Impacts of Wind Power on Power Spot Prices

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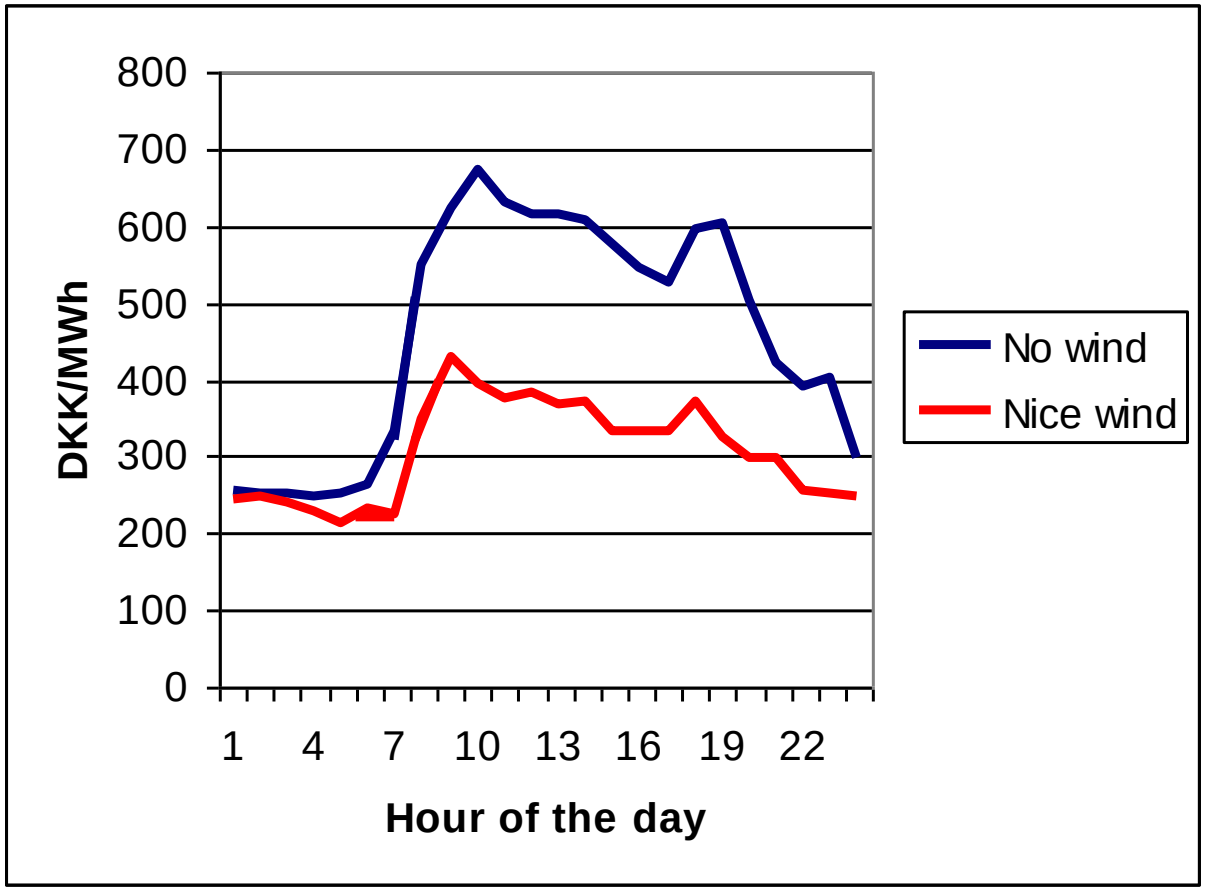
Wind Power and Spot Prices

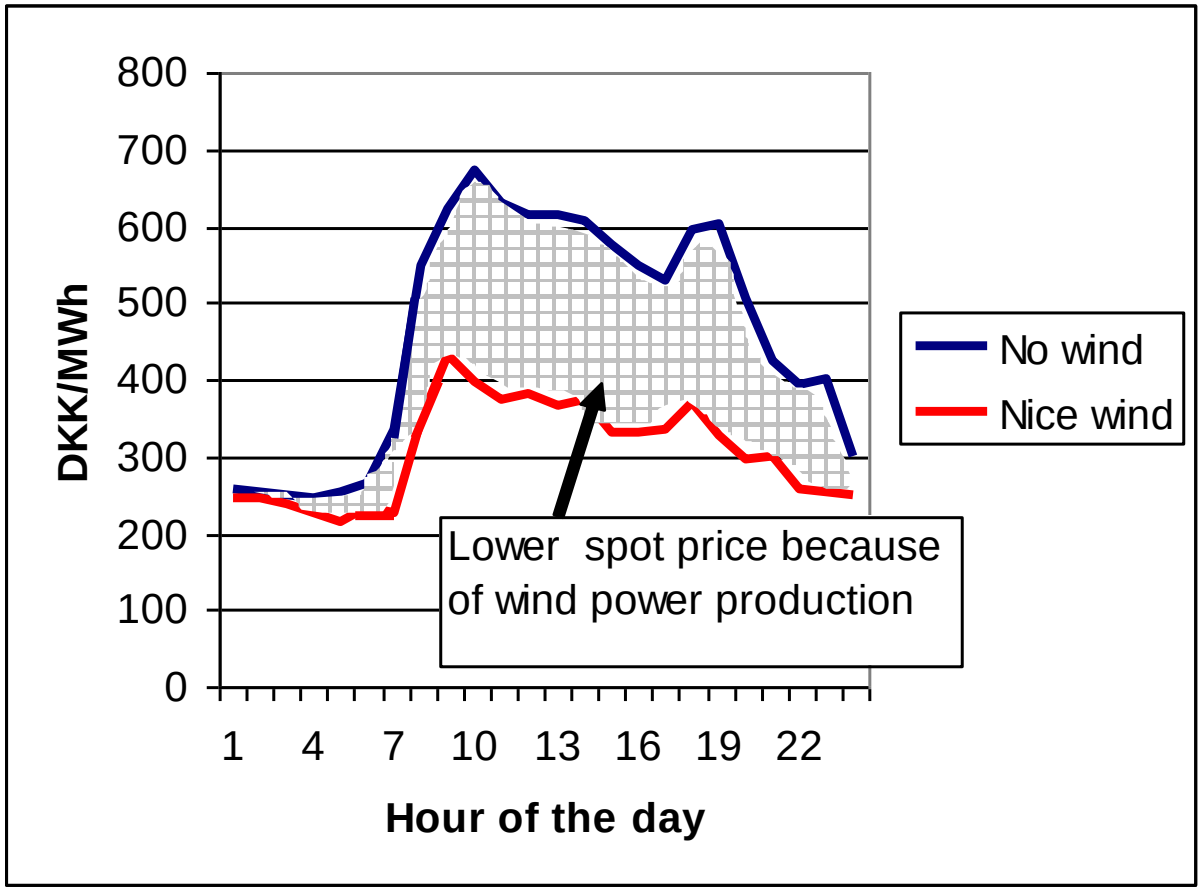
- We know that Wind Power does affect the Spot Price
- …but how much?
- .. and can we somehow calculate the consequences?

Illustrative example



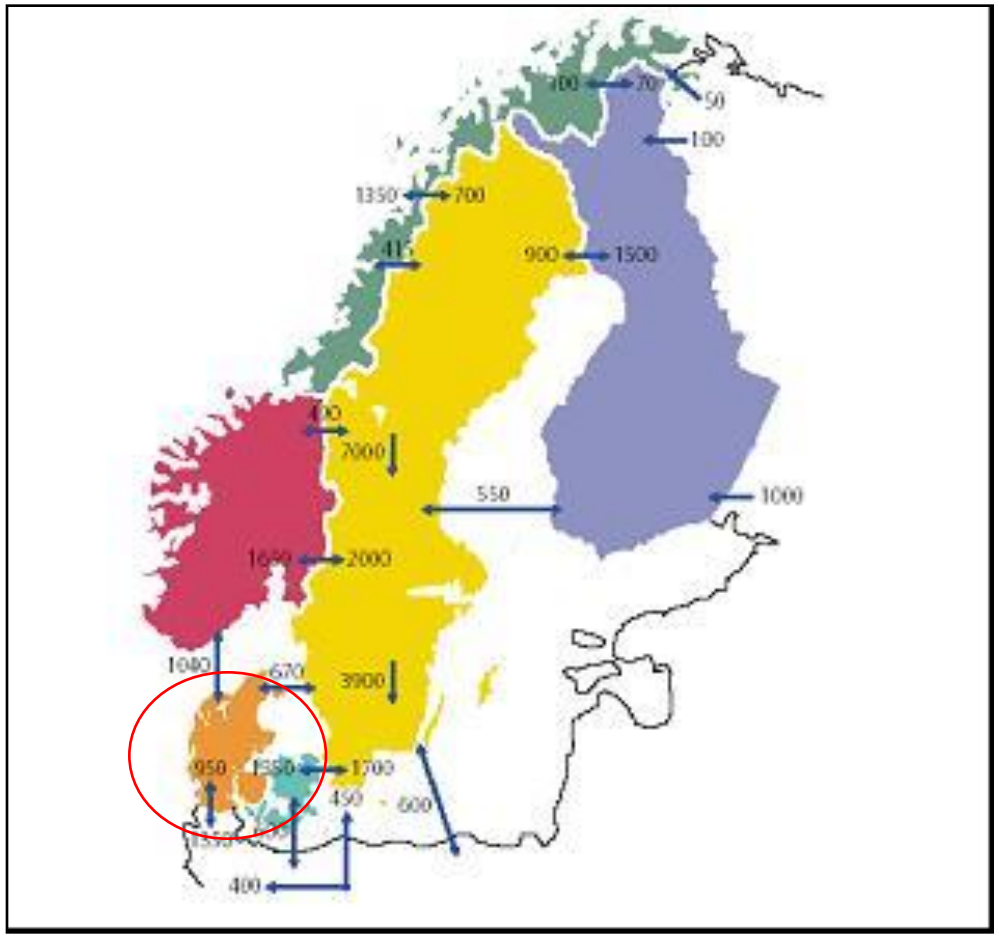
- **At the power market we have power prices and wind power production 24 hours a day**
- **For each hour we divide prices into two categories: No Wind and Nice Wind**
- **We calculate the average**

Illustrative example



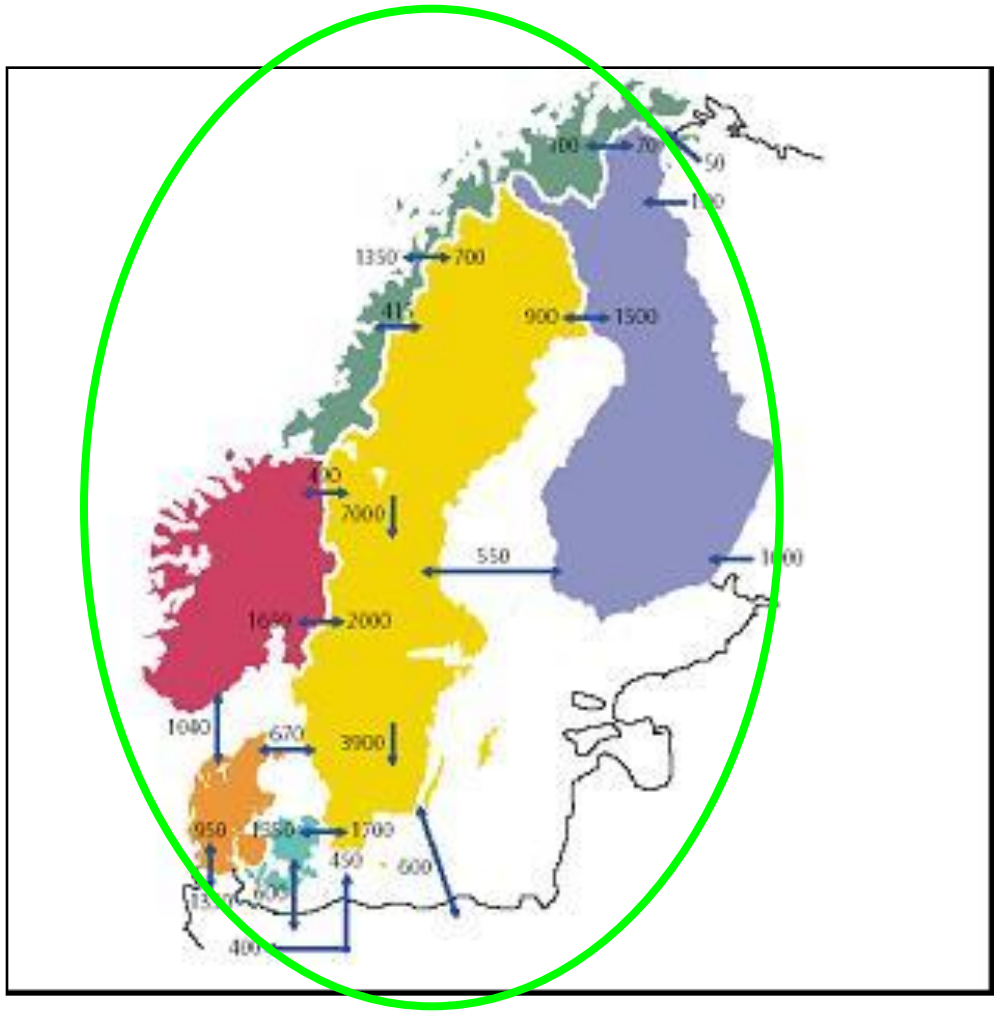
- **The difference between the two curves is caused by wind power production**

Denmark is a small country…..



