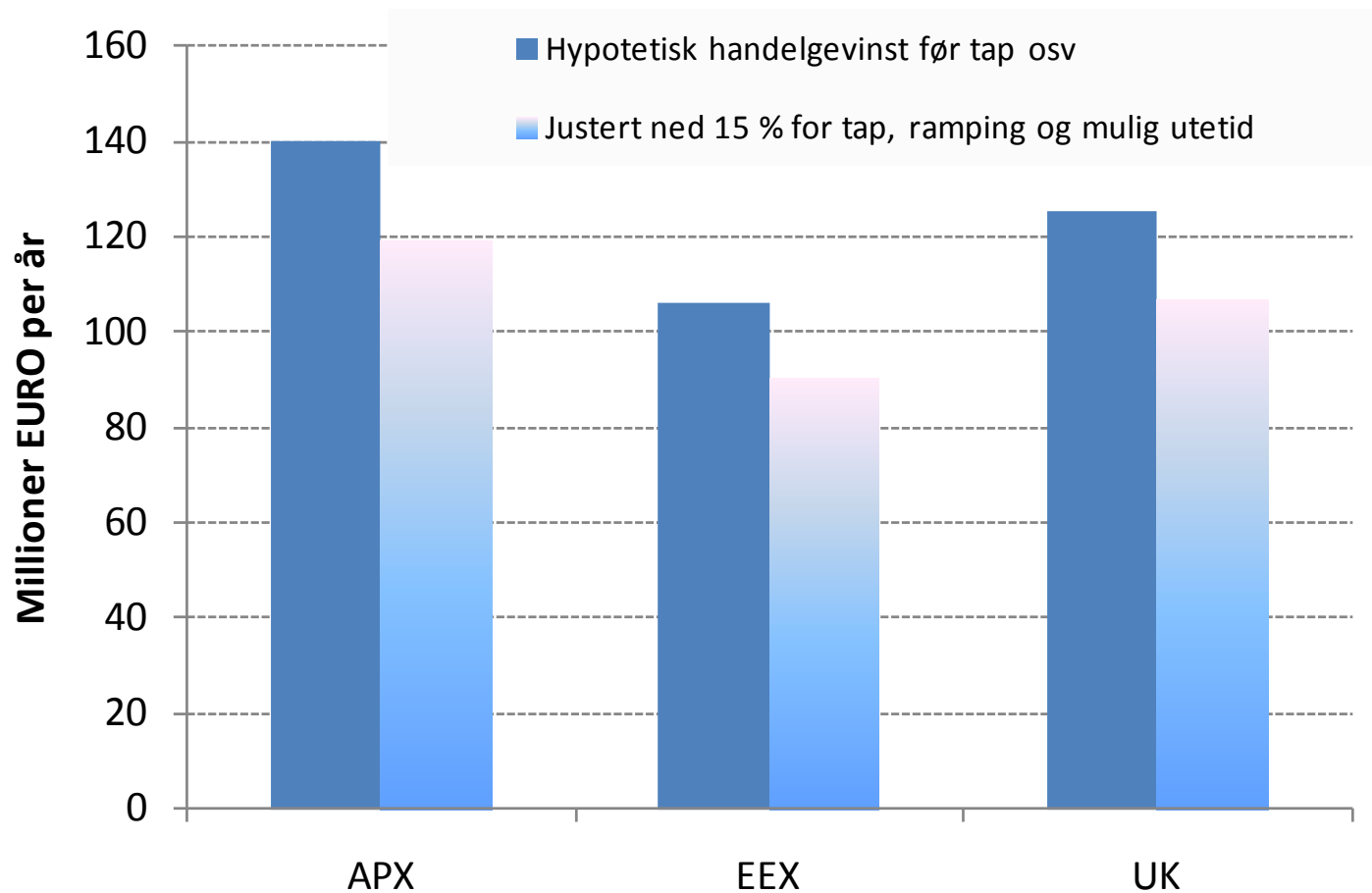
- ❖ More connections out of Nordic



- Trade saves generation cost and give better utilization of resources. Differences in costs (prices) are the key to the revenue
- Products: Day ahead market. Ancillary services, reserves
- Revenue and benefits in a market context:
 - Congestion rent to grid owner and net economic benefits to market players
 - Security of supply
 - Promotes decarbonisation, more stable prices, more competition
- Market design. (Capacity payments) Regulations. ITC. Ramping restrictions
- **Does the revenue exceed the cost?**

