Components of Flexibility

Spanish Fork Wind Farm in Utah, U.S.

iiESI Workshop

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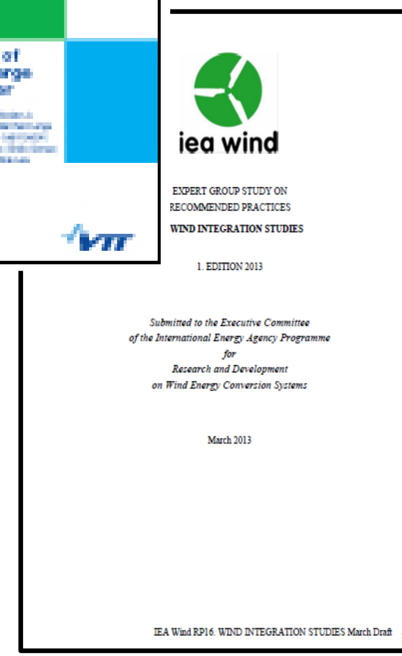
Golden, CO, US

IEA Wind Task 25 – What Does It Do ?

- Started in 2006, now 15 countries + EWEA participate to provide an international forum for exchange of knowledge
- State-of-the-art: review and analyze the studies and results so far:
  - Summary reports published in July 2009 and January 2013.
- Formulate guidelines- Recommended Practices for Integration Studies in 2013:
  - Recommendations for methodologies and input data when estimating impacts and costs of wind power integration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EXPERT GROUP STUDY ON RECOMMENDED PRACTICES
WIND INTEGRATION STUDIES

1. EDITION 2013

Submitted to the Executive Committee of the International Energy Agency Programme for Research and Development on Wind Energy Conversion Systems

March 2013

IEA Wind RP16. WIND INTEGRATION STUDIES March Draft 1

http://www.ieawind.org/task_25.html

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It's All About Dealing with Variability and Uncertainty

- Variability
  - Load varies by seconds, minutes, hours, by day type, and with weather
  - Supply resources may not be available or limited in capacity due to partial outages
  - Prices for power purchases or sales exhibit fluctuations
- Uncertainty
  - Operational plans are made on basis of best available forecasts of needs; some error is inherent
  - Supply side resources available with some probability (usually high)
- Key questions
  - How does wind generation affect existing variability and uncertainty
  - What are the costs associated with the changes
  - What does the future hold

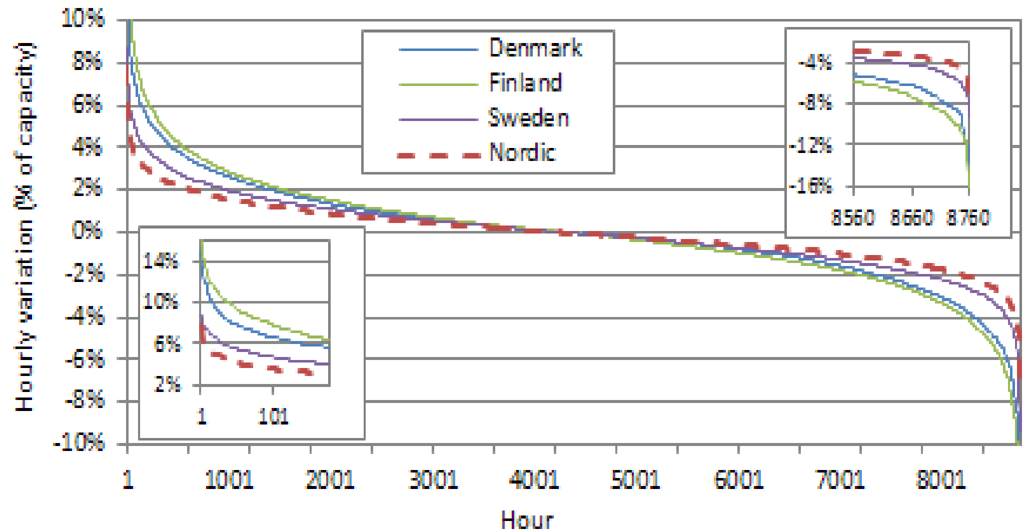
Variability and Uncertainty – Aggregation Benefits

