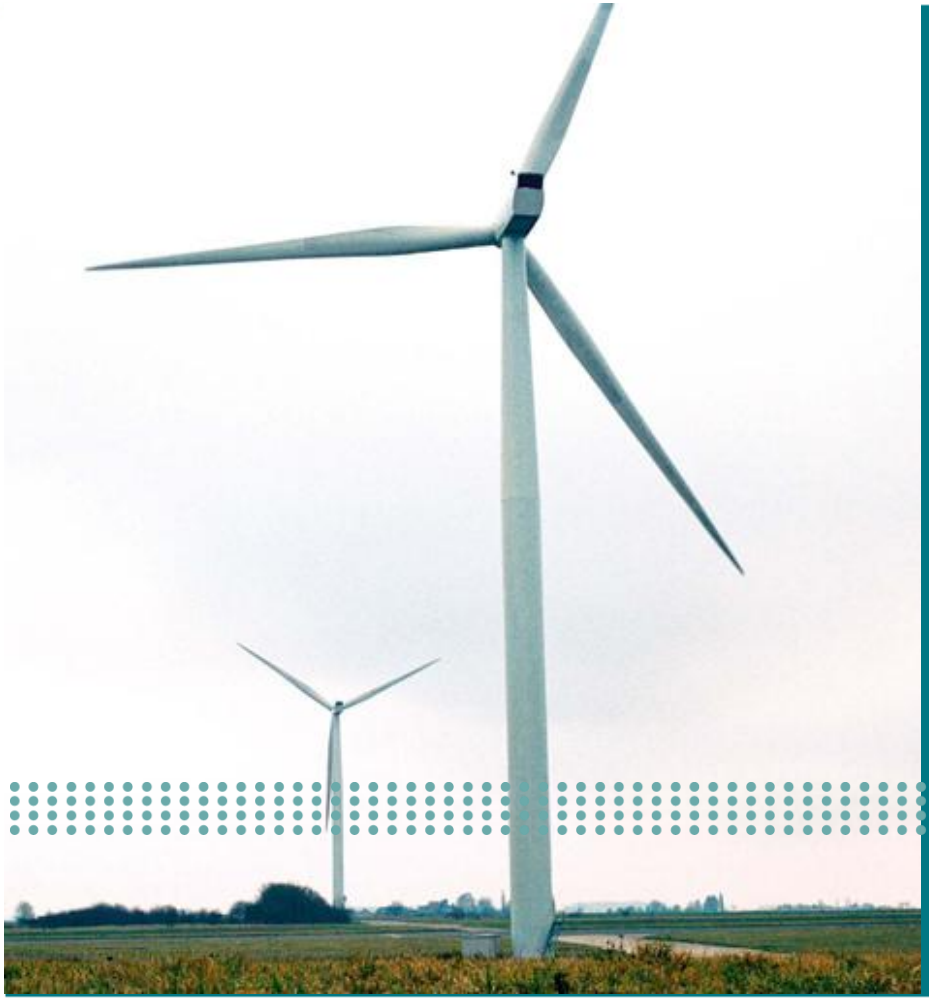

Some Wind Power Issues related to Market Design

