



## Wind power and the power market

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*Publication date:*  
2012

*Document Version*  
Peer reviewed version

[Link back to DTU Orbit](#)

*Citation (APA):*  
Schröder, S. T. (2012). Wind power and the power market. Sound/Visual production (digital)

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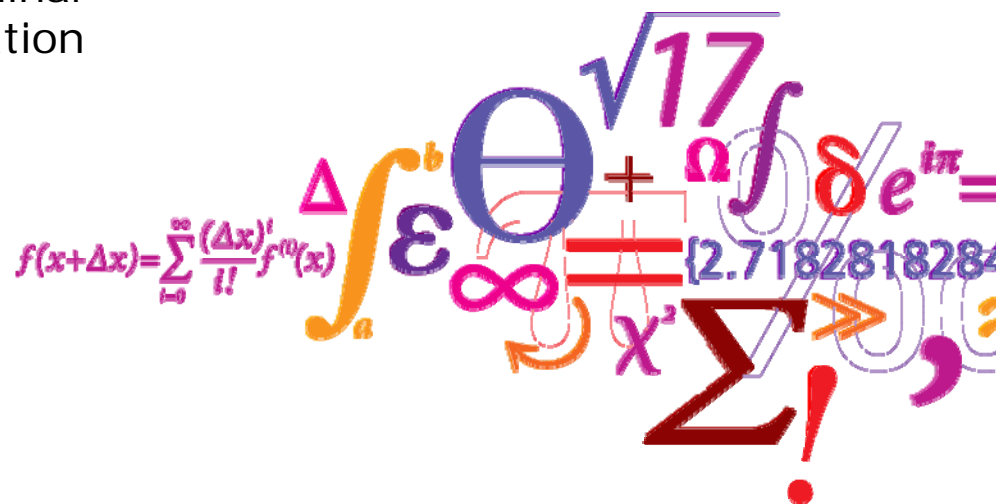
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# Wind power and the power market