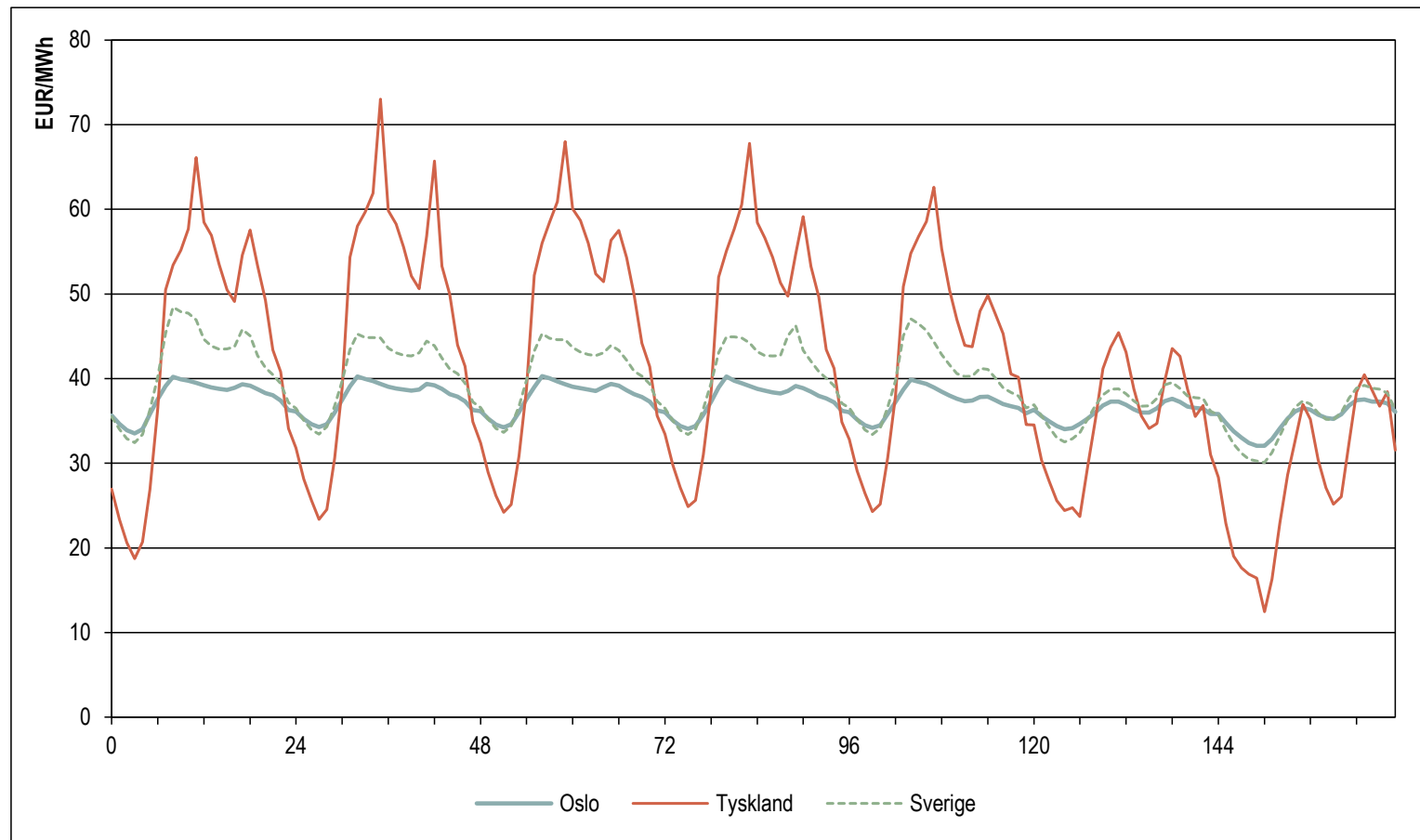
Some interconnectors are profitable even **Statnett** without expansion of renewables