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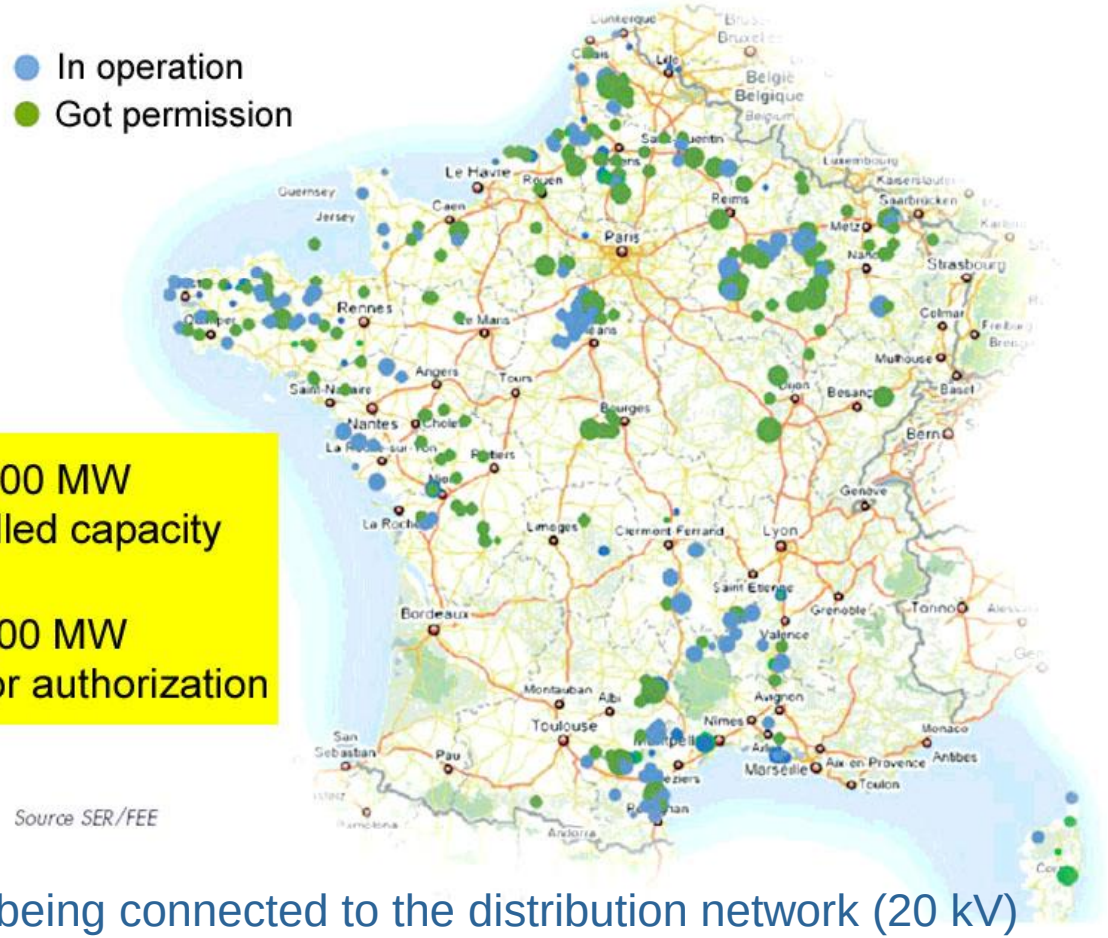
Wind in France : Some Facts and Figures

