Estimating the impacts of wind power on power systems - first results of IEA collaboration

Hannele Holttinen,
Operating Agent, IEA WIND Task 25

Contents

- Background:
  - Wind power penetration increasing: system integration costs is becoming an issue for many countries.
  - Ongoing work in many countries and organisations. Difficult to compare the results: different methodologies and data available to make the estimates as well as system operation procedures
- International Energy Agency (IEA) Wind Task 25
- Recent studies, summary of results
- Recommended practice so far
- Further work

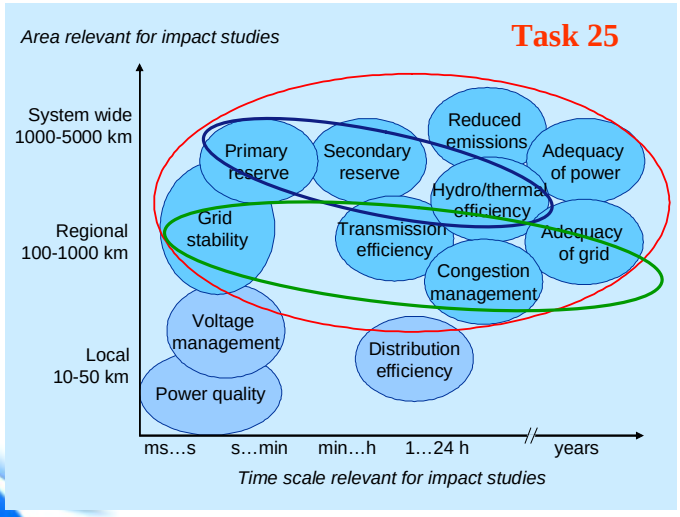
IEA WIND Task 25:
- Design and operation of power systems with large amounts of wind power
- started in 2006
- duration 3 years
- www.ieawind.org

	Country	Participating institution
	Denmark	Risø National Laboratories (Peter Meibom) TSO Energinet.dk (Antje Orths)
	EWEA	European Wind Energy Association (Frans van Hulle)
	Finland	VTT Technical Research Centre of Finland (OA)
	Germany	ISET (Cornel Ensslin), TSOs E.ON (Lutz Hofmann) and RWE (Bernhard Ernst)
	Ireland	Research organisation to be confirmed TSO ESB (Paul Smith)
	Norway	SINTEF (John Olav Tande), Statkraft (Espen Hagstrøm)
	Netherlands	we@sea, ECN (Jan Pierik)
	Portugal	INETI (Ana Estanquiero), UTL-IST (Rui Castro), TSO REN (João Ricardo), INESC-Porto (J. Pecas Lopes)
	Spain	To be confirmed
	Sweden	KTH (Lennart Söder)
	UK	DG&SEE Centre for Distrib.Gener. & Sustainable Electrical Energy (Goran Strbac)
	USA	NREL (Brian Parsons), UWIG (Charles Smith)

Integration costs

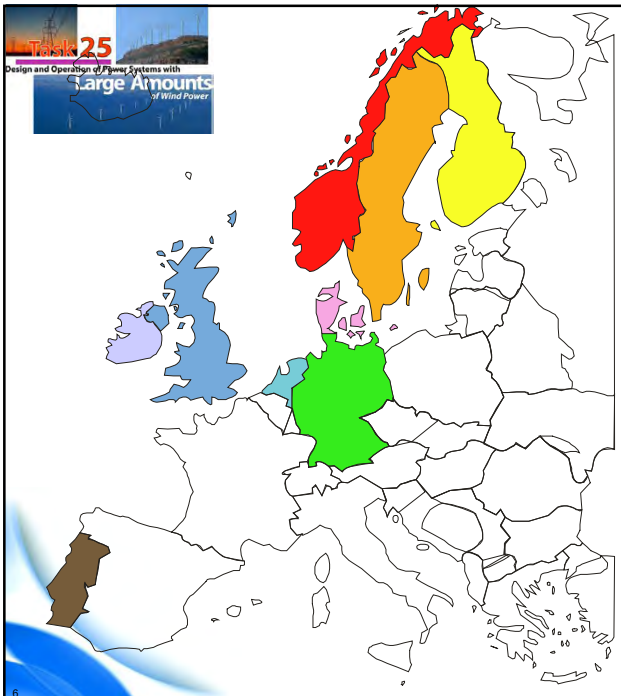
- Extra costs for power system for accommodating wind power
  - Not covered by wind power producers (investment costs for grid connection, …)
  - Part of the these costs may be allocated to wind power in some power systems (network charges, imbalance payments, …)
- Policymakers
  - To ensure that the benefits of increasing wind energy will not be offset by negative impacts
- System operators, regulators
  - To ensure fair treatment of all producers: market design and rules, tariffs, allocation of costs

Possible impacts of wind power on the power system: impacts on reliability and efficiency



Balancing

Grid



Recent studies in Europe and USA

H.Holttinen, P.Meibom, A.Orths, C.Ensslin, L.Hofmann, J.McCann, J.Pierik, J.O.Tande, A.Estanqueiro, L.Söder, G.Strbac, B.Parsons, J.C.Smith: ***"Design and Operation of Power Systems with Large Amounts of Wind Power, first results of IEA collaboration"***

- *GWPC2006 Adelaide 18-21.9.2006*
- *6th Large-Scale Integration and Offshore Wind Farms, 26-28.10.2006 Delft*

Recent studies: levels of wind power studied

Nordic: 69 GW peak load, up to 20 GW wind (29 %)

UK: 65 GW peak load, up to 26 GW (40 %)