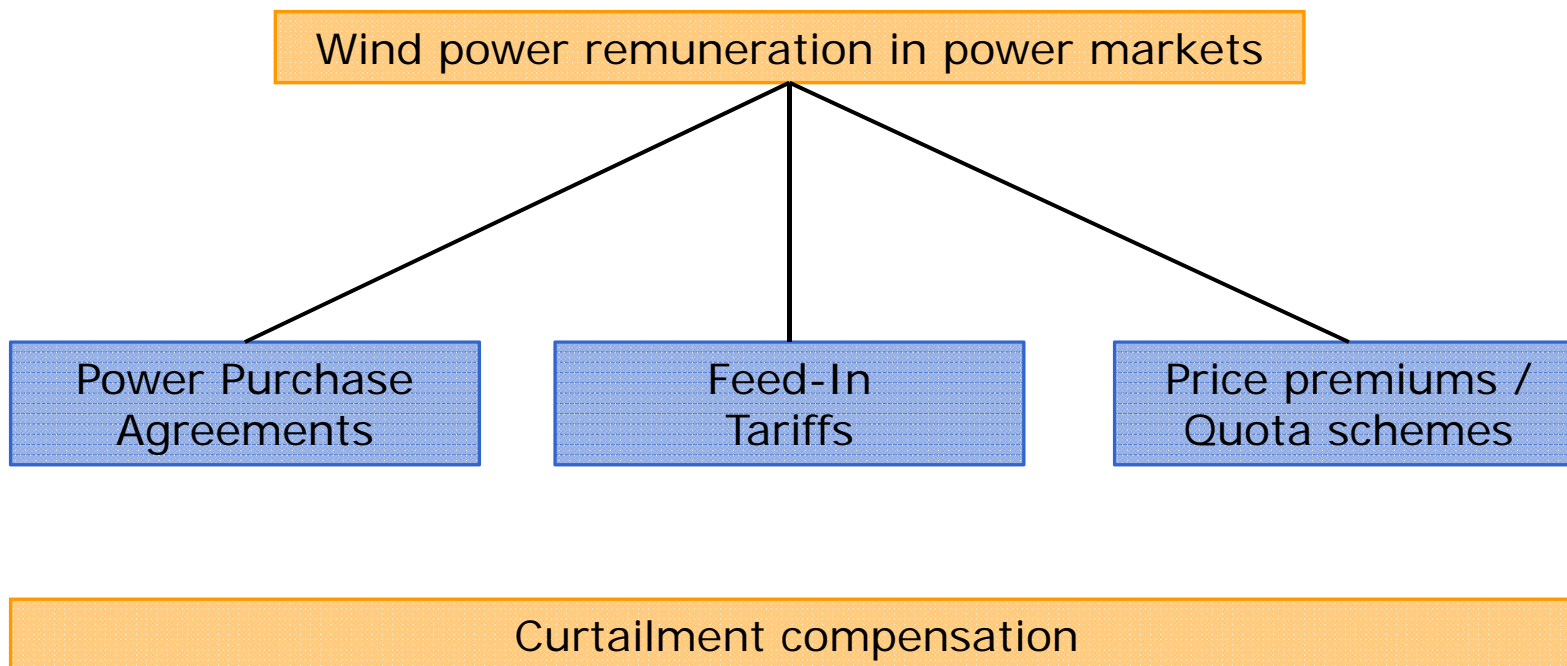
Sascha T. Schröder

EWEA2012 Pre-Conference Grid Seminar  
by the Danish Wind Industry Association

April 15<sup>th</sup>, 2012



# Outline



# Power Purchase Agreements – Definition

## Criterion

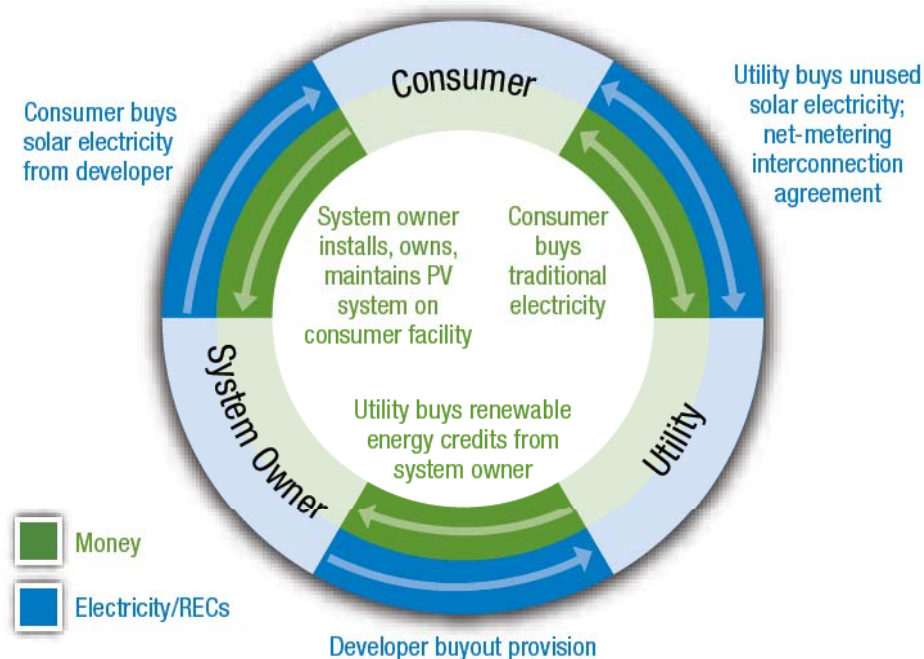
Duration

Tariff

- fixed price/kWh
- fixed escalator price/kWh

Financing

- attractive if increasing tariff rates are expected
- combination with net metering
- comparatively positive impact on network
- transaction costs: favours larger projects