- Hourly price differences 2002-2008. Revenue with 700 MW



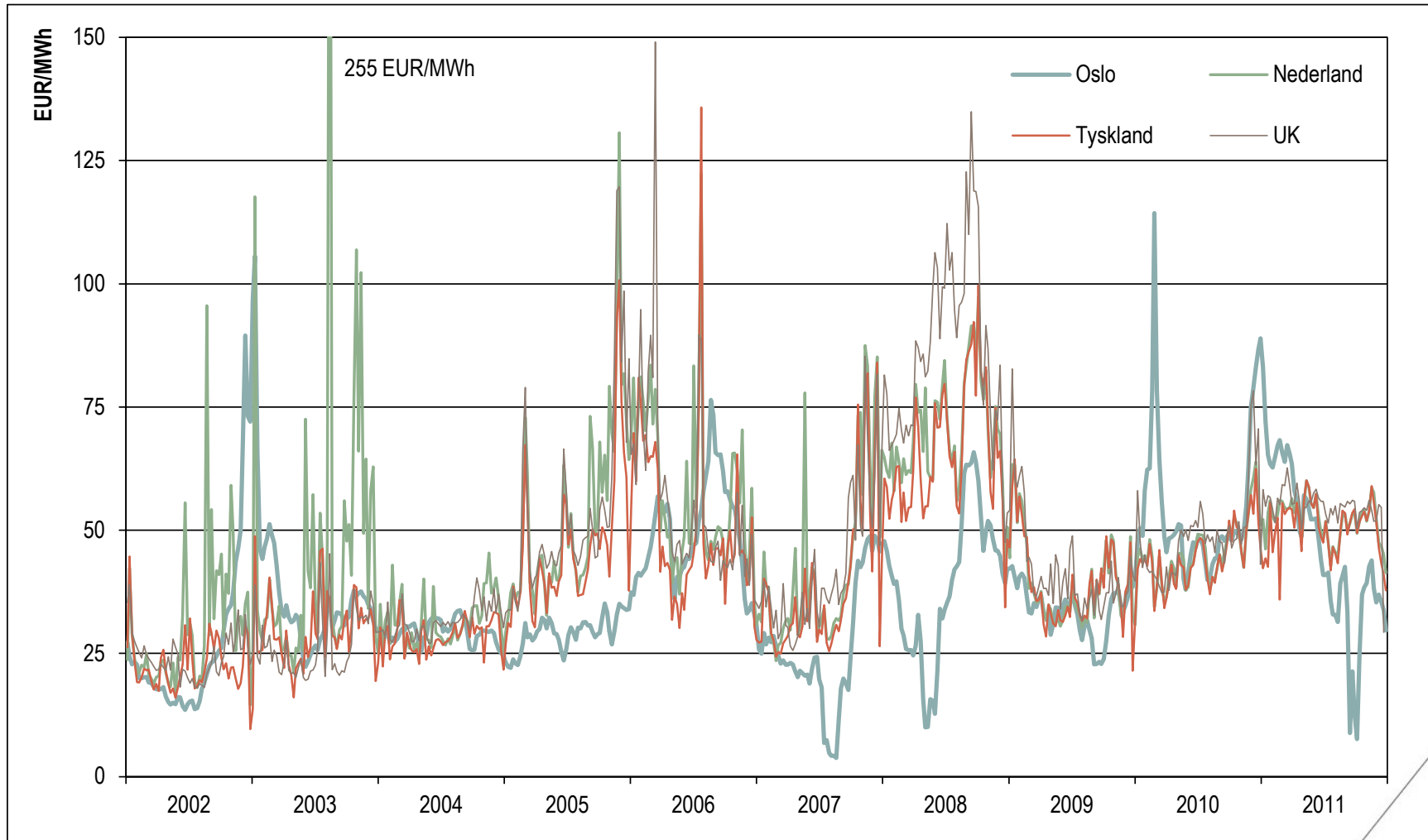
Why so profitable?

