2nd Solar Electric Utility Conference

PV and liberalized electricity markets

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Background

GHG emissions

Business as usual

- Reduce emissions
- Increase renewables (RE)
- Efficiency etc.

UNFCCC target
80%
additional emissions

UNFCCC recommendation

1990 2050
Support for power production from RE

- As costs of power production from RE are currently higher power prices, increase of production is generally supported through public schemes such as:
  - Feed-in tariffs
  - Quota / tradable permits (GO)
  - Tenders
  - Investments subsidies...

- But:
  - How long?

What costs are we talking about?
Different kinds of costs exist

**Total average costs**

= total costs / quantity

**“variable costs“ (marginal costs)** = additional costs for the production of an additional unit (kWh)

Relevant für **Investment decisions**

Relevant für **operational decisions / price formation**
Microeconomic Theorie

- Marginal analysis
  - thinking in small unit / small changes
- Market form: here perfect competition
  ≠ Monopol etc.
- Short-term analysis
  - e. g. power market at EEX, tomorrow, 11-12 am

On the supply side, prices form on the basis of marginal costs of production
Price formation in competitive markets

Supply = marginal costs of production

Energy (MWh)

Costs / WTP / Price (Euro / MWh)

price \( p^* \)

demand

renewable energies

equilibrium quantity

nuclear lignite coal gas oil
Price formation in competitive markets

Costs / WTP / Price (Euro / MWh)

Energy (MWh)

additional renewable energies

Wholesale price decrease

equilibrium quantity

Supply (w/o)

Supply (with)

demand

$p^*$

$p_{with_{RE}}^*$
Price formation in competitive markets

→ Extreme: whole sale price = zero → revenue with direct sale = zero
→ Systematic revenue problem for RE → support scheme permanently necessary, if high market penetration desired
Emperical evidence EEX (wind)

- Factors
  - RE production in Germany (hourly, 2006)
  - Other factors
    - CO\textsubscript{2}-prices
    - Fuel prices (Öl, Gas, Kohle)
    - Plant break downs
    - Im- and exports
    - ...

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Wind power and EEX prices

\[ y = -0.0019x + 57.442 \]

Korrelationscoefficient = -0.1222
Wind energy and power prices in Denmark

Quelle: Morthorst, Poul (2007) Impacts of Wind Power on Power Spot Prices

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Price and the impact of PV

- Slope of supply curve generally increasing
- PV: power production at high load / prices
- Price reducing effect of PV on average higher than for other RE (relevant for higher PV capacity)
A broader market view

- Power production from PV, wind, hydro causes a decrease of power prices (whole sale market)
- Conventional plants also affected
- Fluctuating production of PV and wind causes disruptions of continuous operation of “base load plants” (as we know to day)
- If plants to be operated with CCS – technical problems are likely to occur

→ Decarbonisation of a liberalised power market is a tricky issue
A broader market view

Minimum monthly remaining load (Germany 2006)
(Remaining load = consumption minus power production from RE)
A broader market view

Minimum monthly remaining load (Germany, 2030)
(Remaining load = consumption minus power production from RE)
Conclusion

• Costs of power production from PV generally > power price, i.e. > revenue
• Support schemes have been introduced
• In competitive markets RE (PV) can still reduce the whole power price given its low marginal costs of production
• Systematic reduction of power price (e.g. „when the sun shines“) reduces the revenue stream systematically if power sold at power exchange
  • Long-term support scheme presumably necessary (even if total cost of production of RE < TAC of fossils; lobbying necessary?)
  • To be considered during investment decision making in liberalised market, especially with high RE penetration
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Further reading (selection)

• Bode, Sven; Groscurth, Helmuth (2009) Incentives to Invest in Electricity Production from Renewable Energy under Different Support Schemes, arrhenius Discussion Paper 1 E


• Bode, Sven (2006) On the impact of renewable energy support schemes on power prices, HWWI Research Paper 4-7


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