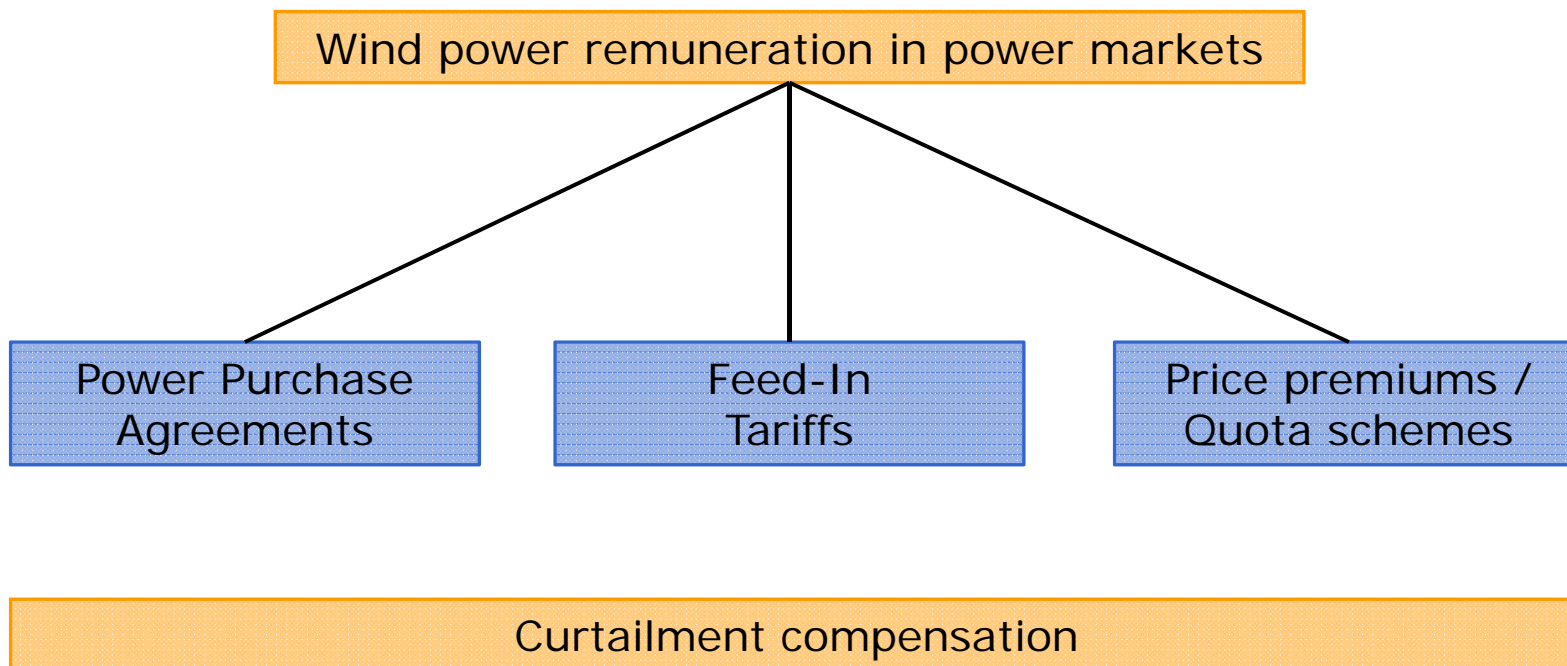
Source: NREL

# Power Purchase Agreements – Best practice



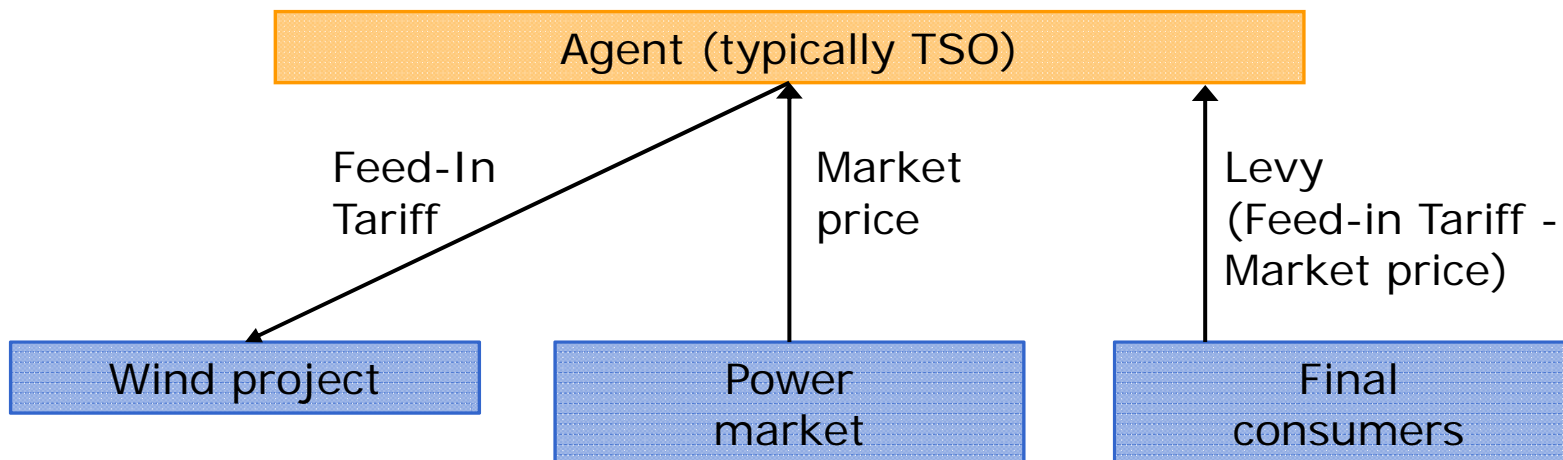
Criterion	Best practice
Duration	e.g. 15, 20 or 25 years
Tariff <ul style="list-style-type: none"> <li>•fixed price/kWh</li> <li>•fixed escalator price/kWh</li> </ul>	escalator e.g. driven by inflation or expected tariff increases
Financing <ul style="list-style-type: none"> <li>•attractive if increasing tariff rates are expected</li> <li>•combination with net metering</li> <li>•comparatively positive impact on network</li> <li>•transaction costs: favours larger projects</li> </ul>	<ul style="list-style-type: none"> <li>•provide planning security to project developers!</li> <li>•for small-scale applications</li> <li>•set locational incentives and publish them, if possible</li> <li>•shallow connection charges: project developer pays only equipment to connection point</li> </ul>