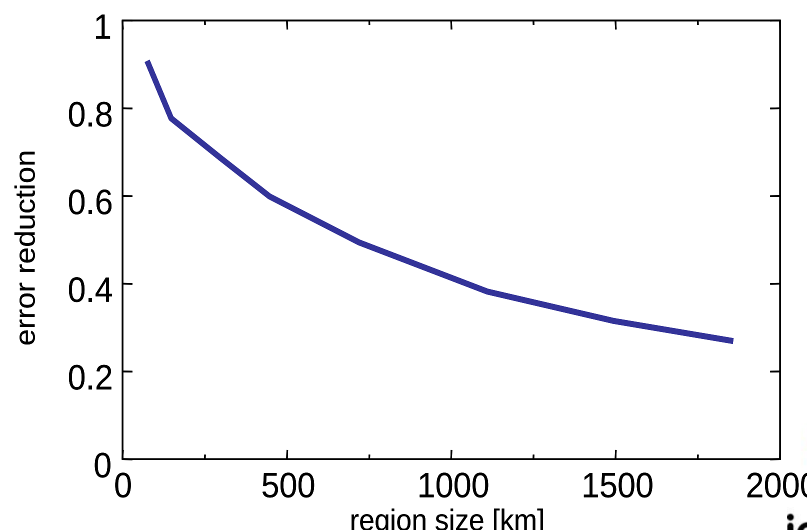
Variability

- Hourly step changes less than ± 20% in a region and less than ± 10% of installed capacity in larger areas
- Less in shorter time scales

Uncertainty

- Easier to forecast 1-6 hours ahead than day ahead
- Aggregated power production from dispersed wind power can reduce forecast errors to half of a single site



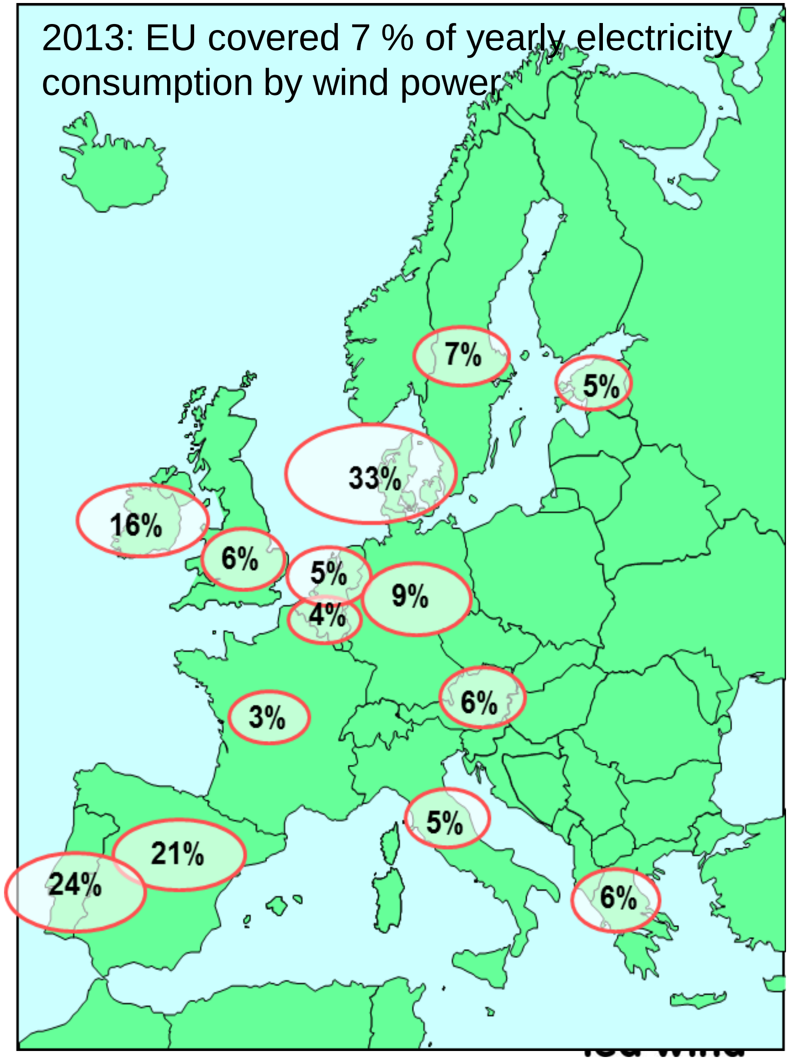


Wind Power Forecasting – Why Is it Important

- Economics
  - Better forecasts mean lower operating reserves
  - Lower operating reserves mean lower operating costs
  - Avoid penalties for bad forecasts
- Reliability
  - Situational awareness for operators
  - System positioning for ramping events
  - Preparation for extreme events
- Market Operation
  - Understand need for and provide incentives for the right market products with high VG penetration
  - Align market rules with forecasting capabilities

Experience from Wind Power Integration is Growing

- System operators (TSOs) use updated information from on-line production and forecasts as well as the possibility to curtail in critical situations
- TSOs see increase in use of short term reserve/load following capacity
- Technical capabilities of wind power plants used more, and evolving
- Operational strategies to cope with wind generation from a high to a very high level (> 20-30 %) are still being developed.
- Transmission has become recognized as a key enabler, regional planning efforts being undertaken