- 1. Differences in weekly price structure

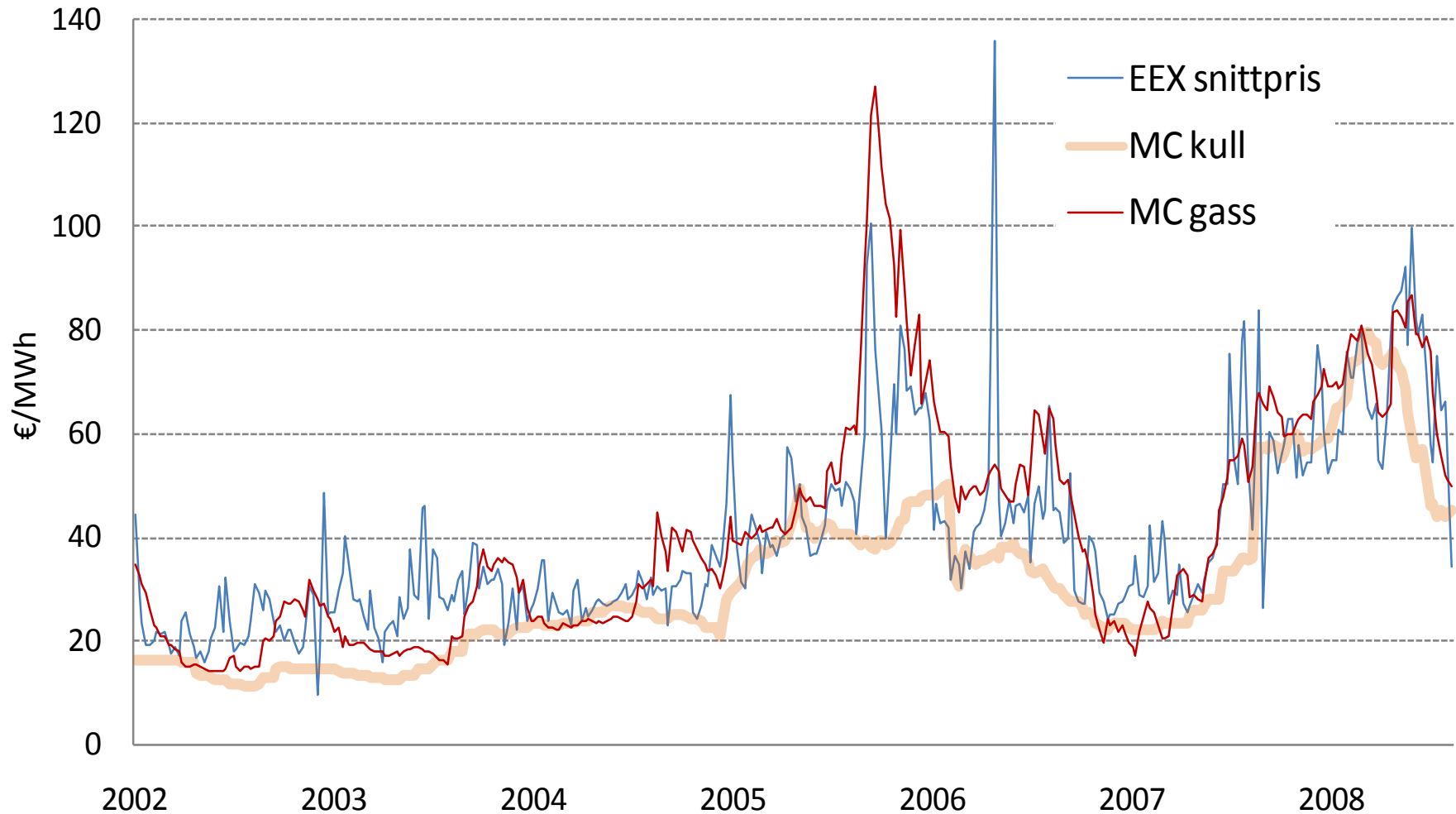


Why so profitable?