# Outline



# Feed-In Tariffs

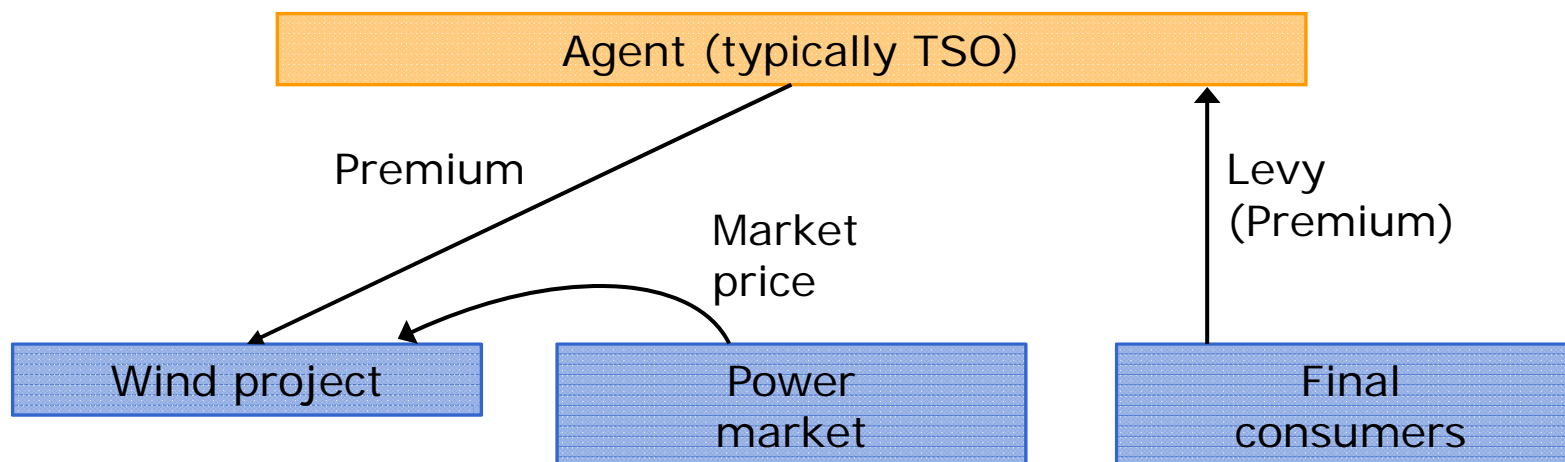
- fixed tariff/kWh over specific time period



- fit for early and mid-penetration markets
- balancing of forecast errors done centrally by TSO
  - good tools, multiple tools combined
- technical connection rules (network stability) adjusted for wind penetration level
- locational incentives could be set via connection charges – but keep them shallow