- **Nordic power market comprising Sweden, Norway, Finland and Denmark**
- **In Denmark we have 3200 MW wind power – app. 4500 turbines**
- **Wind power covers 21% of Danish electricity consumption**

Bottlenecks in transmission between countries



- **No bottlenecks in transmission**

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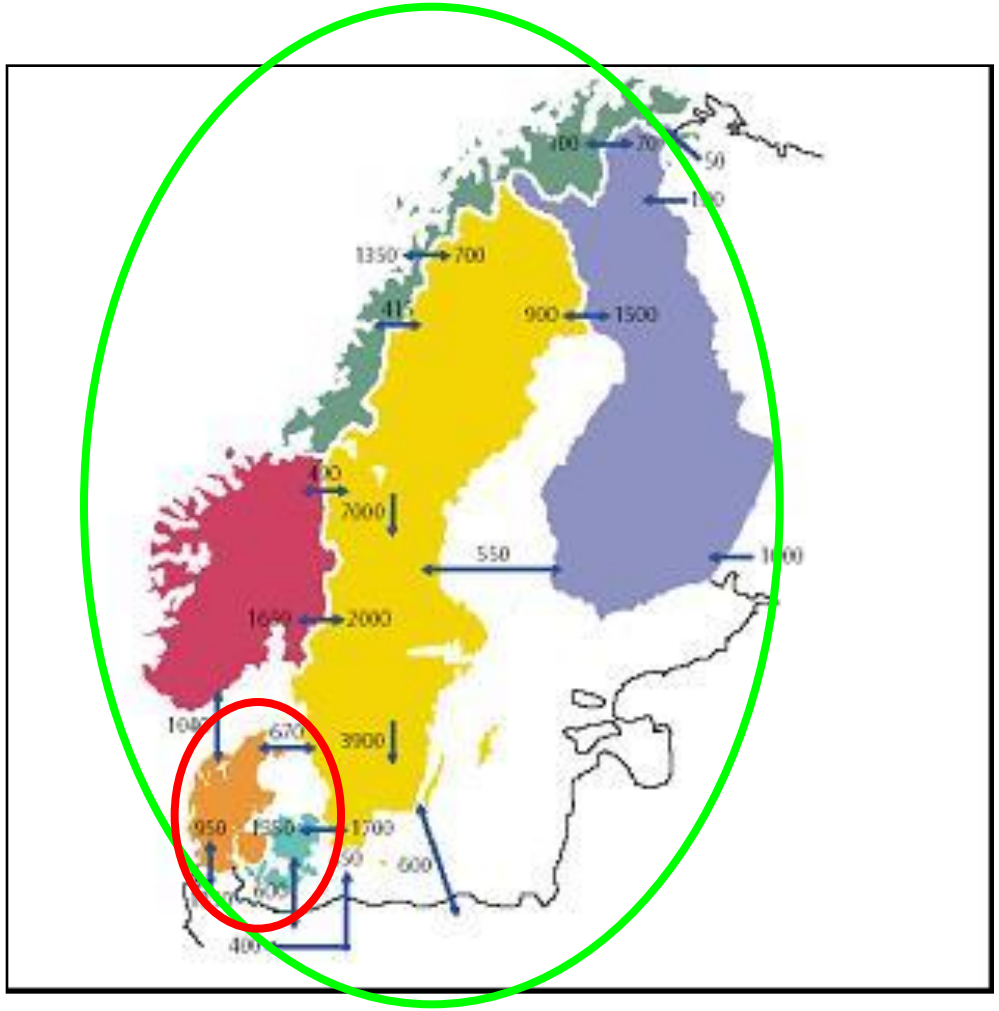
- **One spot price for the whole area**

Bottlenecks in transmission between countries



- **Bottlenecks in transmission between Denmark and the other countries**

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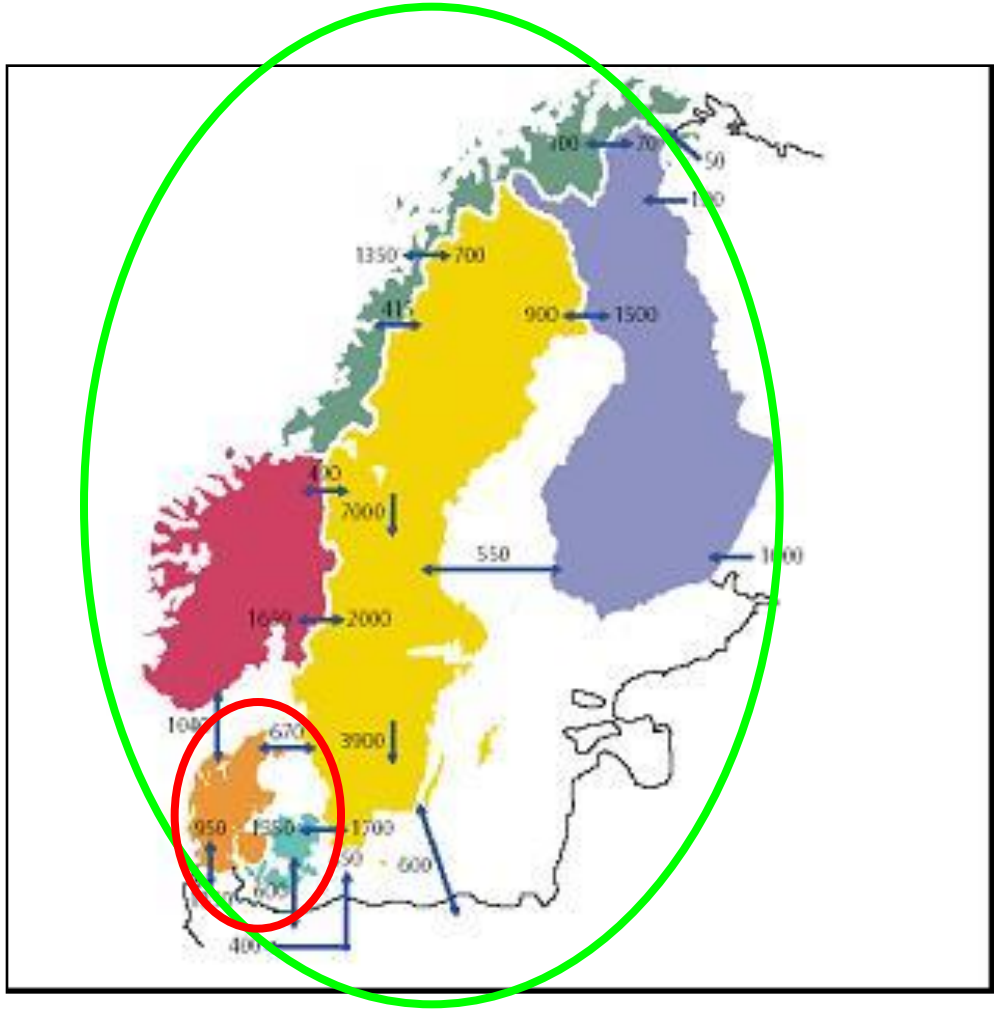
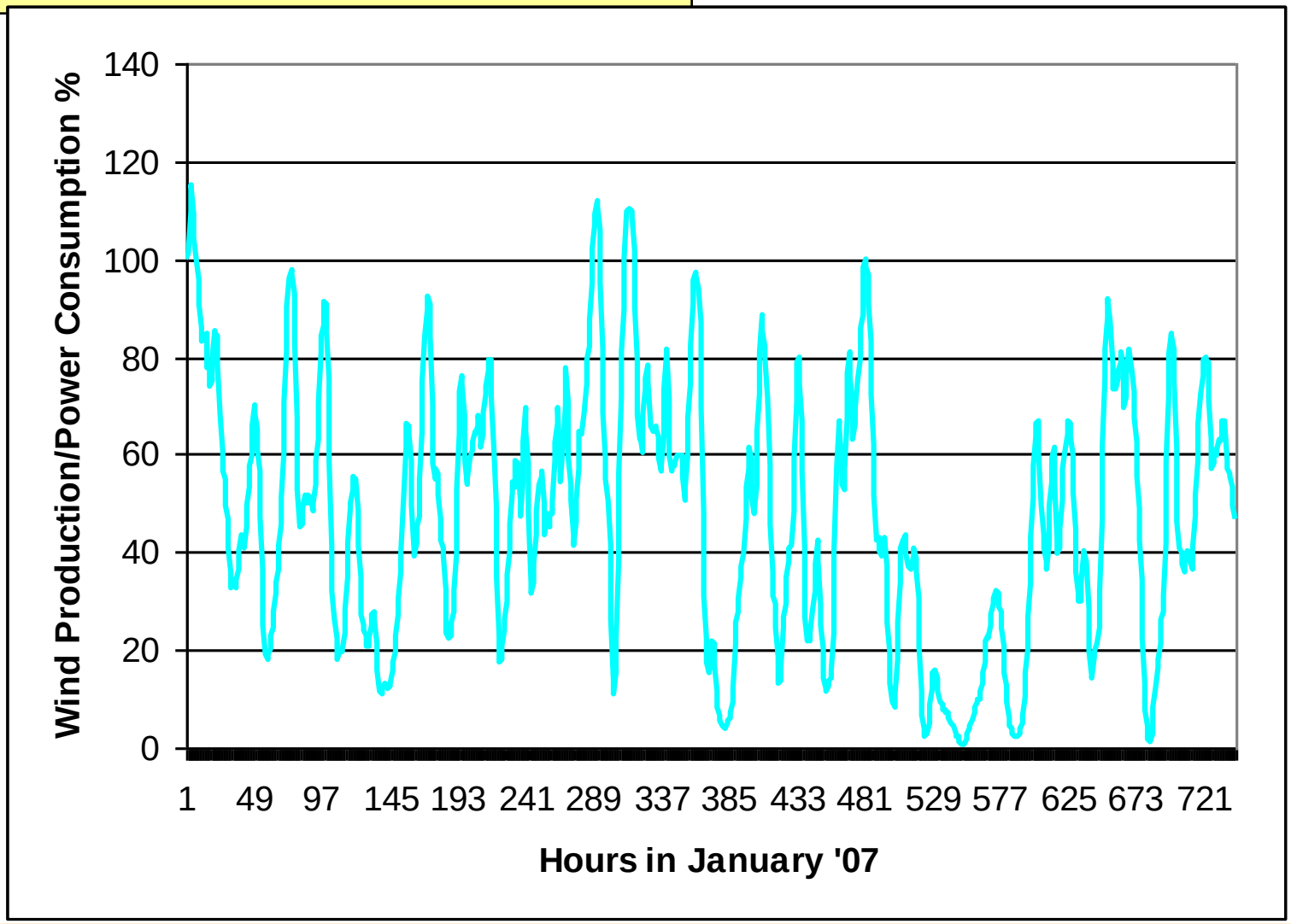
- **Denmark constitutes its own spot price area**

Denmark is divided into two areas..