Grid Codes and Models

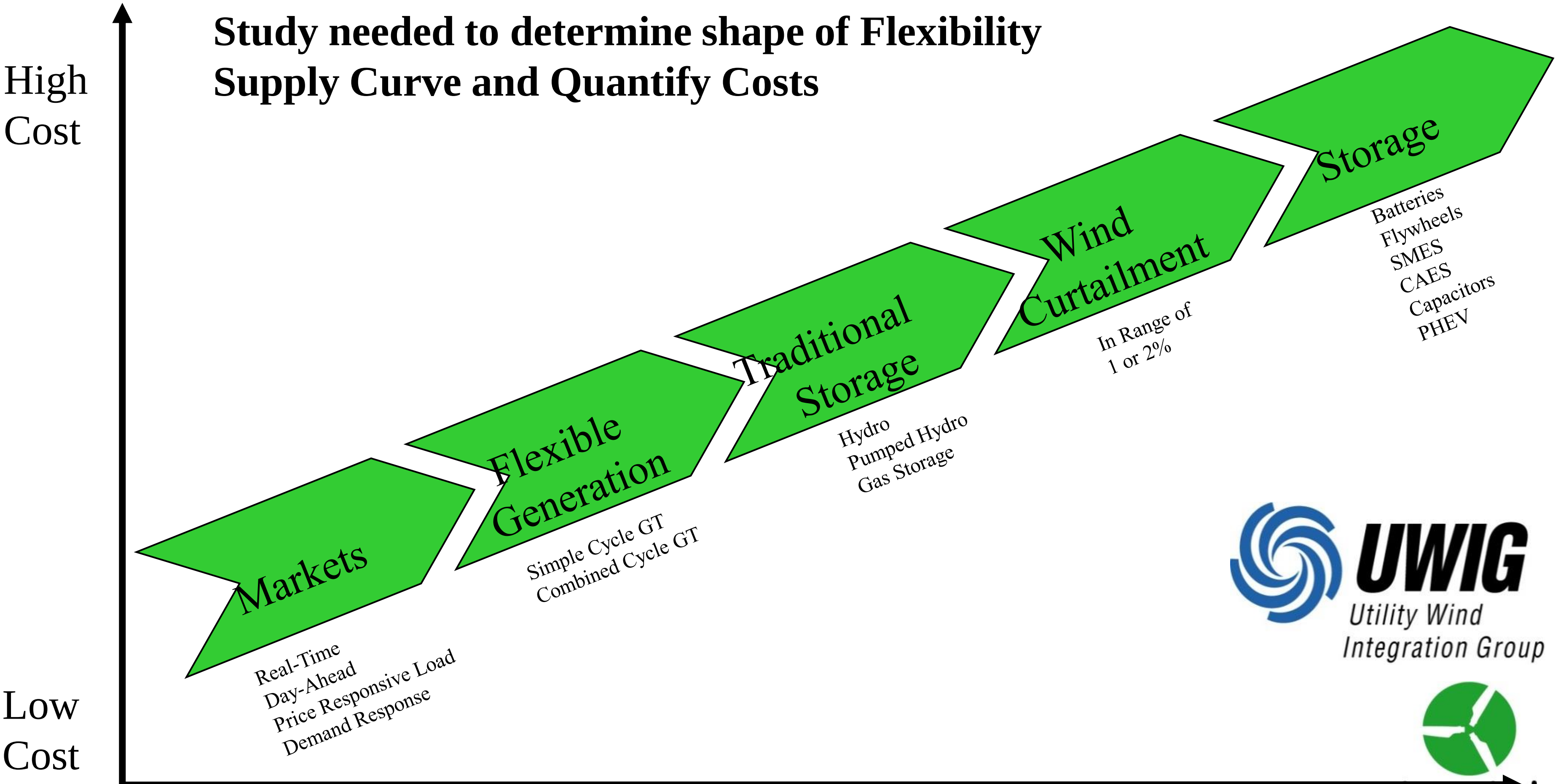
- Strong grid code is in the best interest of both the manufacturer/developer and the utility
  - Wind power plants are very capable machines
  - Wind plants must support system reliability requirements
- Grid code should identify the following requirements
  - Real power
  - Reactive power
  - Voltage and frequency ride through
  - Frequency and inertial response
  - Provision of ancillary services
  - Detailed dynamic models for facility interconnection study
  - Communications between wind plant and grid operator

Increasing Flexibility - Options

- Using existing assets more - operational practices
  - Scheduling and dispatch closer to real time
  - Bids from all options for balancing
  - Balancing for larger areas - using interconnections between balancing areas
- Increasing flexibility of power plants
  - Lower minimum load points
  - Faster ramp rates
  - Quicker start-up times
- Increasing transmission and interconnections
- Enabling demand side response
- Using flexibility of wind power plants
- Building storage

Cost Effectiveness of Flexibility

- Usually possibilities exist to add more cost effective flexibility than new storage.



