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# The Impact of Renewables On Electricity Market Design

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# Issues...

- More renewables are expected to lead to
  - higher incidence of supply shocks
  - greater and more irregular price variations
  - and, perhaps, longer periods of low prices
- Architecture and design response
  - market integration
  - efficient price setting
  - system operation
- Keeping in mind
  - stabilising factors
  - endogenous adaptations

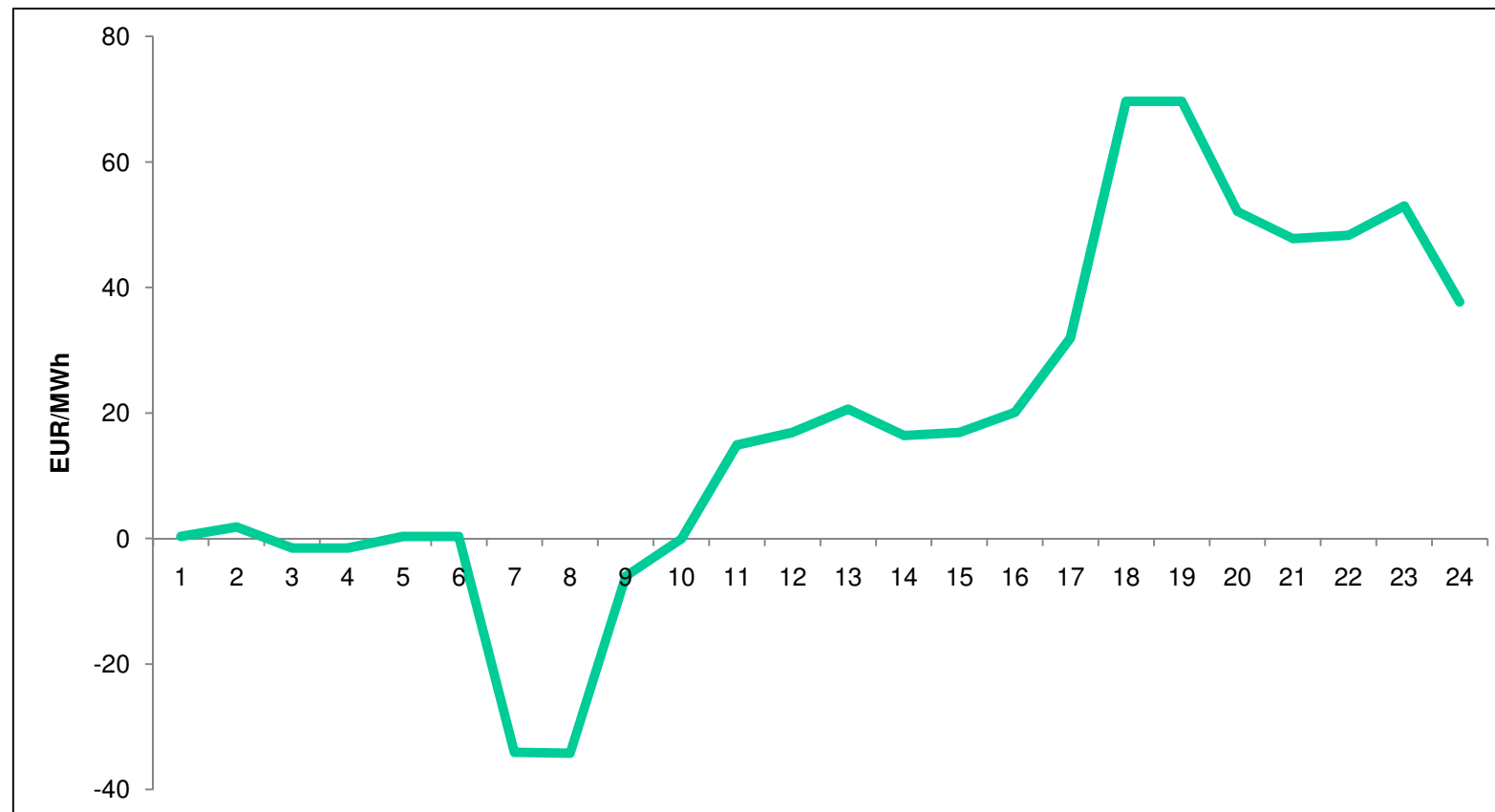
# The Nordic Region...

## Key figures for 2008

		Nordel
Population	mill.	25.2
Total consumption	TWh	412.7
Maximum load <sup>1</sup>	GW	61.0
Electricity generation	TWh	414,0
<b>Breakdown of electricity generation:</b>		
Hydropower	%	58
Nuclear power	%	20
Other thermal power	%	19
Wind power	%	3
Geothermal power	%	-