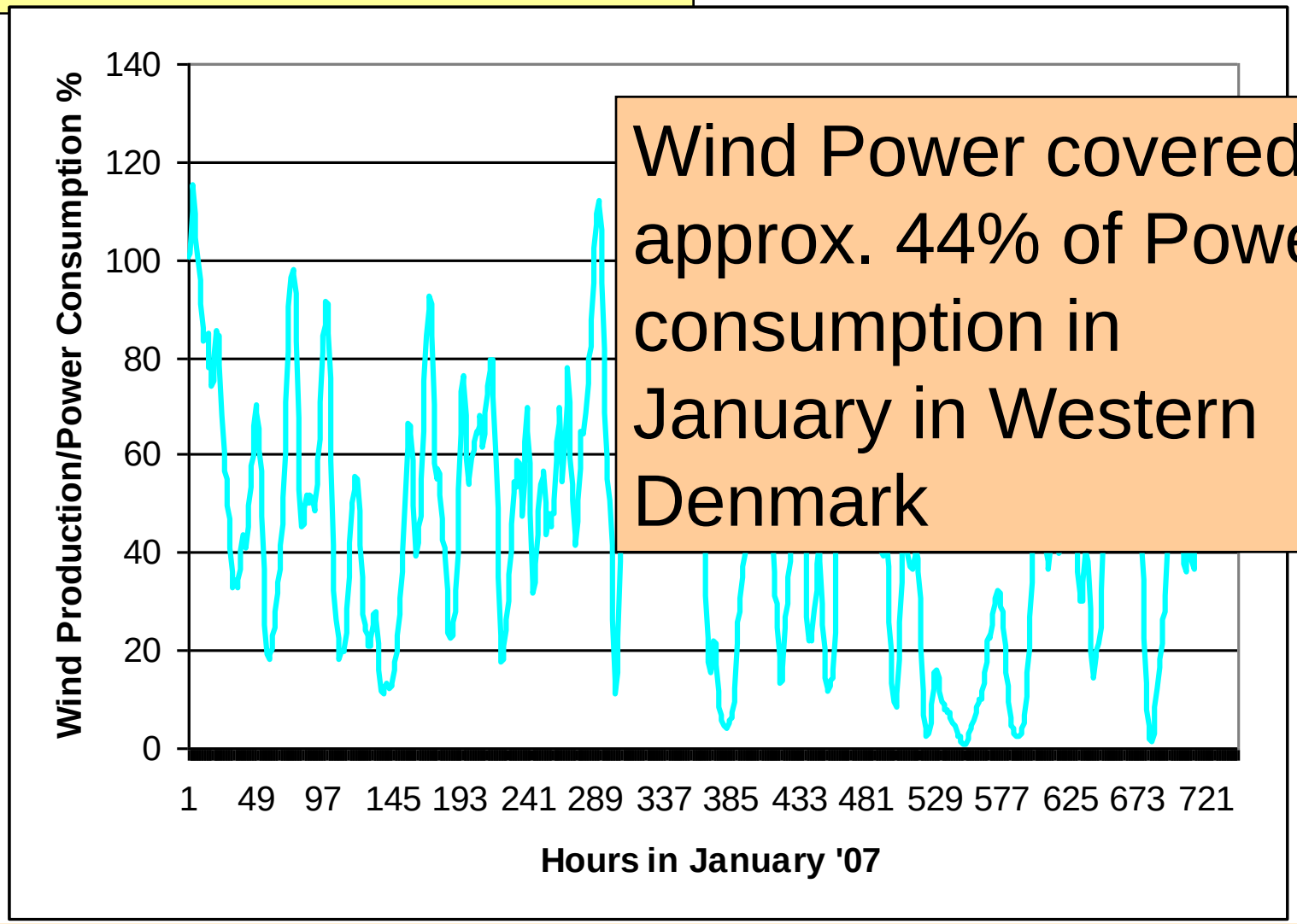


- **Eastern and Western denmark are not electrical connected**
- **Western Denmark Has approx. 75% of wind power capacity**

Wind power in Western Denmark

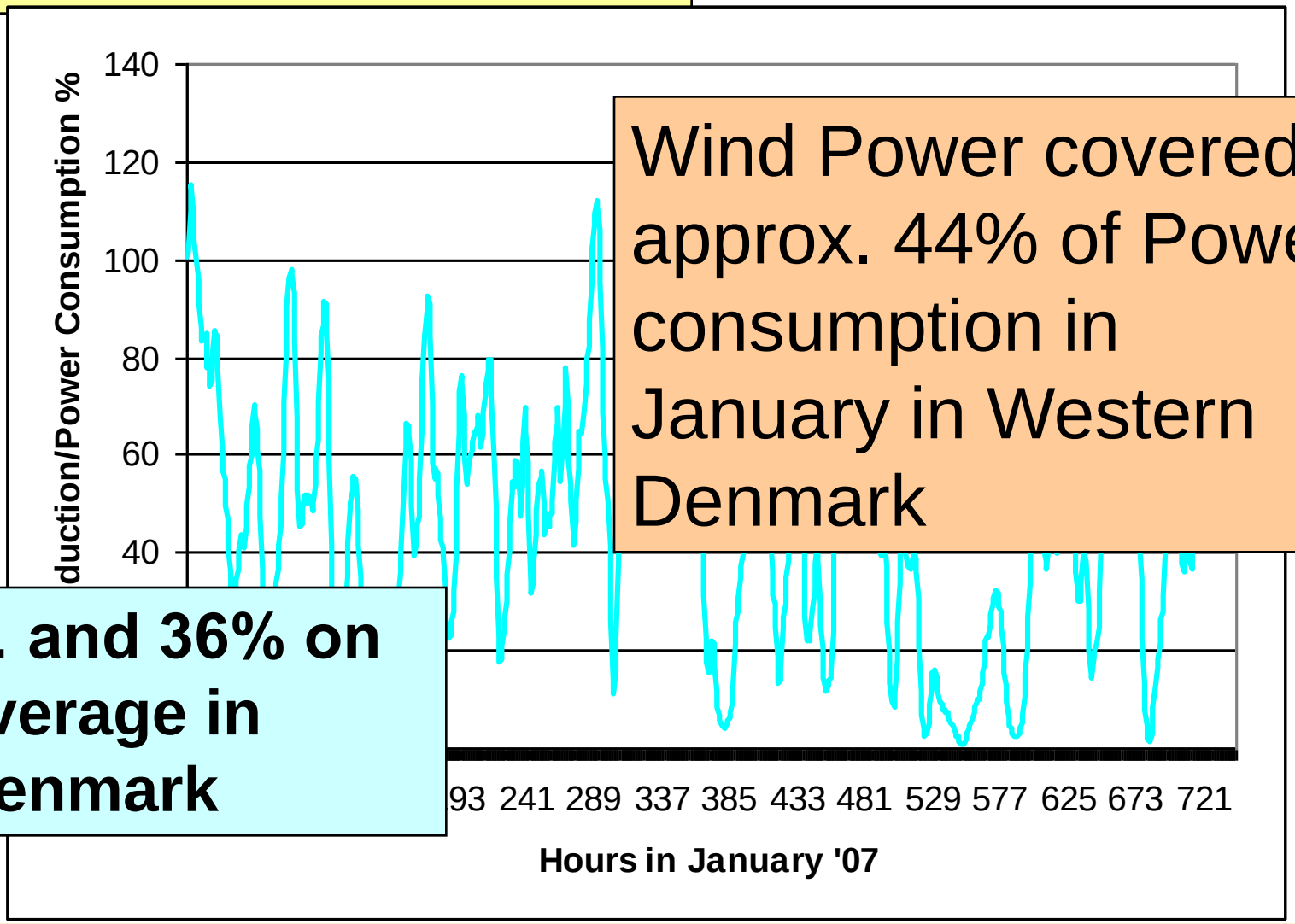


Wind power in Western Denmark



Wind Power covered approx. 44% of Power consumption in January in Western Denmark

