Centre for environmental design of renewable energy - CEDREN

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Balancing of wind and solar production in Northern Europe with Norwegian hydropower

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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 based 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"

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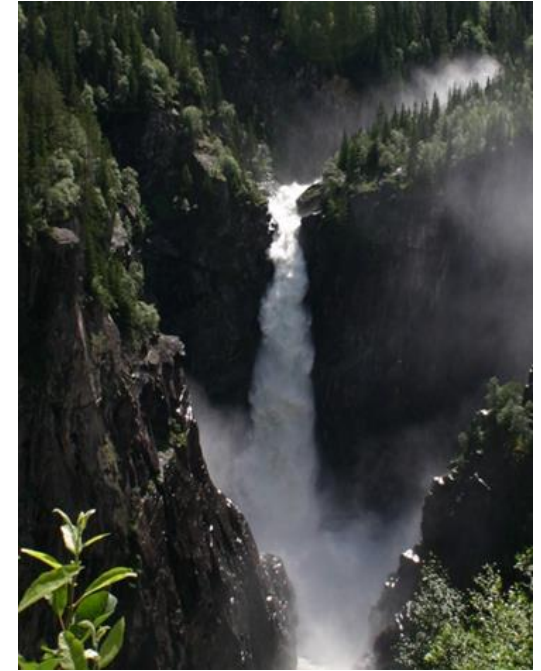
The **overall** objective is to develop methodology and models for assessing the potential value of the Norwegian hydro power resources system for balancing of variable wind and solar production.

Sub-Objectives

- Develop a **scheme** for systematically categorization of variability of renewable wind and solar production for different time horizons

- Develop **a data model** with high spatial and temporal resolution for different scenarios of wind and solar production in Northern Europe

- Establish a possibility for **analyses of several markets** (day-ahead, intraday, balancing)

- **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

Results I:III Scheme for systematically categorization of wind and solar variability

Variability cannot be considered as a distinct resource property with a single measurable parameter, but is a multi-faced concept best described by a range of distinct characters

Distribution long term

Distribution short term

Step changes/ramping

Auto Correlation

Spatial correlation

Cross correlation

Predictable patterns

Unpredictability

Results II:III Data model

- Further development of Aigner's PhD work
- Numerical weather prediction model: COSMO EU (DWD)
- Include both wind (2007-2015), solar radiation (2011-2015) and temperature
- Hourly resolution
- Spatial resolution: 7x7 km Europe and Northern Africa
- Installed wind capacity: "The Wind Power"
- Installed PV capacities: regional capacities

Results III:III Verification of data model