



Improving the value of variable and uncertain power generation in energy systems (VaGe)

The energy sector is under transformation. The share of *variable power generation*, such as wind power and photovoltaic (PV), is increasing rapidly. Their output is dependent on weather and therefore much more variable and uncertain than the output from more conventional power generation. Variability and uncertainty brings challenges to power system operators and lowers the value of wind power and PV for the overall energy system and therefore also for the society at large. Variability decreases value since it causes periods with surplus electricity and periods with high net demand (demand minus the generation from wind power and PV – i.e. what other power plants need to provide for). Uncertainty decreases value since decision making under uncertainty is more difficult. Uncertainty leads to suboptimal decisions concerning e.g. when to store energy and when to start up power plants.

VaGe project objective is to improve operational decision making in the power systems when considering the variability and uncertainty of wind, solar, water inflow, heat and electricity demand, their correlations and possible sources of flexibility. Decision making under weather related variability and uncertainty is improved in two different time scales: 1) *short-term* power plant unit commitment and dispatch decisions (look-ahead up to 36 hours) and 2) *medium-term* optimization of storage use, consumer resources and other slow processes (look-ahead up to two weeks). More information, i.e. better and more comprehensive forecasts, and energy system flexibility can mitigate variability and uncertainty. Due to systemic interactions, it is important to assess all relevant sources of flexibility. The general objective is split into:

- O1: Improve the uncertainty estimates of weather related power generation on both medium-term and short-term time scales
- O2: Improve the representation and modelling of weather related uncertainties within the energy system optimisation models – including a new model for the medium-term
- O3: Find solutions to mitigate variability and uncertainty utilizing better forecasts as well as flexibility from biomass, consumer participation and electrification of heat and transport

The project provides partial funding for 1 post-doc, 2 PhDs and 2 PhDs turning to post-docs during the project.

International collaboration is foreseen with VTT and Electricity Research Centre of University College Dublin. At VTT the work is linked to IEA Wind Task 25 on wind integration and WILMAR user group. At FMI there is collaboration with HIRLAM-B consortia members and ALADIN consortia members

Web pages

Link to CLEEN and FLEXe SHOK programme

<http://www.cleen.fi/en/research>

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