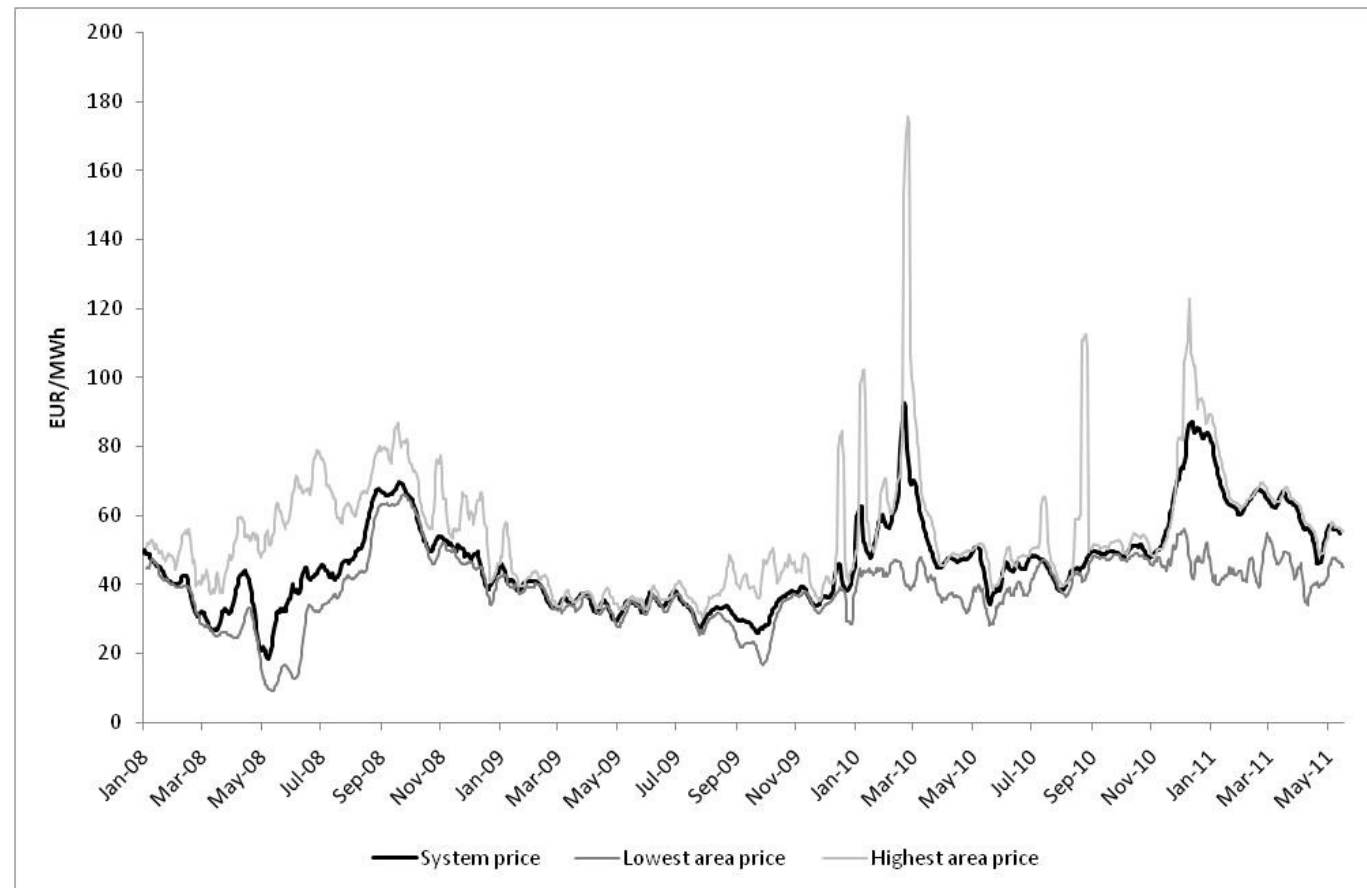


# Price Variation in the Short Term...



Hourly prices, Western Denmark, January 1, 2011. Source: Nord Pool Spot.

# Price Variation in the Long Term...



Daily prices, 7-day moving average. Source: Nord Pool Spot.

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# Market Integration...

- Reduces impact of supply shocks
  - law of large numbers
  - imperfect correlation across regions and technologies
- Improves market response
  - greater access to flexible supply sources
  - larger total demand
- Requires
  - investment in networks
  - reduction in trade barriers
  - access to market places



# Efficient Price Setting...

- Reduces impact of supply shocks
  - demand and supply response
  - hedging of price and quantity risks
- Improves market response
  - provides adequate information to market participants
  - encourages investment in demand and supply flexibility
  - encourages introduction of adequate contract formats
- Requires
  - availability of contracts
  - liquid market places
  - also, symmetric treatment of technologies, incl. renewables



# Adequate System Operation...

- Reduces impact of supply shocks
  - maintains quality of supply
  - increases utilisation of available network capacity
  - reduces costly actions to protect against disruptions
- Improves market response
  - encourages investment in flexibility
  - allows for demand participation
- Requires
  - sufficient resources and instruments for system operators
  - combination of market-based and direct controls
  - integration of system operations across jurisdictions





# Conclusion...

- The Nordic experience
  - renewables supply shocks, short run (wind) and long run (hydro)
  - high supply quality, but considerable variation in spot prices
  - adequate investment and high supply security
- Success factors
  - market integration across regions with different technology mixes
  - wide range of contracts traded on liquid markets
  - coordinated system operations
- Also
  - market-based, light-handed regulatory regimes
  - subsidies to renewables, but no explicit capacity payments