- 2. Variations in average price per week

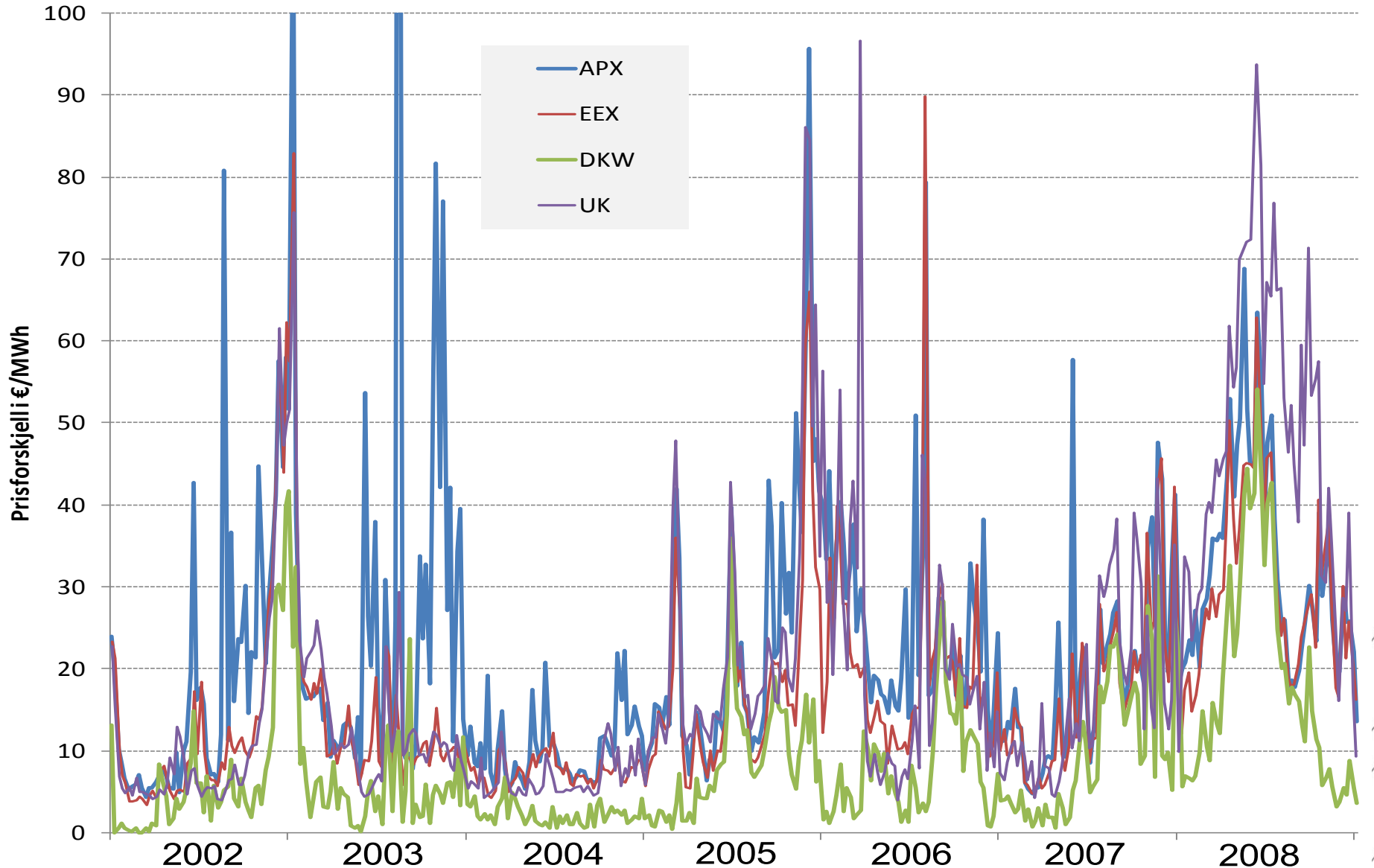


Fuel price variation is a part of the explanation



Huge variation in average revenue per week

(average of price difference per hour for every week used as proxy)



- **Challenges related to Big Blue Battery**
 - How much is economically efficient and possible?
 - How can it be achieved?