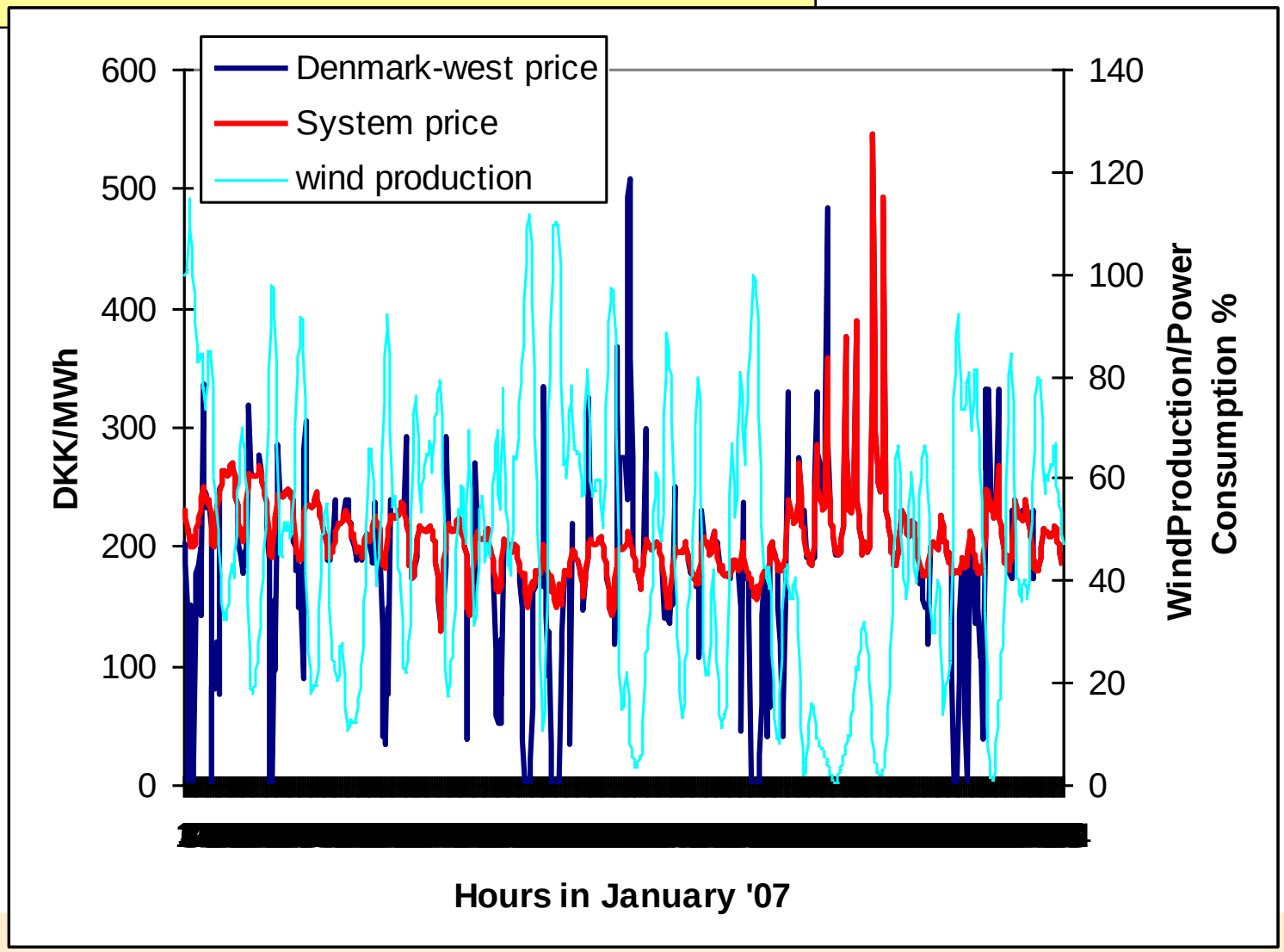
Wind power in Western Denmark



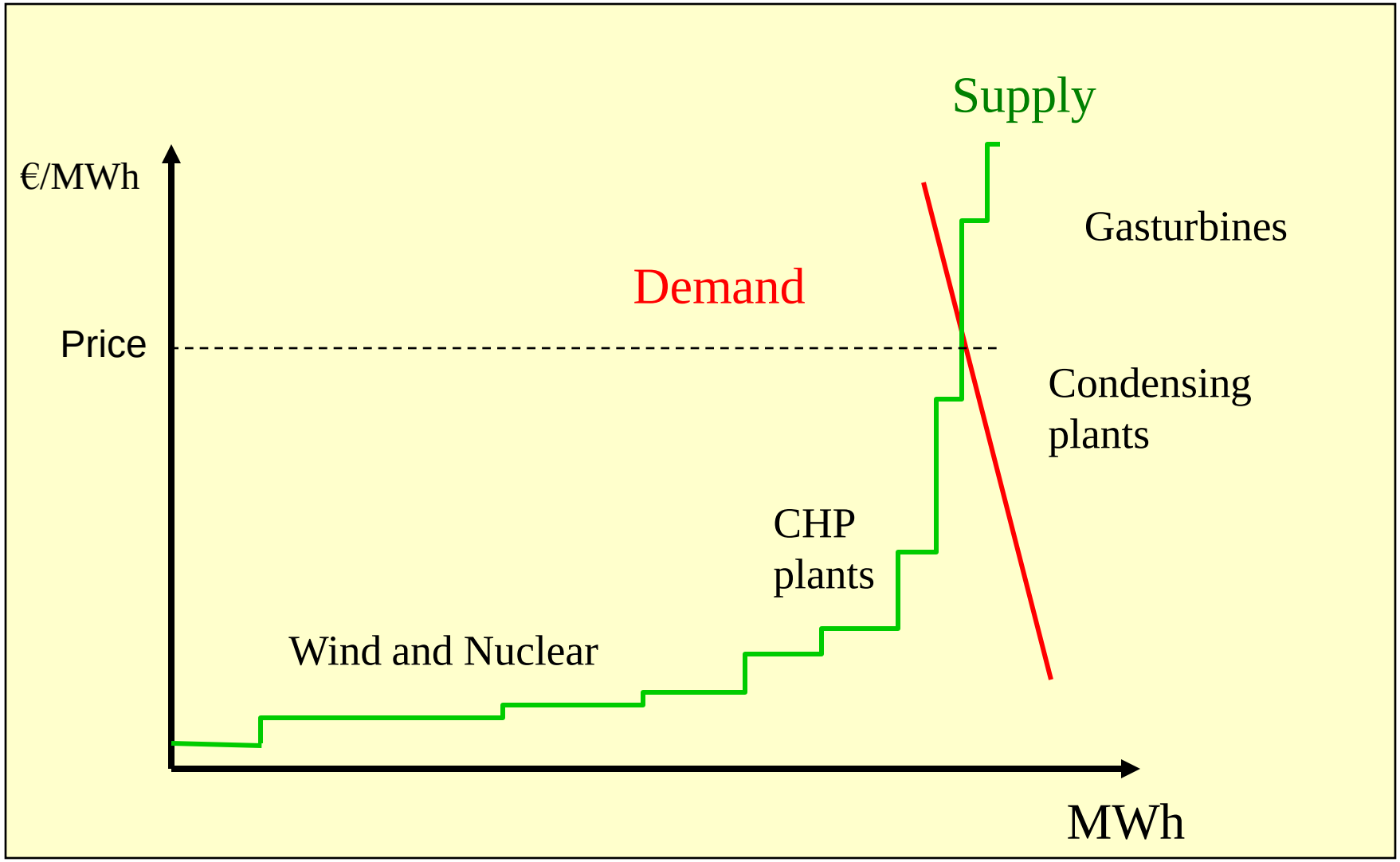
Wind Power covered approx. 44% of Power consumption in January in Western Denmark