Situation in France on 1st January 2008



2300 MW
of installed capacity

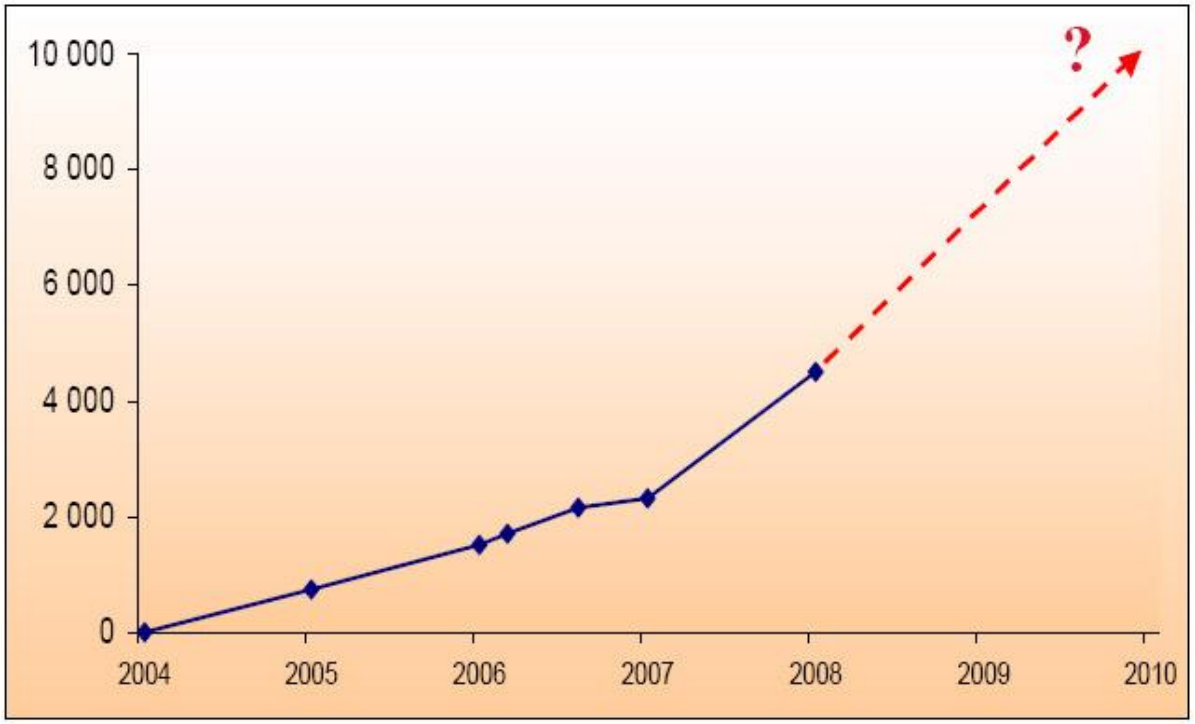
6000 MW
applying for authorization

Source SER/FEE

300 sites, 98% of them being connected to the distribution network (20 kV)
Feed-in tariff (compulsory purchase by EDF ; integrated to EDF balancing perimeter)
