Resources adequacy – Analysis of renewable generation variability

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Overview

The enormous increase in the integration of renewables (RES) into the energy system with the system of subsidies (in particular the guaranteed purchase price, ie. Feed-in tariff) had serious consequences in the energy markets and the operation of the electrical system. The current way of supporting renewable energy sources and market mechanisms caused a surge supported sources, a significant change in the mix (conventional plants and operationally expensive resource are pushed out – called merit order effect) and last but not least, a significant increase in electricity prices for end users.

One of very important terms related to RES integration is Resources (generation) adequacy. Generation adequacy is the ability of the sources in the power system to match the load on the power system at all times. Developing this definition more broadly and focusing on generation side, we can consider this definition as a looking for the optimal structure of sources for electricity generation considering all economic, environmental and technical aspects of all types of sources. Importance of generation adequacy analysis increases with wide RES development. Unpredictable variability of renewable production dependent on natural conditions requires adequate sources to cover so called residual load. This electricity generation should be reliable and as much as possible cost effective.

This paper aims to analyse short-term variability of renewable production and to analyse residual load. The results are used to state characteristics of backup sources needed to provide stable and secure electricity supply. These characteristics can be used to establish optimal economic environment for achieving of an optimal structure of sources from technical-economic point of view.

Methods

This paper presents short-term variability analysis of RES production dataset from different sources in the Czech Republic. Hourly gradients of production are analyzed to be used for extensive analysis of short-term variability and probability of hourly changes of renewable production. We used standard stochastic approach of data analysis and we set characteristics of hourly variability of renewable production (capacity factor, capacity credit).

We provided analysis of load demand in the Czech Republic and we analysed renewable production to set characteristic of residual load.

Results

Results of analysis of short-term renewable production meeting load is used to develop a probabilistic model of renewables production. These results are necessary for dimensioning residual generation, which should be economically-effectively provided. Residual load model is the key to provide the generation adequacy analysis.

Conclusions

This paper deals with renewable short-term variability analysis and load variability analysis. Characteristics of residual load behaviour is used to develop the probabilistic model of residual sources needed to provide stable and secure supply of electricity. These results can be used to set conditions for a developing a optimal portfolio of sources reflecting all technical and economical aspects of operation.

References

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