UWIG Utility Wind Integration Group

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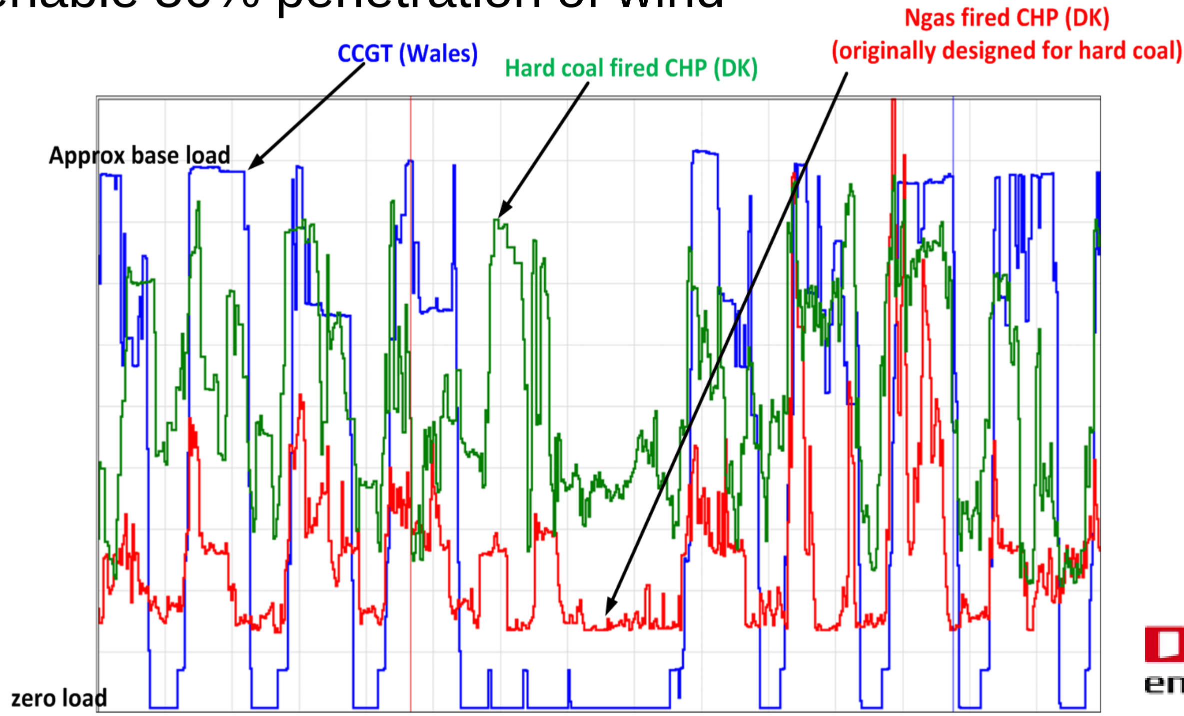
Examples of Enhancing Flexibility - Denmark

- Combined heat and power plants – operation according to electrity prices, electric boilers (heat from electricity)
- Lowering minimum on-line requirement of larger power plants
- More interconnections to Nordic market
- DSM and heat/gas and transportation system integration to enable 50% penetration of wind



Task 25 Country Participation

	Country	Institution
	Canada	Hydro Quebec (A. Forcione, N.Menemenlis); Manitoba Hydro (?)
	China	SGERI (Bai Jianhua, Liu Jun); CEPRI
	Denmark	DTU Wind (N.Cutululis); TSO Energinet.dk (A. Orths)
	EWEA	European Wind Energy Association (I. Pineda)
	Finland	VTT (H. Holttinen, J. Kiviluoma) – **Operating Agent**
	Germany	Fraunhofer IWES (J. Dobschinski); TSO TenneT (A. Gesino)
	Ireland	SEAI (J.McCann). Observer (Mark O'Malley)
	Italy	TSO Terna Rete Italia (Enrico Maria Carlini)
	Japan	Tokyo Uni (J.Kondoh); Kansai Uni (Y.Yasuda); TEPCO (R.Tanabe)
	Norway	SINTEF (John Olav Tande, Atle Rygg Årdal)
	Netherlands	ECN (J.Pierik); TUDelft (M. Gibescu); TSO TenneT (A.Ciupuliga)
	Portugal	LNEG (Ana Estanquiero); TSO REN (Jose Osario); INESC-Porto (J. Pecas Lopes); UTL-IST (Ferreira Jesus)
	Spain	University of Castilla La Mancha (Emilio Gomez Lazaro)
	Sweden	KTH (Lennart Söder)
	UK	DG&SEE (Goran Strbac, Imperial; O. Anaya-Lara, Strathclyde)
	USA	NREL (M.Milligan); UVIG (J.C.Smith); DoE (C. Clark)

2 new countries in process of joining: Mexico and France

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Thank you!

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