Cost partly recovered via consumers tax (CSPE)

Wind in France : Some Facts and Figures

Development of Wind Power in France



1500 MW end of 2006

2300 MW end of 2007

4500 MW end of 2008 ?

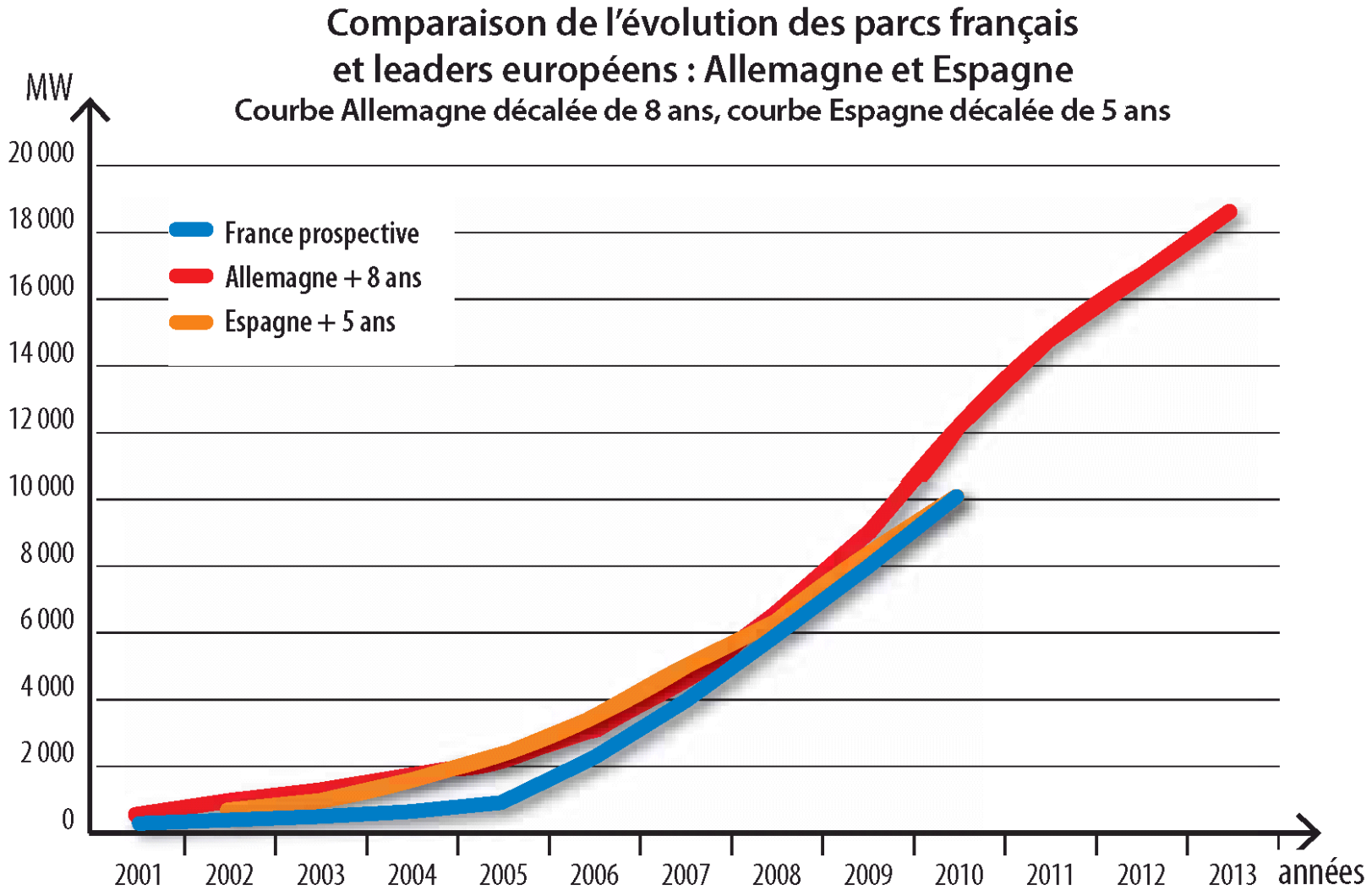
10000 MW end of 2010 ?