## Price premiums / quota schemes

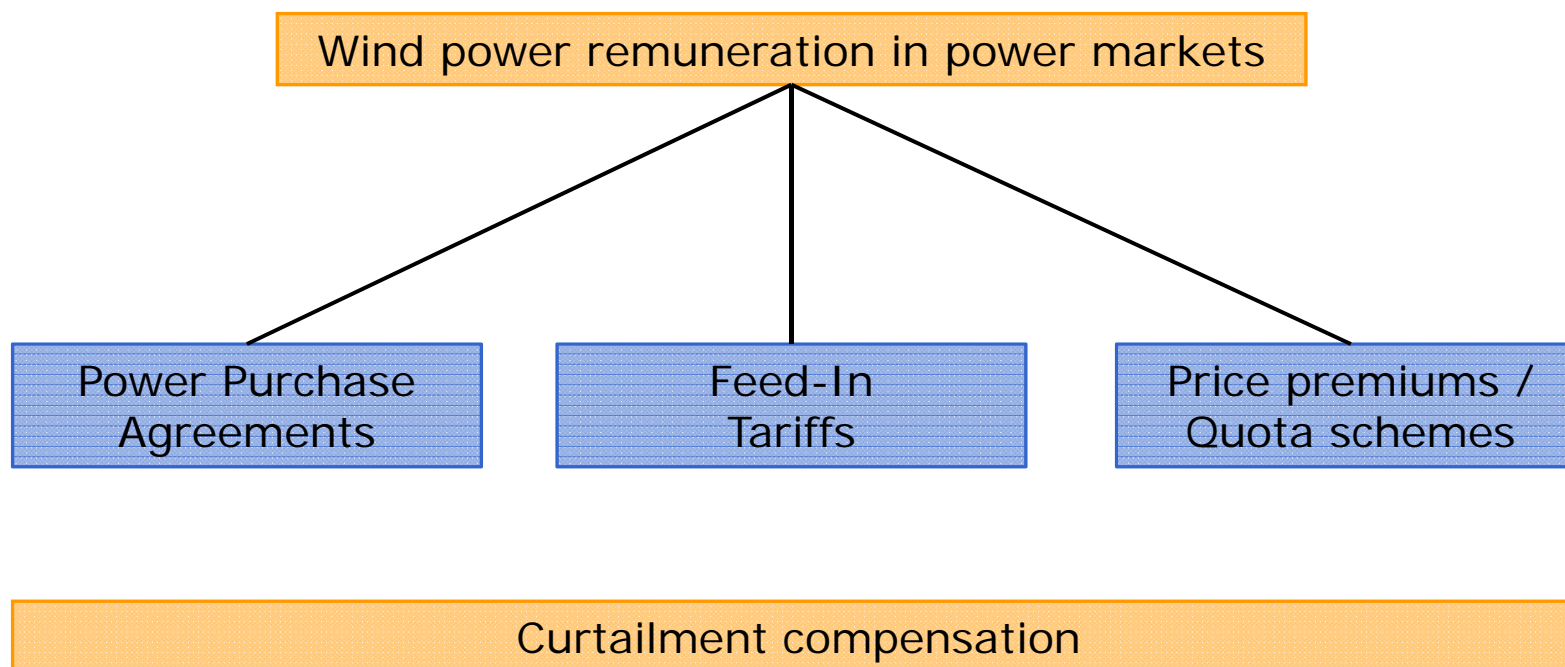
- fixed premium/kWh or variable quota price/kWh over specific time period



- fit for mature markets and high penetration levels
- risk premiums from developers' point of view
- balancing of forecast errors done centrally by single actors
- technical connection rules (network stability) adjusted for wind penetration level
- locational incentives could be set via connection charges – but keep them shallow



# Outline



# Curtailment

- 2 types of curtailment
  - involuntary: reduced generation due to e.g. grid problems
  - voluntary: reduced generation due to power market signals
- static conditions: network capacity that can absorb all generation is overdimensioned (e.g. offshore)
- contractual agreement on a maximum number of curtailment hours possible
  - part of a PPA / network connection agreement
  - also as locational signal
  - otherwise: compensation at outage income level
  - curtailment agreements need to be regulated

## Food for thought & discussion

- connection conditions: transparent & foreseeable, technical specifications adjusted to wind penetration level
- Power Purchase Agreements
  - value of power
  - insurance function against rising fuel prices
  - impact on network, possible impact after network extensions
- General:
  - proactive approach to wind integration
  - shallow connection charges
  - optimal curtailment level
  - curtailment compensation



*Thank you for your attention!*

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