Ireland: 6 GW peak load, up to 2 GW wind (45%)

Denmark: up to 100 % penetration

Germany: 80 GW peak load, up to 36 GW wind (45 %)

Netherlands: 16 GW peak load, up to 6 GW wind (38 %)

Portugal: 10-12 GW peak load, up to 5 GW wind (50 %)

Recent studies in USA

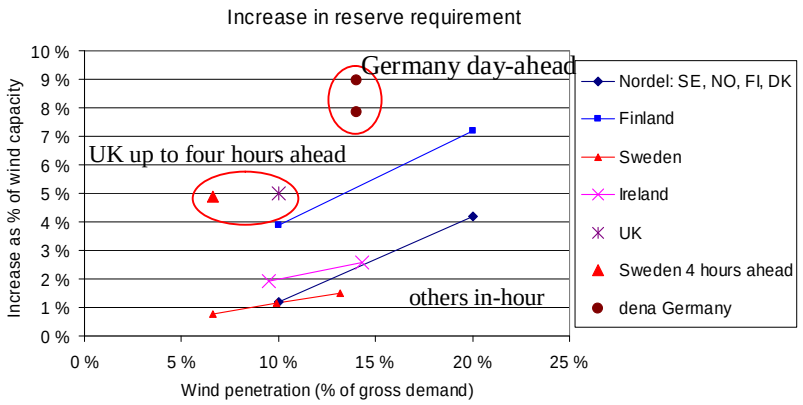
- Minnesota: 1500 MW of wind in 10 GW peak load system (=15 %)
- New York: 3300 MW of wind in 33 GW peak load system (=10 %)
- Colorado 700 and 1050 MW in 7 GW peak load system (=10-15 %)
- California: existing wind power, 4 % of peak load

Summary grid reinforcements

- UK : £50-100 / kW (70-140 €/kW).
- Netherlands : 60-110 €/kW for 6000 MW offshore
- Portugal : 53 €/kW
- German dena study:100 €/kW

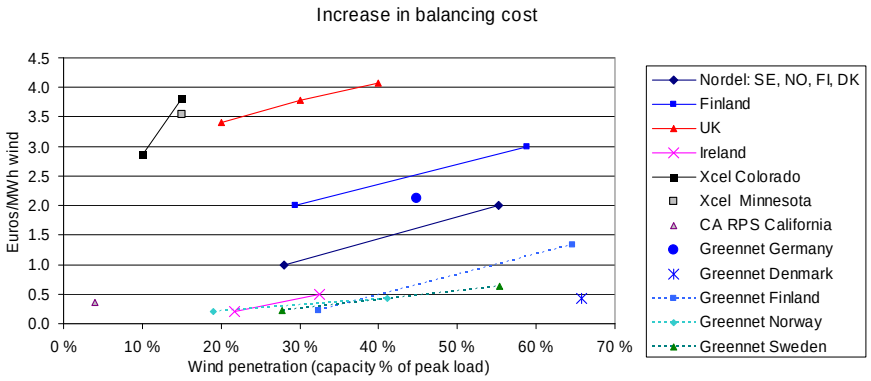
- Problems in comparisons:
  - Depends on wind resource location versus load centres
  - Grid reinforcement costs are not continuous, there can be single very high cost reinforcements
  - The way that grid costs are allocated to wind power can differ:
    - Shallow/deep costs
    - Wind farm and power system interface

Summary balancing requirements



- different time scales for estimating the reserve requirement
- different methodology used

Summary balancing costs



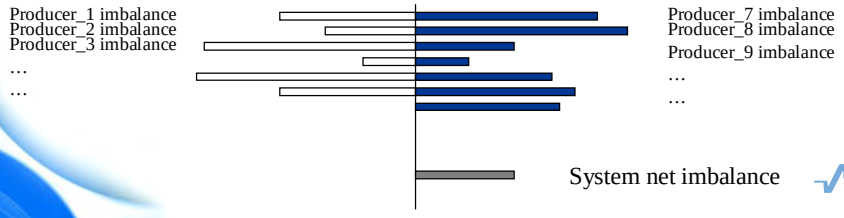
- Not directly comparable due to: different time scales; allocating investment for new reserve or only use of reserves; method for calculating costs based on assumptions on thermal power; possibilities for power exchange to neighbouring countries etc

Current practise and recommendations so far

- Capture the smoothed out variability of wind power production time series for the geographic diversity assumed:
  - Actual data from tens of wind farms and/or met towers or synchronized weather simulation
  - Wind forecasting best practice for the uncertainty of wind power production.
- Examine wind variation in combination with load variations
- Capture system response through operational simulations
- Examine actual costs independent of tariff design structure

Summary balancing

- Integration costs 0.5 - 4 €/MWh
  - very different results, depending on how conservative assumptions and what has and has not been taken into account
- Small compared to
  - production cost of wind power (~ 40-60 €/MWh) or
  - avoided fuel costs (~ 20-30 €/MWh, 2001 price level with no CO_2 tax)
- In some countries wind power producers pay imbalance payments that are far greater than the actual extra cost for the power system



Further work of the IEA Task 25

OBJECTIVE:
to analyse and further develop the methodology to assess the impact of wind on power systems

GOALS:

- Provide an international forum for exchange of knowledge
- State-of-the-art: review and analyse the studies and results so far
  - methodologies and input data, system operation practices, planning methodologies and modifications that have been necessary with high penetration, concepts and technologies enabling enhanced penetration
- Formulate guidelines:
  - recommended methodologies and input data when estimating impacts and costs of wind power integration
- Quantify the impacts of WP on power systems
  - range of impacts/costs; rules of thumb

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