Peak Load in France in 2007 : 89000 MW

Source : RTE

Public energy policy target : 5 to 10 GW in 2010, 17 GW in 2015

Comparison of Development Dynamics

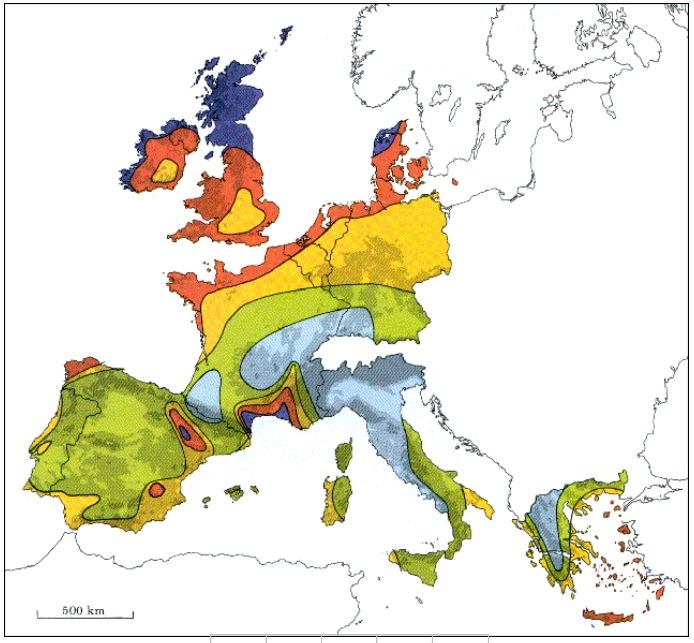


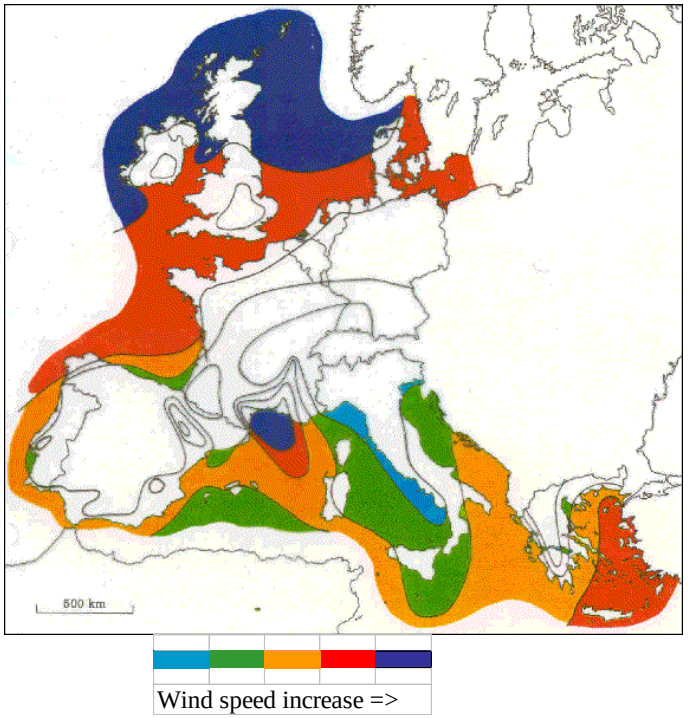
French Wind Resources

Excellent quality

- Second in Europe in terms of amount of resource (after the UK)
- Three de-correlated wind regimes (N, W, S-E)

=> Significant smoothening effect in France





What RTE Says

Seasonal load factor (2005-2007)

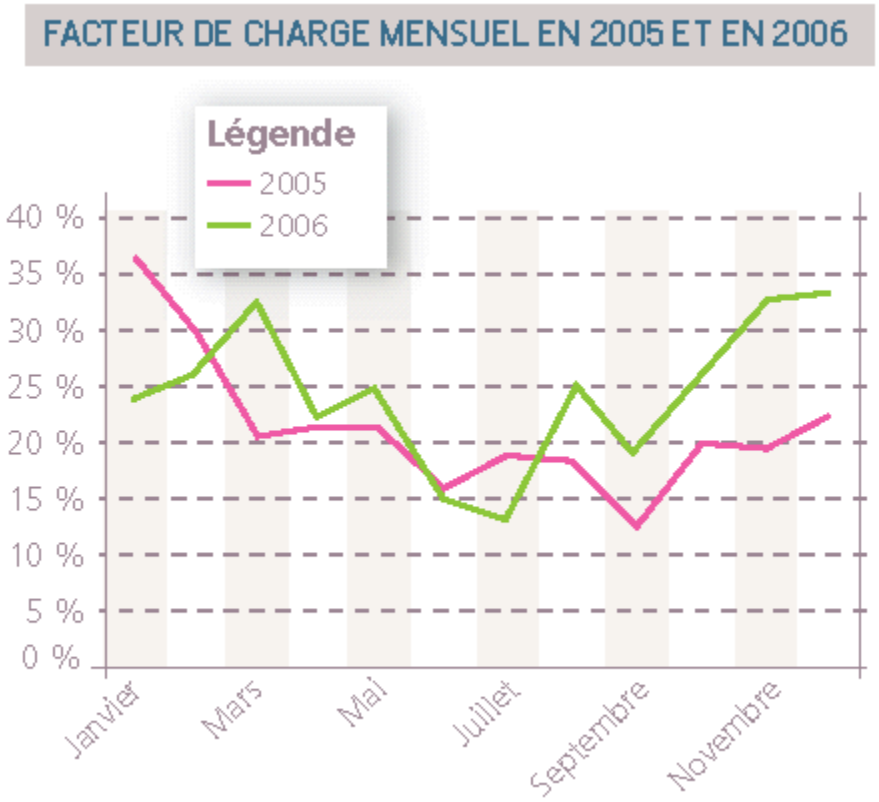
- Year : 24 %
- Winter : 30 % - Summer : 20 %

Wind power variability

- Impacts of the same order of magnitude as temperature or generator unavailabilities
- De-correlated from electric heating and generator unavailabilities

Transmission network acceptability

- 7 GW without reinforcement (2009 ?) and reinforcements take years (decades ?)