… and 36% on average in Denmark

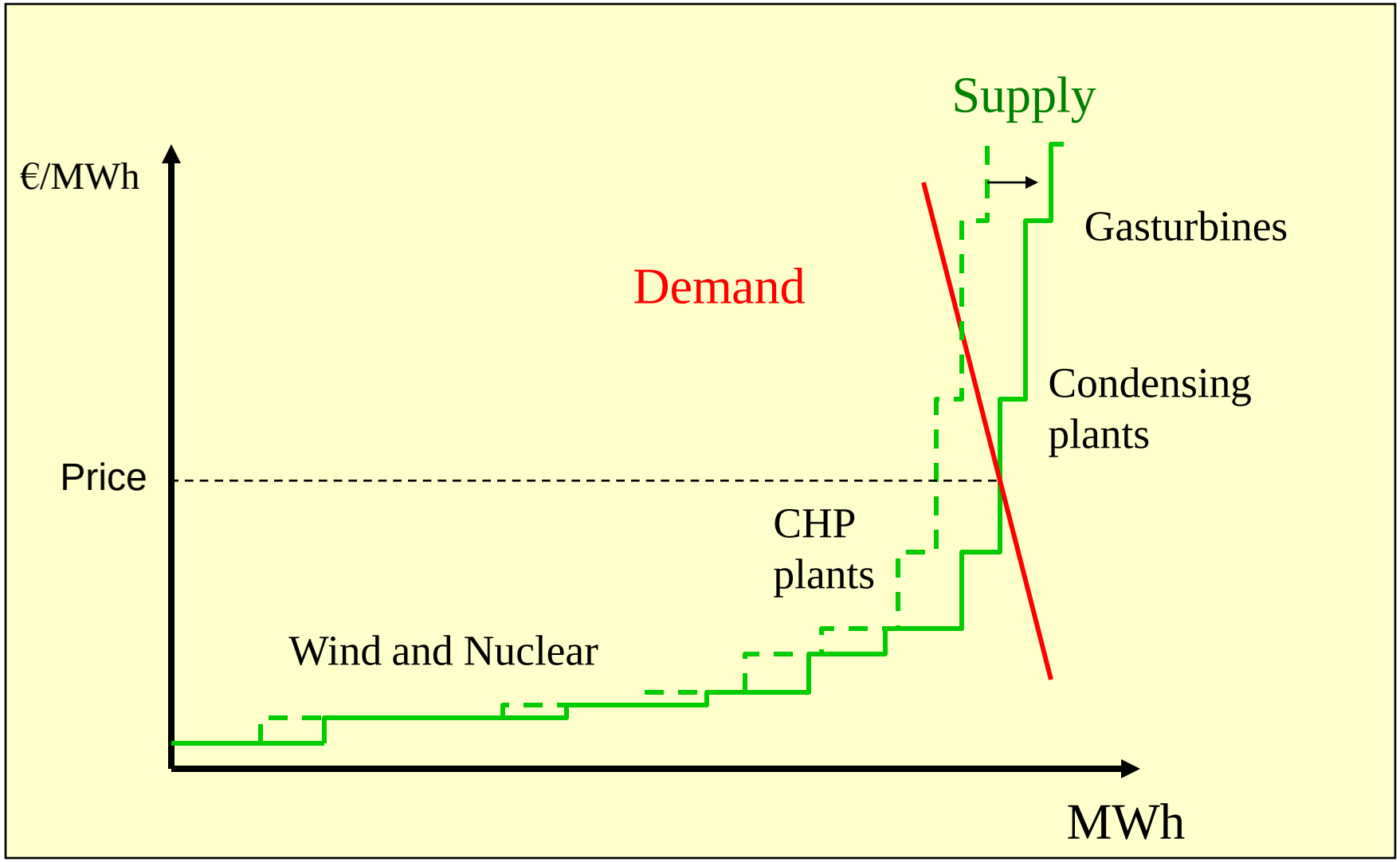
Impact on Spot Price



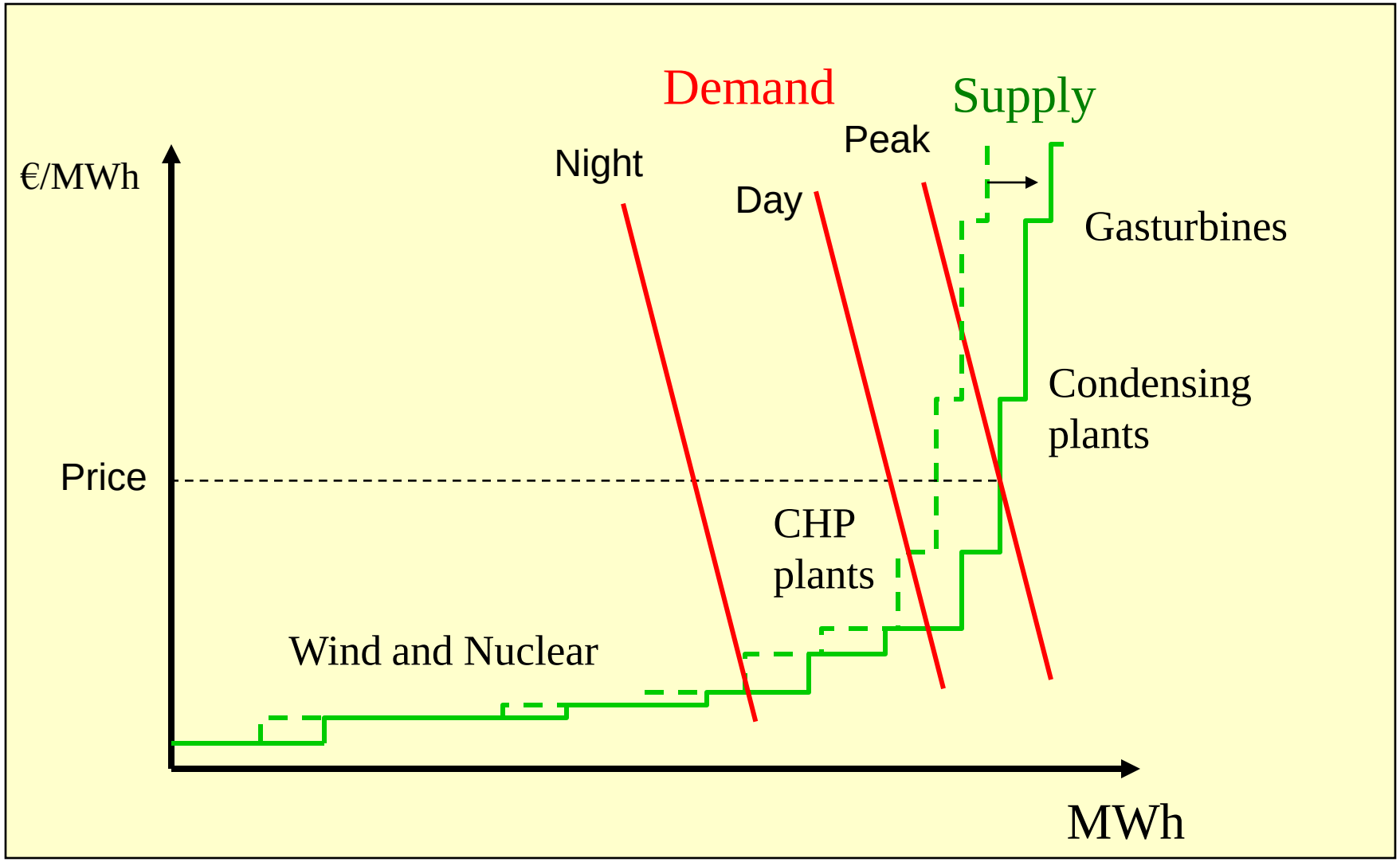
Small amounts of Wind Power



Large amounts of Wind Power



Time of day is important



… many issues impact the spot price

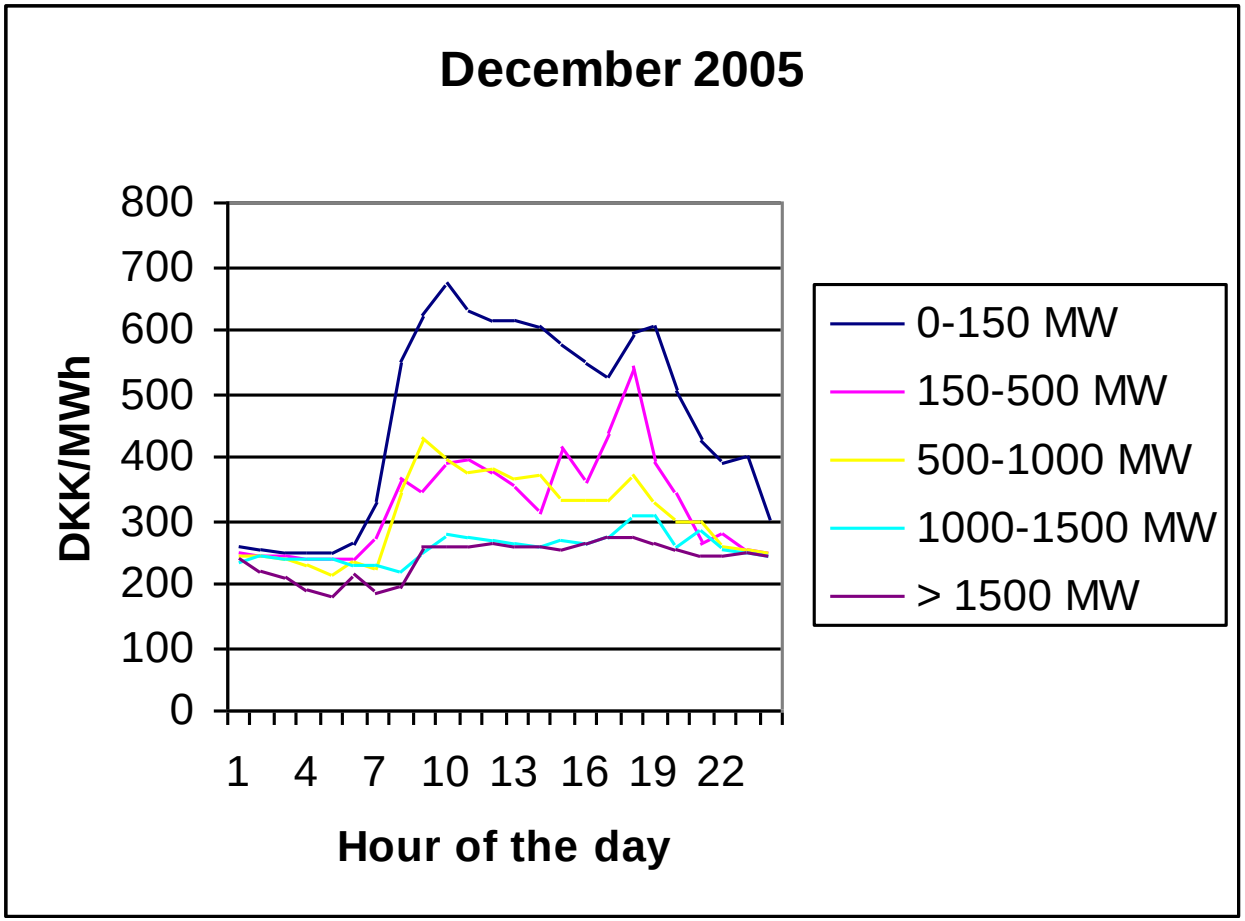
- Journal and seasonal variations in electricity consumption
- Precipitation – hydro power
- Cross-border trade
- Oil- , gas- and CO2-prices
- Trends – less capacity
- Noise

Decomposing – structural analysis

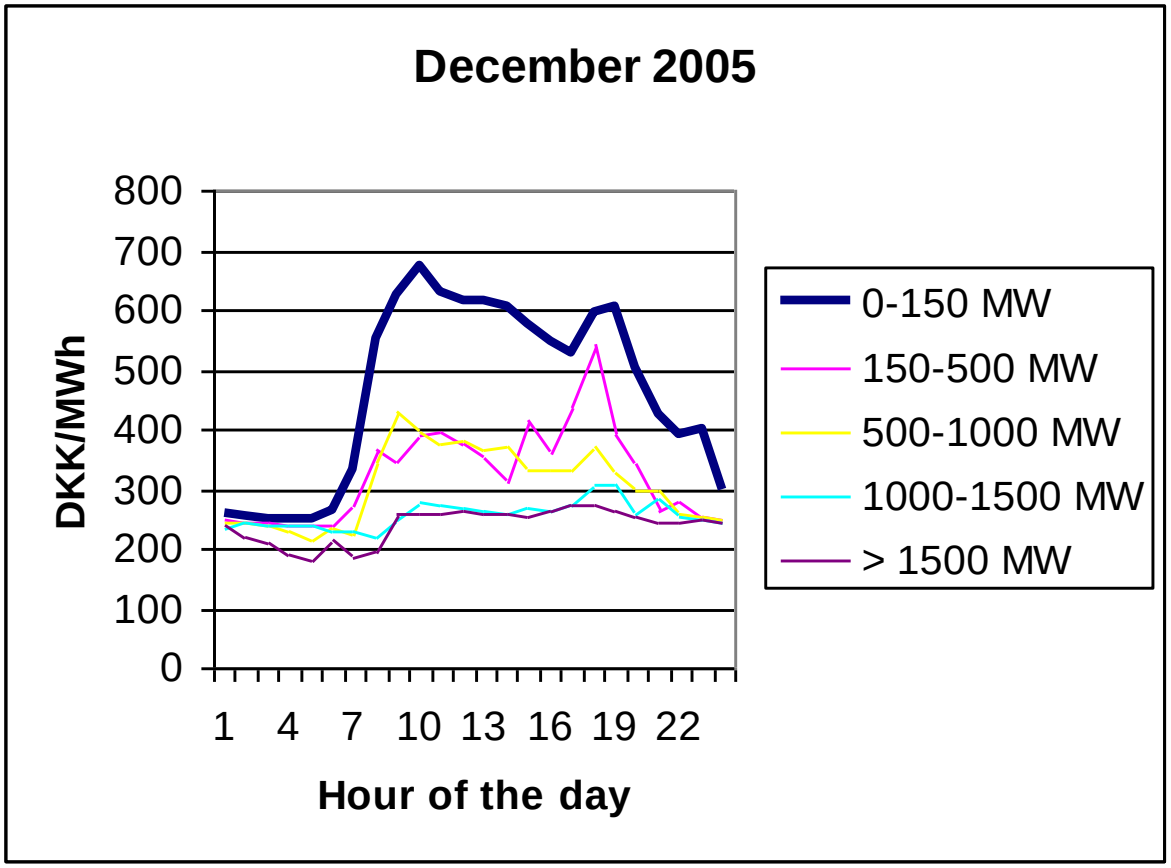
Calculations performed for

- Hour of the day (24 steps)
- Month of the year (max. 12 steps)
  - comparable month are merged
- Five categories of wind power
  - 0 – 150 MW equals ”No wind” reference
  - four more categories from ”low wind” to ”storm”, the lastmentioned covers more than 1500 MW

Impact at the Western-Denmark power market



The reference…

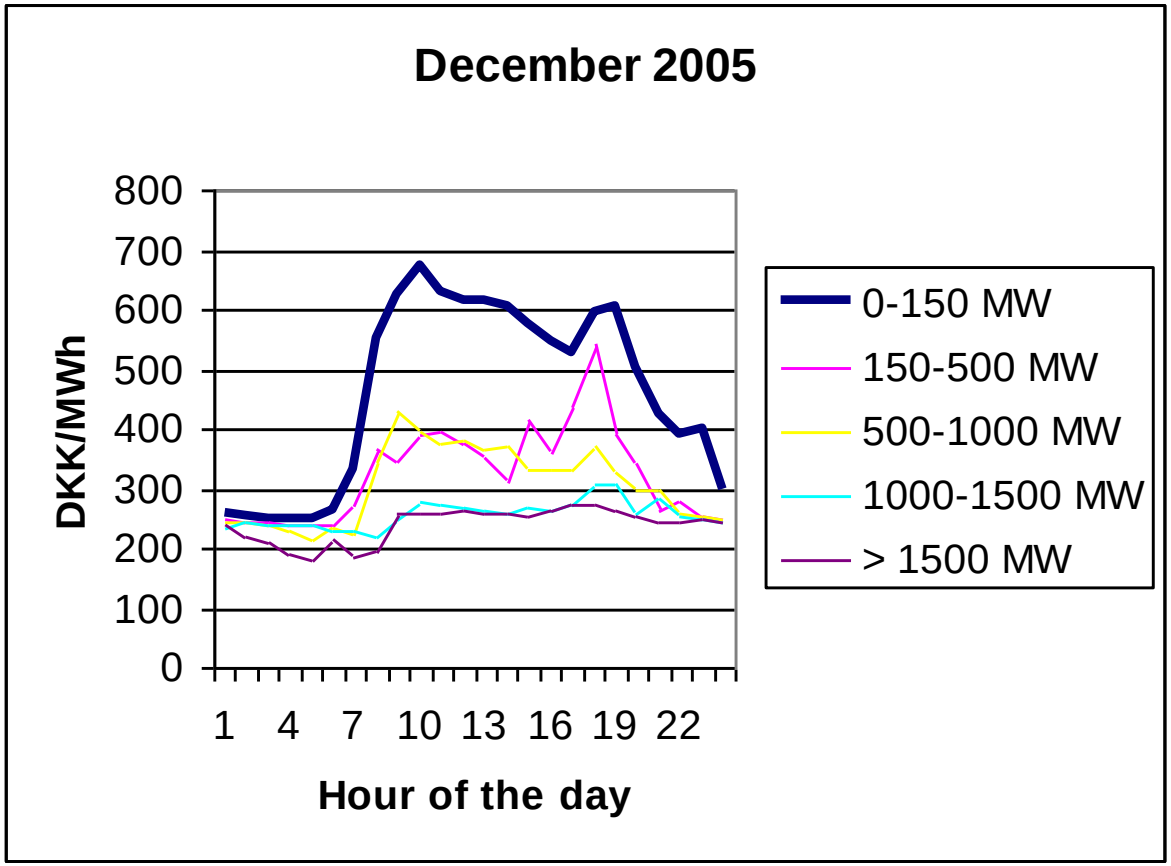


Correlation between spot price and wind power production, Western Denmark 2004-07

