Modelling the power system in a multi-market environment

- PhD study 2014-2017

Ingeborg Graabak
Ingeborg.graabak@sintef.no
SINTEF Energi/NTNU

Supervisor: Professor Magnus Korpås, NTNU

Background

- The European power system is expected to gradually increase its share of production from variable resources like wind and solar and to phase out fossil fuel base production.
- In periods with limited production from the wind turbines and the solar plants, demand has to be covered from other types of production.
- In other periods the production from wind and solar plants may exceed the demand and the energy can be stored for future use.
- The Norwegian power system can provide Europe with some of the future needed flexibility. By further developing the Norwegian system, e.g including more pumping capacity, the value of the system will probably increase.
- Project "Balancing Management in Multinational Power Markets"

Objectives

- **The overall objective is to develop methodology and models for assessing the potential value of the Norwegian hydro power resources system for balancing of variable wind and solar production.** The sub objectives are:

  - Develop a scheme for categorization of variability of renewable wind and solar production for different time horizons
  - Develop a mathematical model of the day-ahead, intra-day and balancing markets and the interaction between the markets
  - Assess the value of application of Norwegian hydro power and storage for balancing of large shares of wind and solar production in future Northern Europe power production based on some principal investigations
  - Improve the assessment by more detailed simulations.

Plan

Period	Courses	Research activity	Deliverable
Autumn 2014	Course ET8209		Exam
		Start "state-of-the-art" studies	Paper PowerTech 2015
Spring 2015		Finalize "state-of the-art" studies	Journal paper
		Finalize "Scheme for systematically categorization of wind and solar resources"	Journal paper
		Start "Overall modelling of multi coupled markets"	
Autumn 2015	Course ET8208		Exam
		Finalize "Overall modelling of multi coupled markets"	Conference paper
Spring 2016		Finalize " Mathematical modelling of multi coupled power markets"	Journal paper
Autumn 2016	Course IØT8401		Exam
		Finalize" Simulation of multi coupled power markets – illustration of principles"	Conference paper
Spring 2017		Finalize " Simulation of multi coupled power markets- extended version"	Journal paper
		Studying abroad (?)	
Autumn 2017		Finalize Doctoral theses	Doctoral theses/ disputation

PhD Thesis "System Impacts From Large Scale Wind Power" – Tobias Aigner – July 2013

- Studies the impact of Wind Power Production on the European power system and proposes measures for its efficient and secure integration.

- Includes the modelling methodology and the associated results of simulating wind power production time series based on numeric wind prediction models and wind speed measurements. Four different wind speed data sources are used to model wind power production with very high accuracy.

PhD Thesis "Integration of Regulating Power Markets in Northern Europe" – Stefan Jaehnert – July 2012

Studies the integration of national regulating power markets enabling the cross-border exchange of balancing services in Northern Europe. Includes the development of a mathematical model for the regulating power market based on a day-ahead spot market model.