



IEA WIND Annex XXV:

Design and operation of power systems with large amounts of wind power

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WIND POWER PRODUCTION INTRODUCES MORE UNCERTAINTY IN OPERATING A POWER SYSTEM

- it is naturally varying at all time scales
- the variations can be predicted, but the accuracy gets poorer the longer ahead predictions are made
- for large power systems, geographically distributed wind power will smooth out the faster variations

THE IMPACTS OF WIND POWER WILL INCREASE WITH INCREASING PENETRATION LEVEL

It is technically possible to integrate very large amounts of wind capacity in power systems, the limits arising from how much can be integrated at socially and economically acceptable costs.

A LOT OF STUDIES ON WIND INTEGRATION EXIST

- National studies; ongoing work at ETSO, CIGRE, EU, UWIG
 - With different wind penetration levels, power system characteristics, tools, methods and data that has been available
- à **Large range of results**, difficulties in comparing the results and applying results from one study to other regions

FOR CONCLUSIONS ON THE RANGE AND COSTS OF IMPACTS

- In-depth analysis of the methodology, tools and data used in the existing studies is required:
- Conservative assumptions? Omitted impacts?
 - Lack of data?
 - Terminology used comparable?

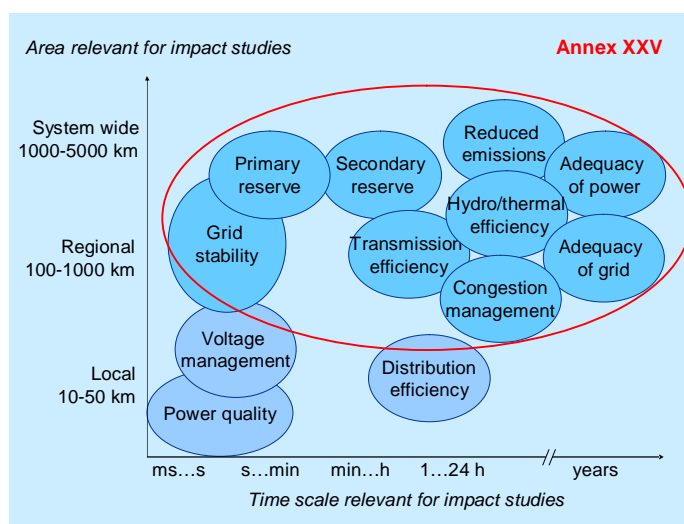
International Energy Agency, IEA R&D Wind, Annex XXV:
 “Design and Operation of Power Systems with Large Amounts of Wind Power”, 2006-2008.

Goal: to analyse and further develop the methodology to assess the power system impacts of wind power.
Main emphasis: to reliability and efficiency (losses) of the power system, impacts that are system wide, not local.
State-of-the-art report will be processed during 2006.
Guidelines and best practices will be published at the end of the 3 year period, in 2008.

DIFFERENT TIME SCALES – DIFFERENT STUDIES

- **Stability** (time scale seconds to minutes): possibilities to support the system when a disturbance occurs.
- **Reserve/regulation** (time scale seconds to half hour): how the uncertainty introduced by wind power will affect the allocation and use of reserves in the system. Unpredicted part of the variations of large area wind power should be combined with any other unpredicted variations the power system sees, like unpredicted variations in load.
- **Efficiency, unit commitment** (time scale hours to days): how the variations and prediction errors of wind power change the way other power plants are run and how power flows between regions. Either losses or benefits, depending on the amount of wind, its location relative to load centres and system operation practices.
- **Adequacy** (time scale hours to years): ensuring sufficient electricity production to meet the load demand or constraints within the transmission and distribution system. Capacity credit of wind power shows the value of wind to adequacy of power. When determining adequacy of grid both steady-state load flow and dynamic system stability analysis is needed.

POSSIBLE POWER SYSTEM IMPACTS OF WIND POWER



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