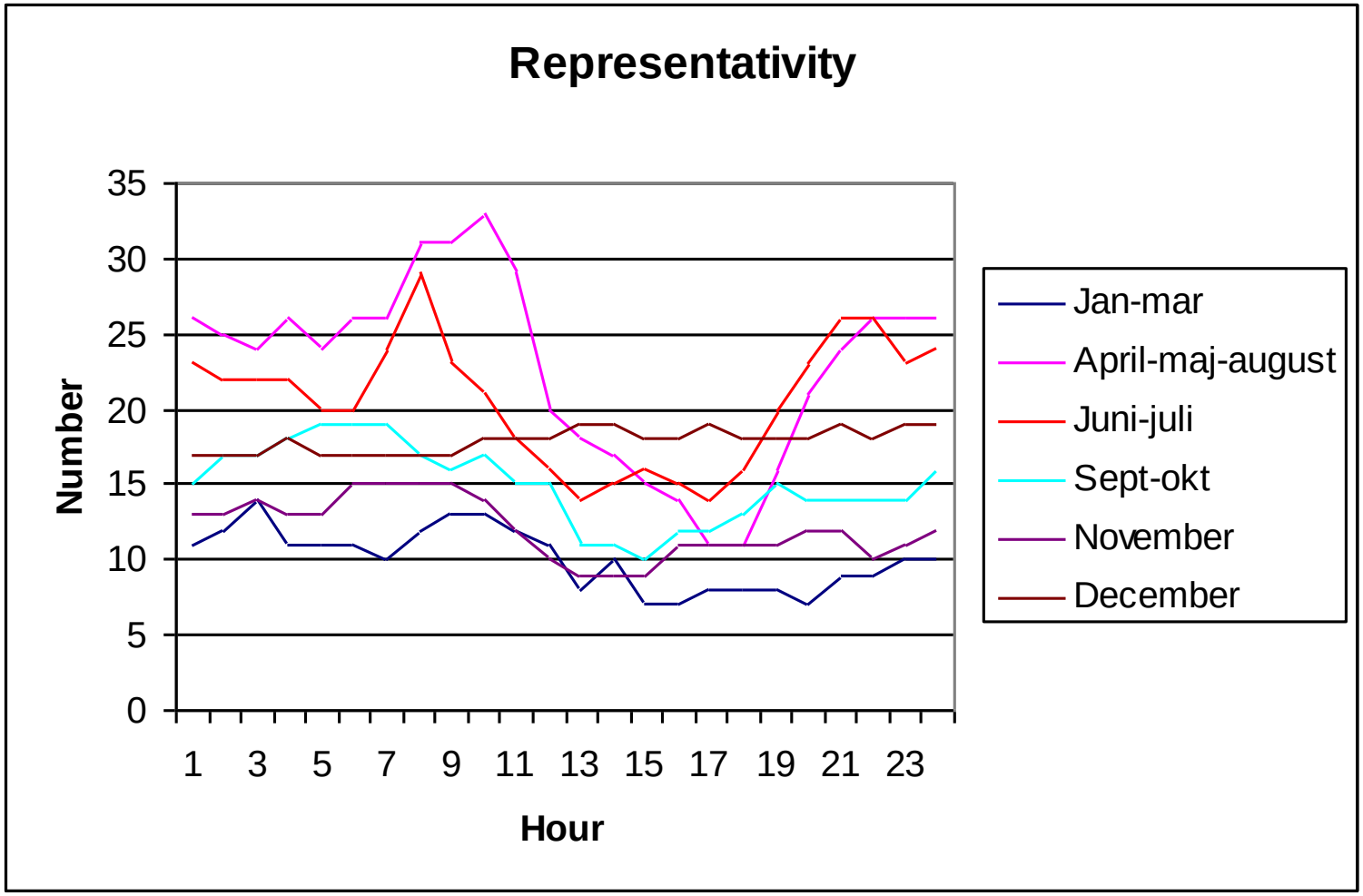
	2008	2007	2006	2005	2004
January	-0,32	-0,36	-0,15	-0,35	-0,39
February	-0,61	-0,30	-0,17	-0,22	-0,31
March*	-0,43	-0,37	-0,29	-0,20	-0,36
April		-0,12	-0,27	-0,35	-0,36
May		-0,12	-0,13	-0,10	-0,11
June		-0,01	-0,09	-0,05	-0,16
July		-0,19	-0,09	-0,25	-0,14
August		0,07	-0,05	-0,01	-0,15
September		-0,13	-0,13	-0,05	-0,30
October		-0,16	-0,37	-0,27	-0,09
November		-0,21	-0,30	-0,41	-0,30
December		-0,32	-0,17	-0,39	-0,29
Year		**-0,18**	**-0,30**	**-0,29**	**-0,28**

*** for the first 20 days of march 2008**

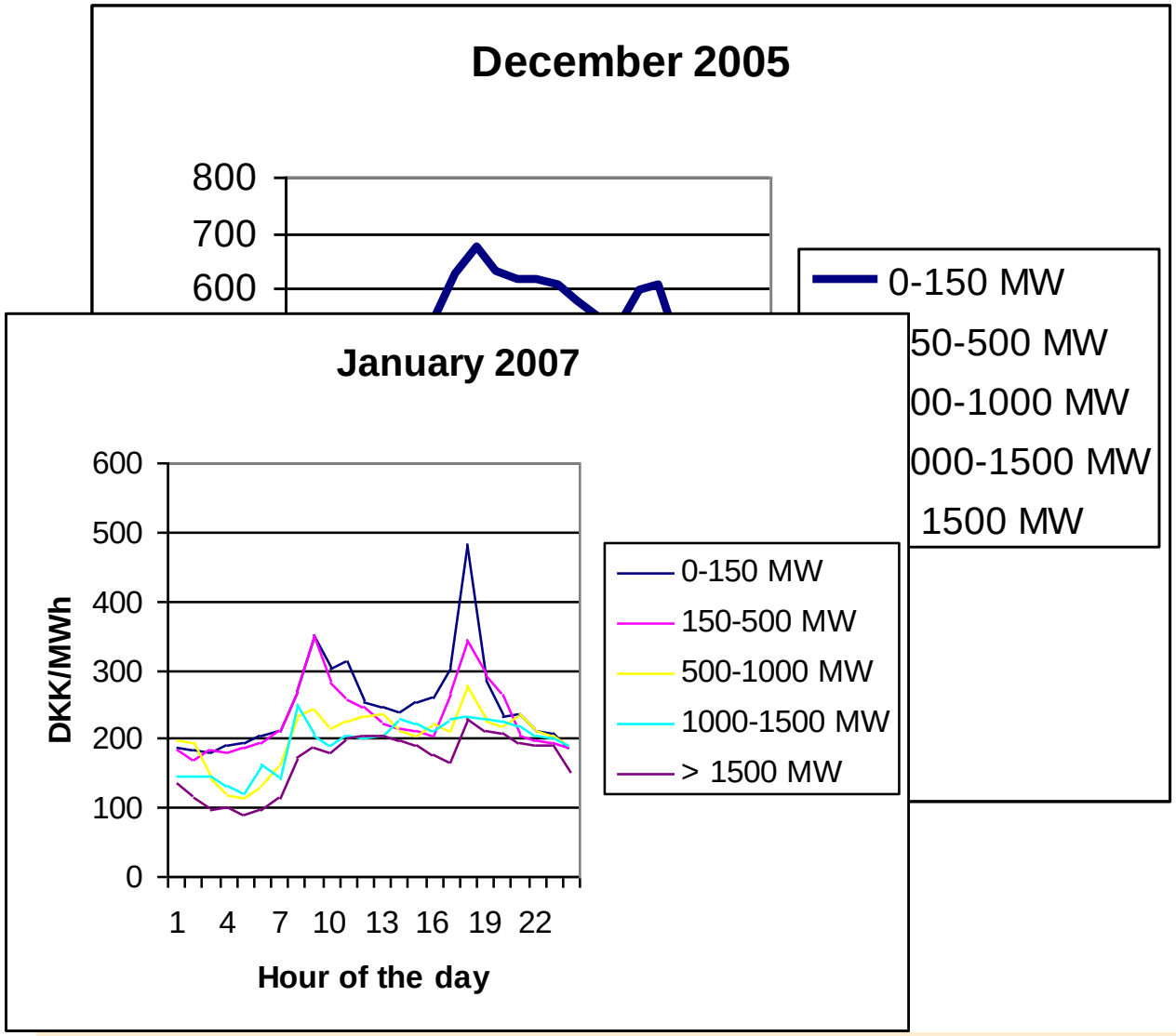
All levels statistically tested against the reference