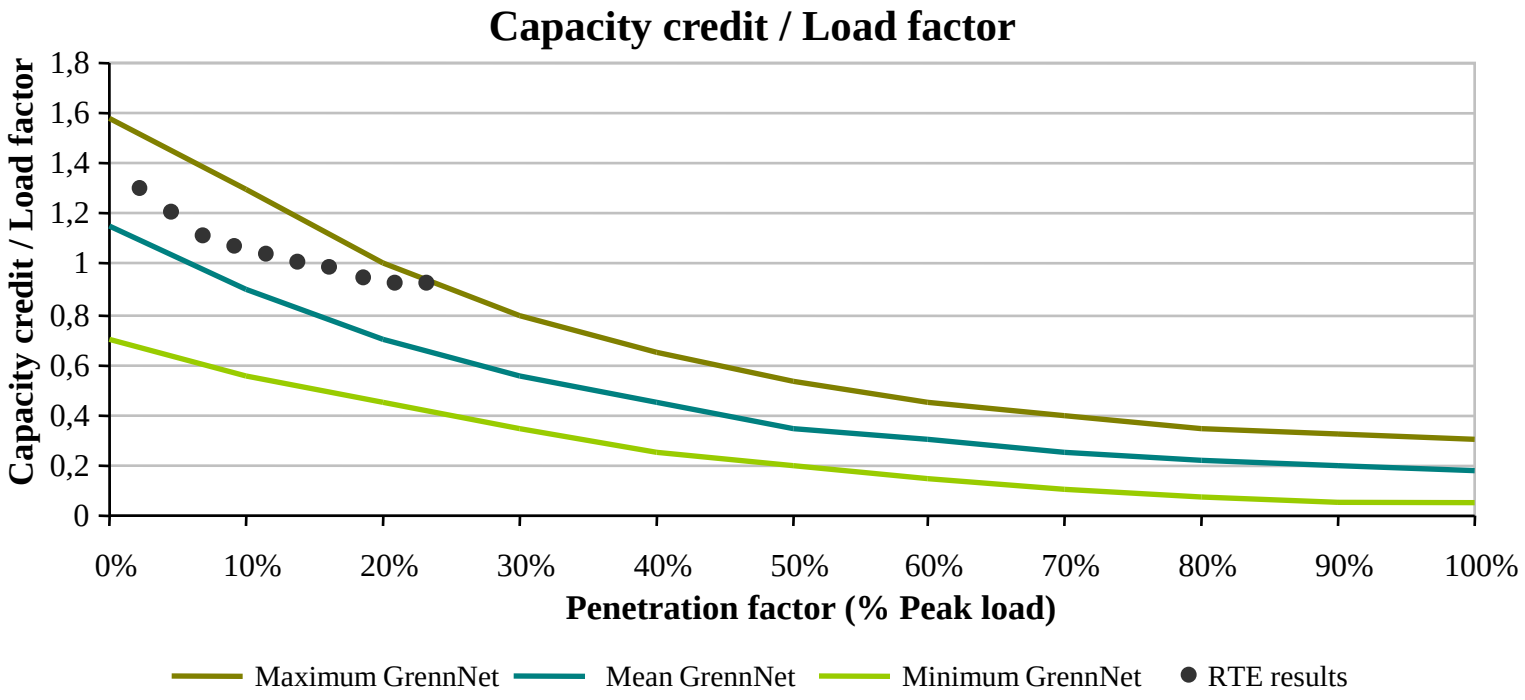
Sources : 2007 Forecasting statement, 2006 Investment planning study

Capacity Credit

Capacity credit (source : RTE)