The zero emission target

❖ Flexibility becomes scarce

⇒ More transmission capacity needed in all directions in Europa

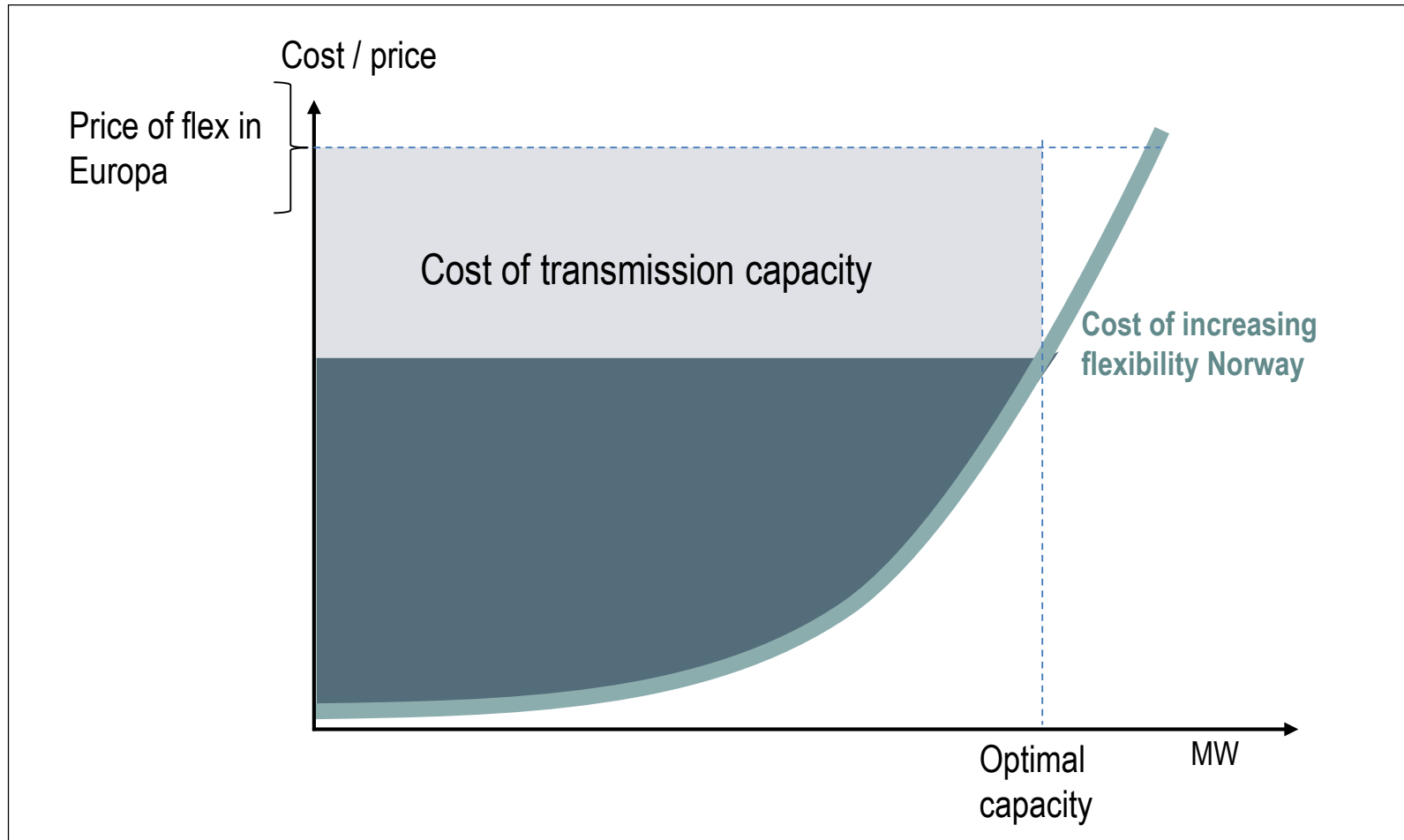
⇒ Need to develop new flexibility where possible

- Hydro and pumped storage, heat demand and CHP, hydrogen, other energy storage, demand flexibility
- *We know little about this power system*
 - Technology and regulations, prices and costs, price volatility etc

Robust, but declining profitability of interconnectors (and new hydro flex)

- ❖ Norway's own need covered with the planned expansion
 - Variation of hydro inflow etc
- ❖ 10.000 MW will use all the *existing* flexibility (give or take)
- ❖ Further expansion requires new generation capacity and soon also pumping. Low cost projects first

Robust, but declining profitability + Many uncertain factors



Challenges to implementation

- ❖ All parties must expect to gain
 - Marked design and capacity payment
 - Perception of risk
- ❖ Fast expansion – can the market do it?
 - Cable production capacity
 - Investments in transmission and cables may be closely linked to investments in generation and pumping
 - Coordination and packing?
- ❖ Government involvement?

Thank you for your attention!