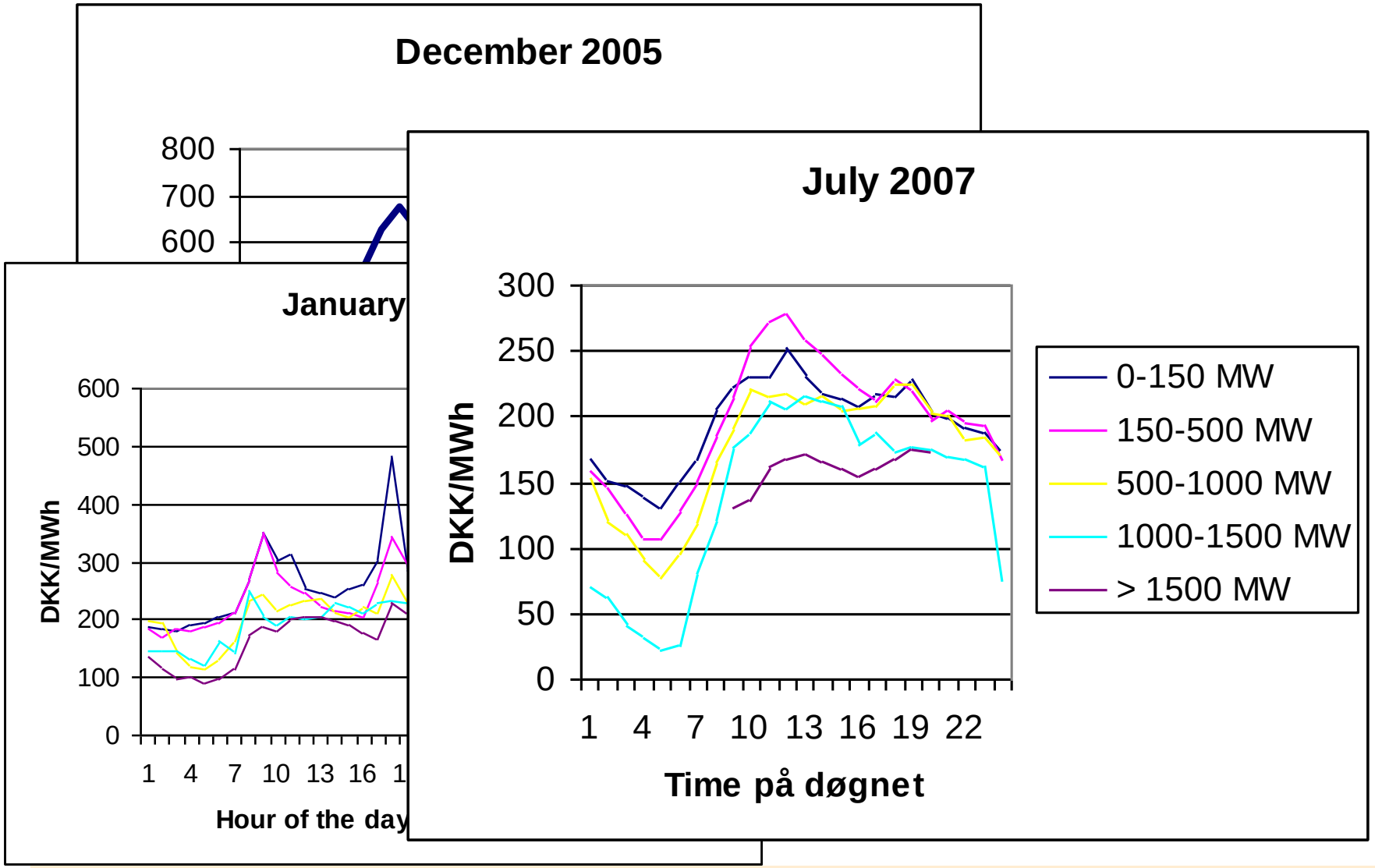
Representativity



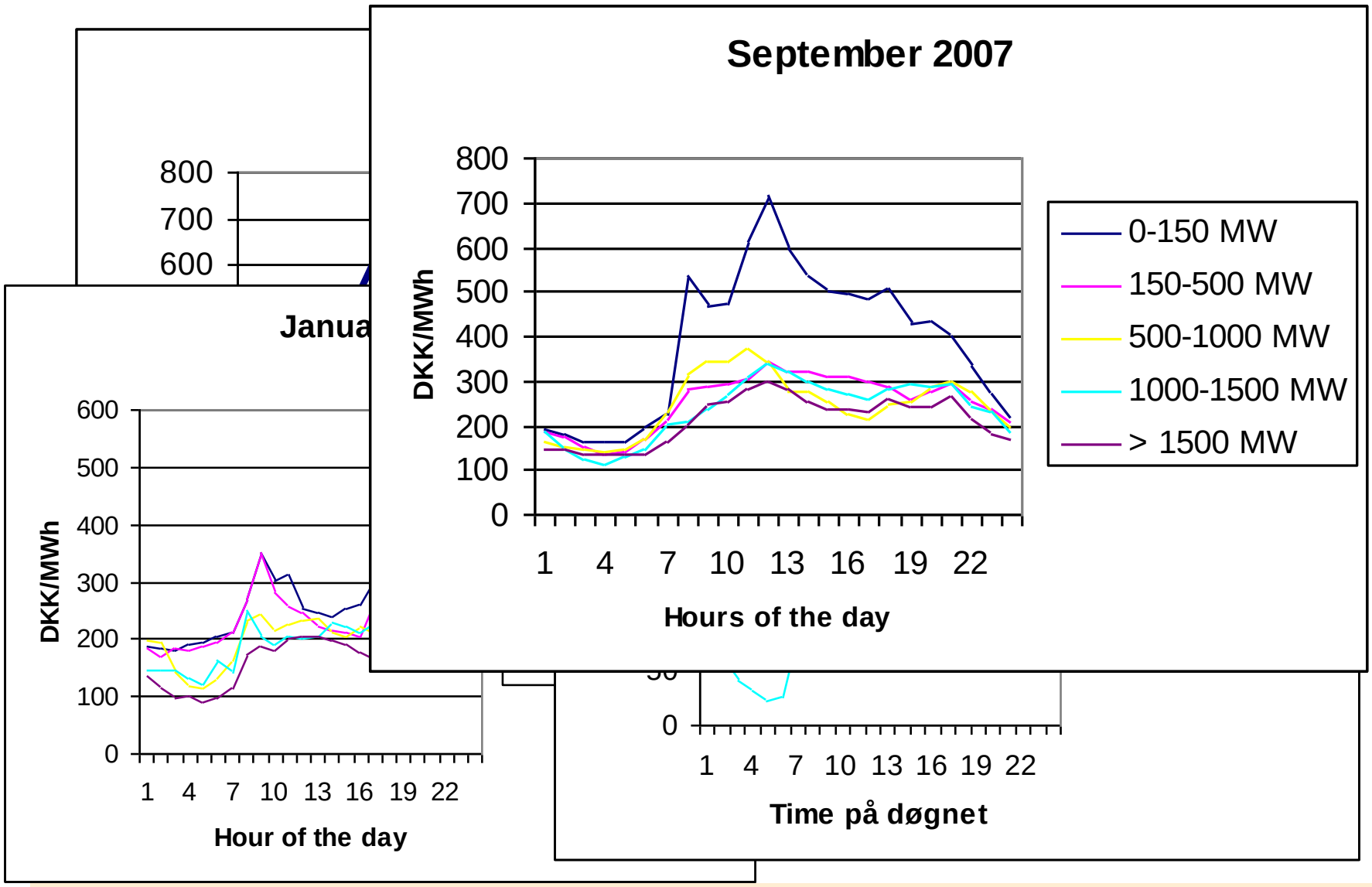
Not all month are equally pretty…



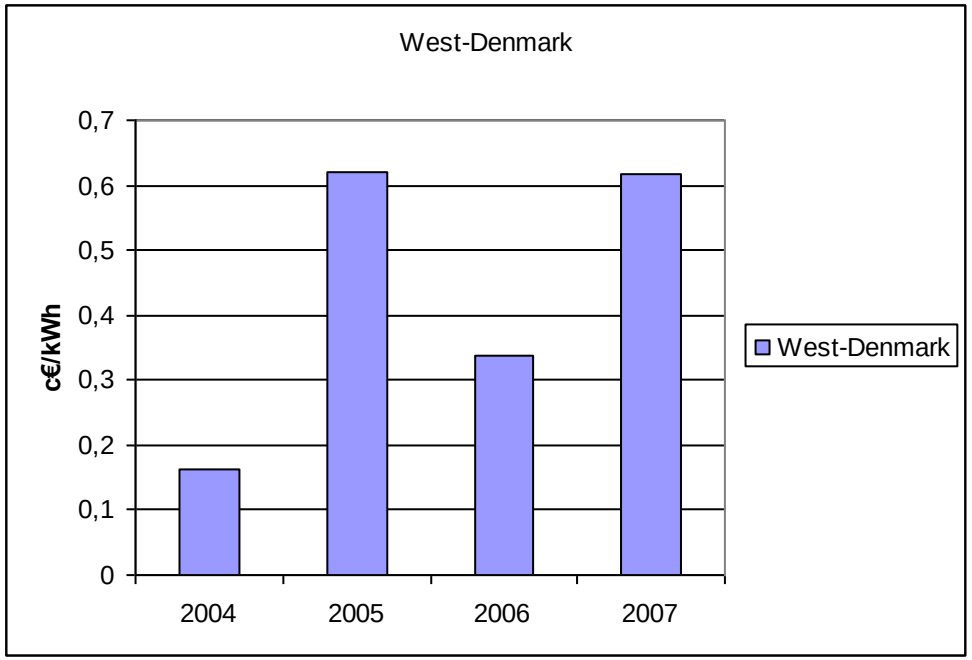
..also significant impact in the summertime…..



..but several months look fairly nice……



Consequences for Power Consumers in Western-Denmark



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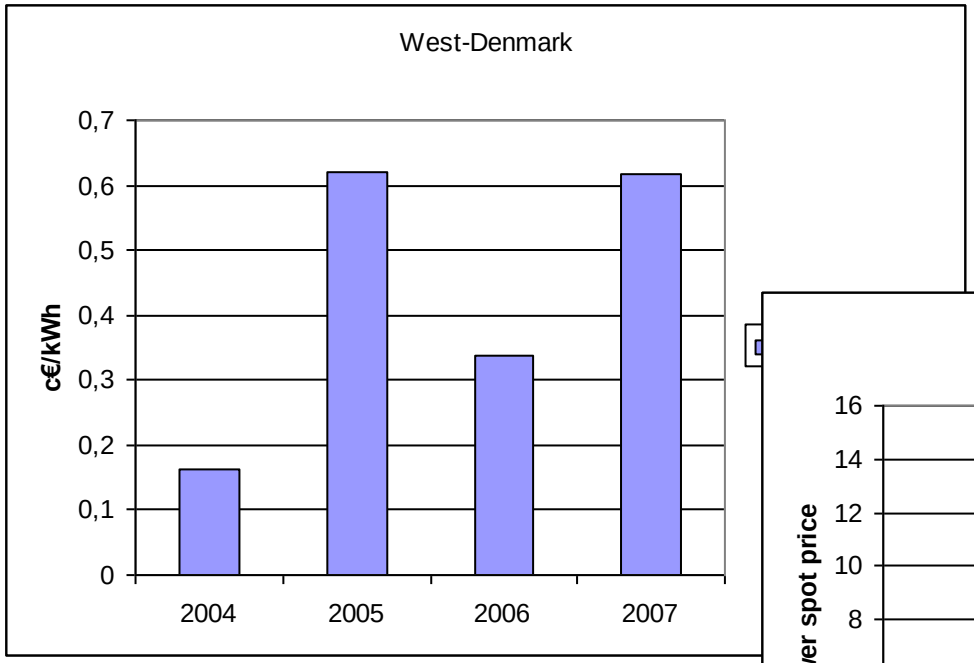
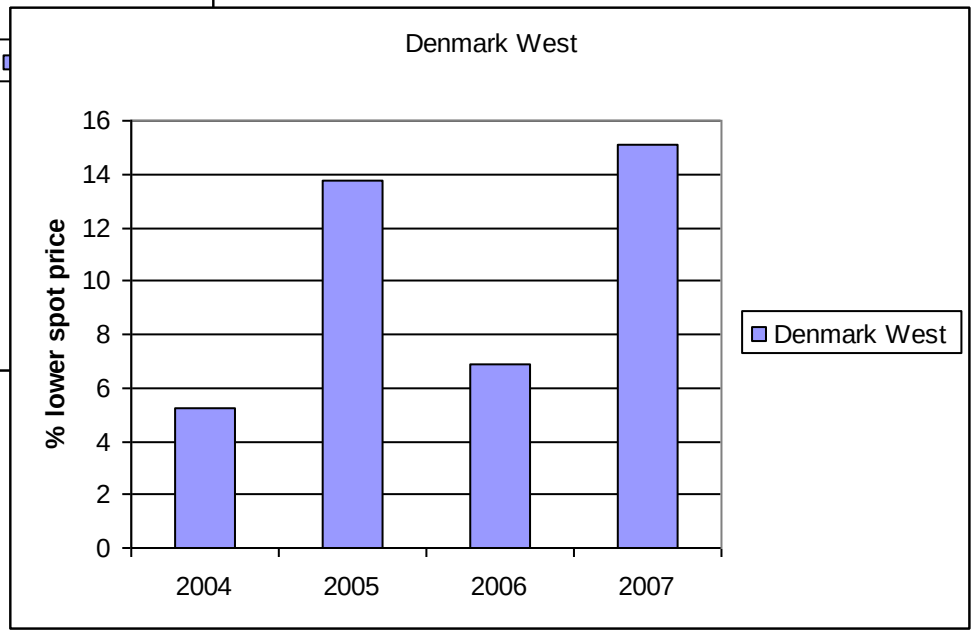
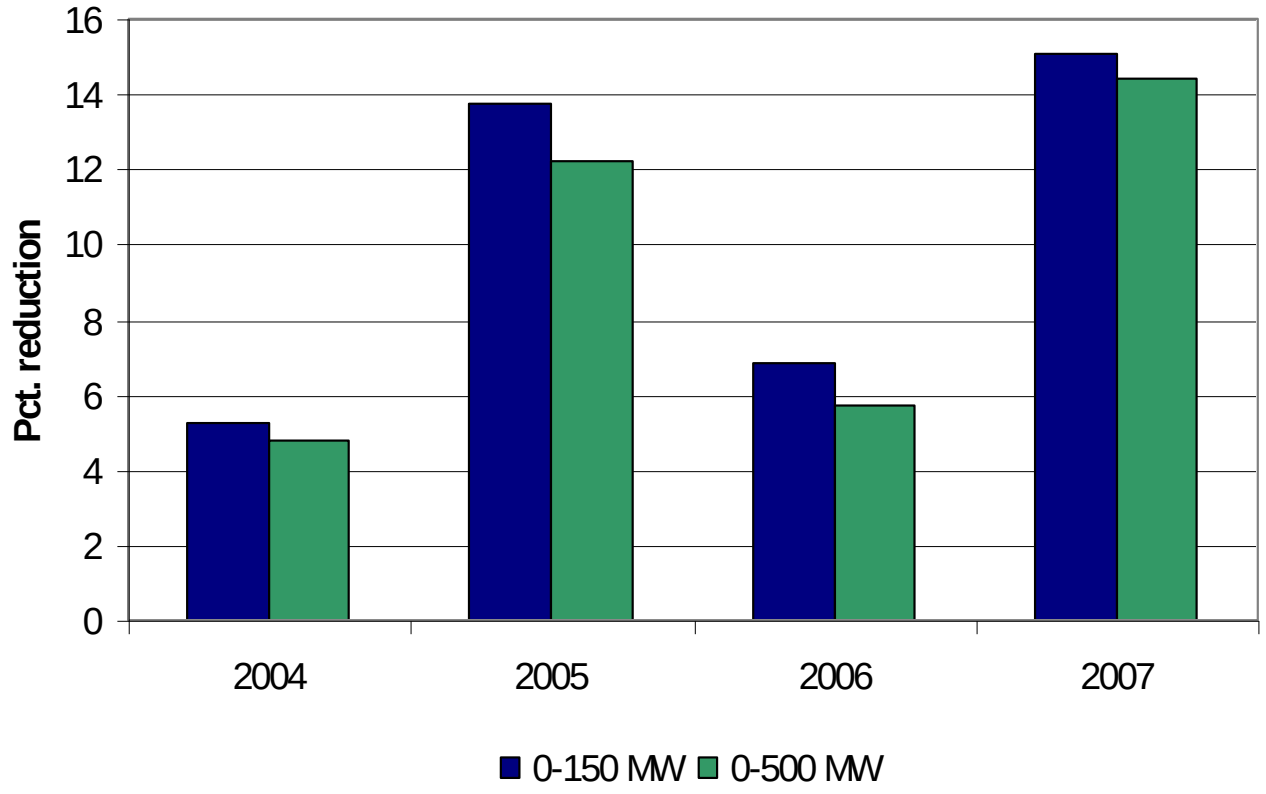
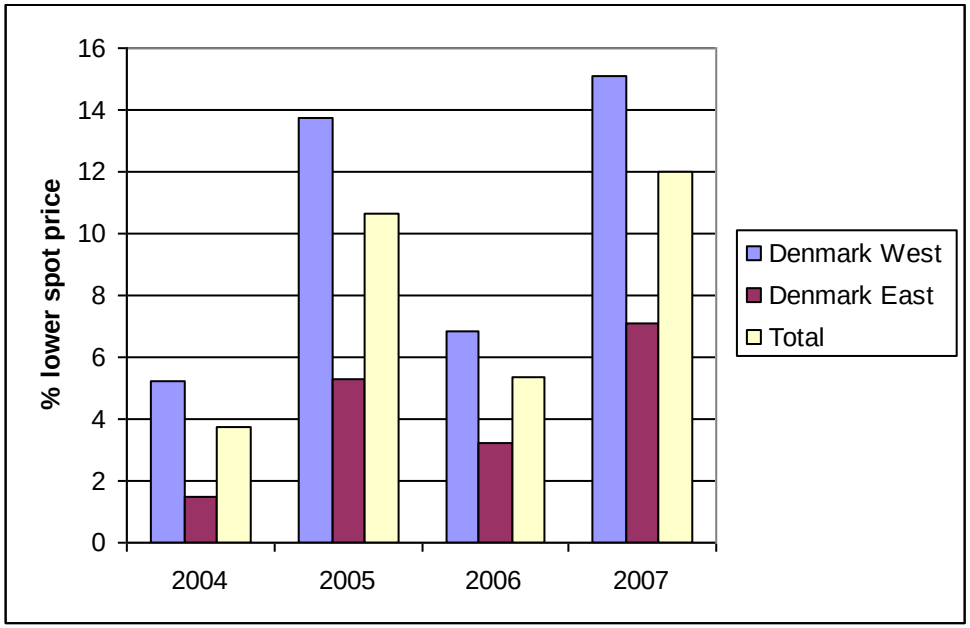