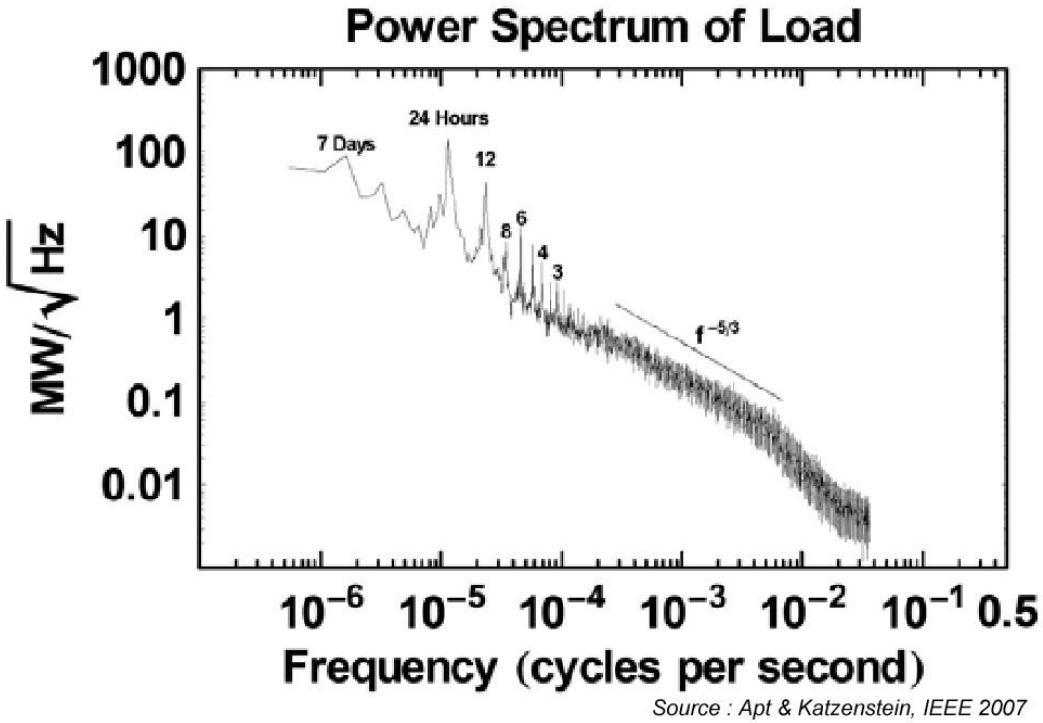
30 % if < 5 GW,

20 % for 20 GW



In a context of progressive market integration, what is the pertinent perimeter to assess capacity credits ?

Wind Power Fluctuations and Balancing Costs



Source : Apt & Katzenstein, IEEE 2007

Global output of wind turbines in a wide geographical area analysed by means of a Fourier decomposition technique

Observations :

- no significant spectrum line intensity below 3 hours
- typical cycles of several hours, ½ day, one day, several days

Warning ! Such global compensation of short term fluctuations is not valid in the voltage domain, where local considerations are predominant

No significant impact on ancillary services (primary & secondary load frequency control)

Provided that online monitoring and forecasting are available

Provided that adequate fault ride-through requirements prevent common mode tripping

Nevertheless, increase in other reserves will be needed for balancing

Depends fundamentally on the ability to monitor and forecast wind generation

Wind Power and Transmission System

For an approach focused on the access to the resource

- Wind turbine can be built much faster than the transmission upgrade required
- Need for a regional or pan-European approach
- New kind of integrated resource planning ?
- Share of the forthcoming wind rent ?
- How to integrate properly wind power in market coupling mechanisms (who bares the risk of congestion hazards due to wind power fluctuation ? is priority access a good solution ?)

Wind Power and Pan-European Support Mechanism

Features / Efficiency of the proposed Certificates of Origin

- All technologies treated simultaneously ?
- Past and/or new renewable units ?
- Voluntary or mandatory ?
- To what extent (at which conditions) they can cross borders ?

Short Term / Long Term Interaction with Markets

Do present markets internalise correctly impacts ?

- Impacts on spot markets (level of prices, volatility)
- Does it give the correct signals to generation investors ?

From an "incentive driven" to a "market driven" approach

- Reinforced needs for integrating all positive and negative externalities
  - Balancing costs and reserves
  - Impact on system adequacy
  - Renewable aspect (vs. limited fuel resource)
  - Carbon content
  - Impact on security of supply (vs. external resource dependency)
  - Value of "input" diversity
  - Etc.

→ Are these externalities correctly addressed today ?
→ Do we need to amplify them thanks to bonus/malus mechanisms ?

Wind Power and Storage

Will the market deliver an optimal mix, particularly for flexible capacity?

- Do the present market designs recognize correctly the value of storage facilities ?
- Do we have to design new market products that properly compensate storage facilities for the benefits they can provide ?
- In the US : storage developers ask for tax credits similar to those enjoyed by the wind generators for the past several years