Robustness of reference in West-Denmark results



Lower spot prices benefit the Power Consumers



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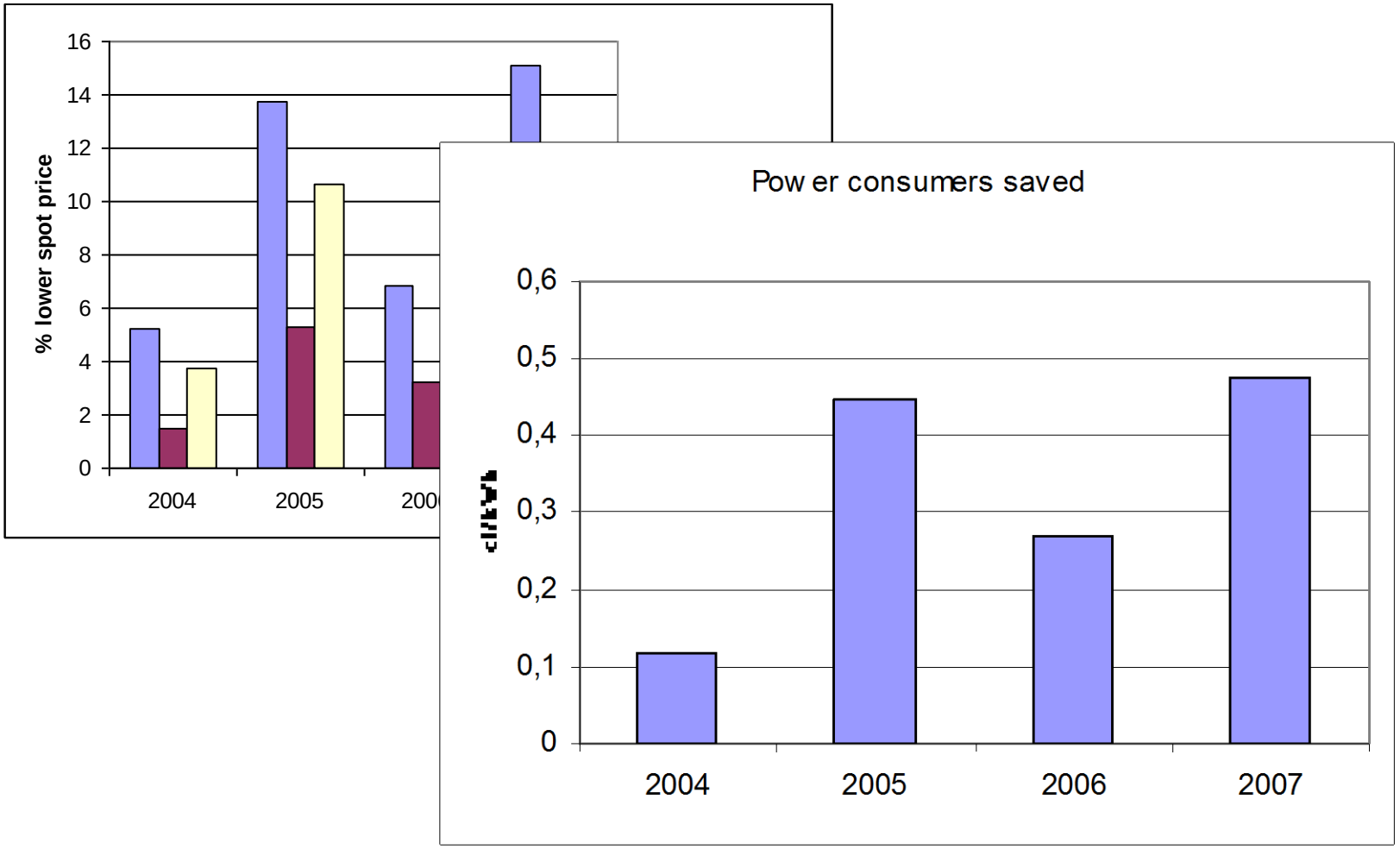
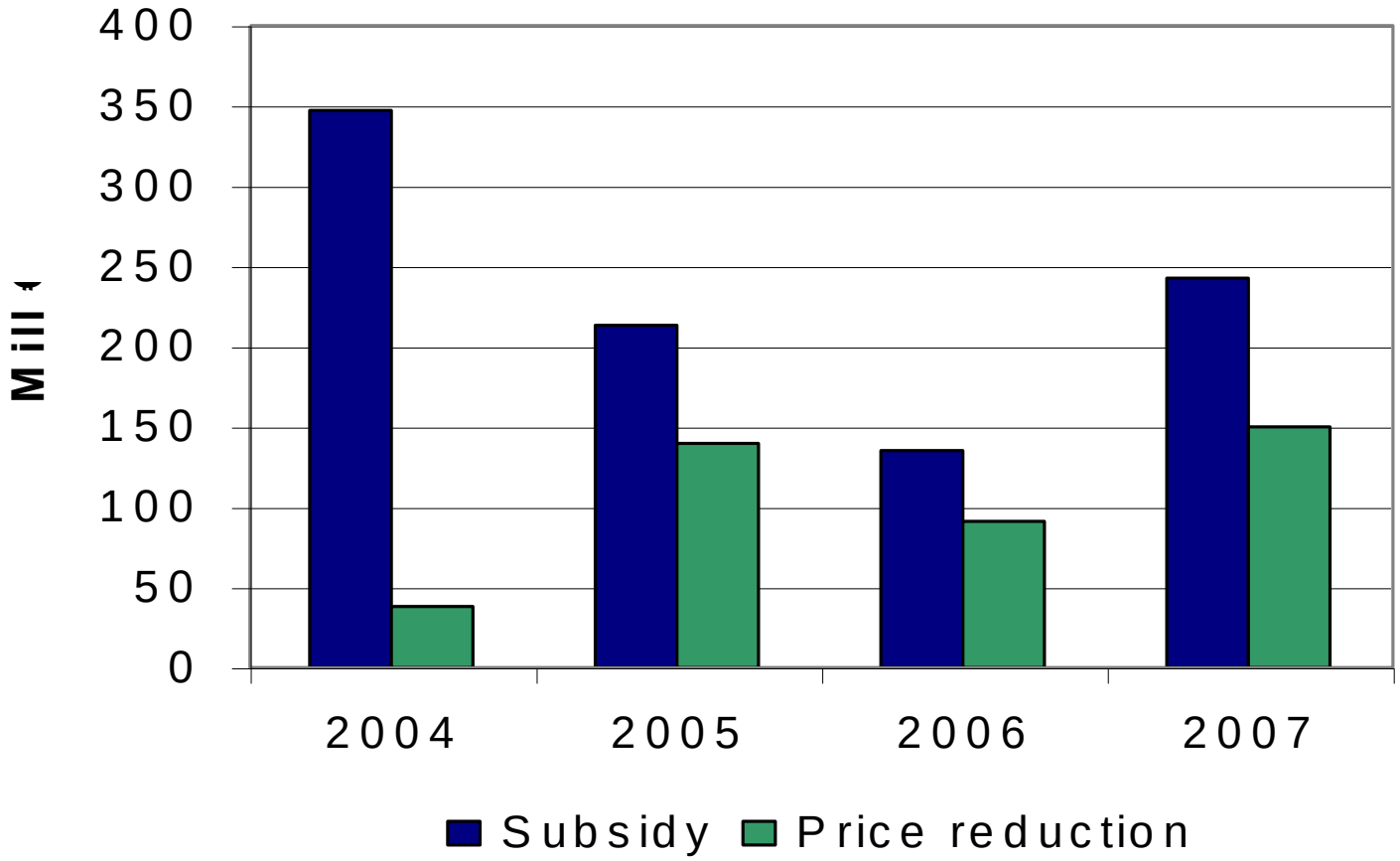


Subsidies vs. Price reduction



Observe that...

- Seen from the viewpoint of society only a smaller part of these savings are ”real” cost reductions
  - Redistribution from power producers to power consumers
  - ”Real” cost savings only for the marginal producing units
- Wind power production may reduce the possibilities for misuse of market power

Conclusions

- Power consumers in Western-Denmark has witnessed a significantly lower spot price
  - Western Denmark app. 15% reduction in 2007, 7% in 2006, 14% in 2005 and app. 5% in 2004
- Subsidies to wind power amount to approximately 0.7 c€/kWh compared to reduced spot prices of 0.25-0.45 c€/kWh in 2005, 2006 and 2007
- It has not been possible to decompose all relevant impacting factors
  - Trade with Germany also influences power prices