FLEXIBILITY IN THE POWER SECTOR OF THE NETHERLANDS, 2015-2050 – KEY MODELLING RESULTS OF THE FLEXNET PROJECT

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Overview

The Netherlands is aiming at a more sustainable, low-carbon energy system. For the Dutch power system this energy transition implies (i) a larger share of electricity from variable renewable energy (VRE), in particular from sun and wind, (ii) a larger share of electricity in total energy use due to the increasing penetration of demand technologies such as electric vehicles (EVs), heat pumps (HPs), power-to-gas (P2G), power-to-heat (P2H), etc., and – as a result of these two trends – (iii) a higher need for system integration and flexibility.

Against this background, the overall objective of the project 'Flexibility of the power system in the Netherlands' (FLEXNET) was to analyse demand and supply of flexibility in the power system of the Netherlands up to 2050 at both the national and regional (grid) level. The paper presents some modelling results and key findings of the FLEXNET project. In particular, it analyses the implications of the energy transition in the Netherlands for demand and supply of flexibility in the Dutch power system over the period 2015-2050 within an EU electricity market and trading context.

Methods

In order to analyse quantitatively the demand for flexibility by the Dutch power sector over the period 2015-2050, we have developed two scenarios:

- The Reference scenario. This scenario is based on the 'accepted policy scenario' of the 'National Energy Outlook 2015' in the Netherlands (ECN et al., 2015). Its major characteristics are: (i) a strong growth of installed VRE capacity in the power sector up to 2030, and (ii) a weak growth of additional electrification of the energy system as a whole. This scenario includes three focal years, labelled as 'R2015', 'R2023' and 'R2030' (where the letter R refers to the Reference scenario);
- The Alternative scenario. This scenario is similar to the reference scenario with one major exception, i.e. it assumes a strong growth of additional electrification of the Dutch energy system by means of electric vehicles (EVs), heating pumps (HPs), and other means of electrification of the energy system in households, services, transport, industry, etc. This scenario includes also three focal years, labelled as 'A2023', 'A2030' and 'A2050' (where the letter A refers to the Alternative scenario).

The demand and supply of flexibility in the Dutch power system has been quantified by means of the following tools/models:

- Annual electricity demand and VRE power supply profiles on an hourly basis for four demand variables (conventional load, EVs, HPs and additional load for other means of electrification) and three VRE supply variables (wind on land, wind on sea and sun PV);
- A static simulation model to quantify the hourly variations in the residual power load and the resulting demand for flexibility by the Dutch power sector;
- The EU28+ electricity market model COMPETES (in order to determine the mix of flexibility options, including in particular power trade within an EU electricity market setting);
- The NL energy system model OPERA (in order to determine and fine-tune the domestic mix of flexibility options, including in particular demand response within an NL energy system setting).

The paper will focus notably on the OPERA modelling results, including the linkage with the EU-NL power trade results of the COMPETES model.

Results

The major results include:

- Quantified analyses of annual electricity demand and VRE supply profiles on an hourly basis in all scenario cases of the Dutch power system, 2015-2050;
- Quantified (modelling) results and analyses of trends in (residual) power demand and supply in the Dutch power system, 2015-2050;
- Quantified (modelling) results of hourly variation in (residual) power demand and supply and the resulting demand and supply of flexibility in the Dutch power system in all scenario cases up to 2050.

Conclusions

The two main conclusions of the paper include:

- The demand for flexibility by the power system in the Netherlands increases six fold between 2015 and 2050;
- This demand is met predominantly by (foreign) power trade and (domestic) demand response, to some extent by conventional generation (gas) and VRE curtailment, but hardly or not by electricity storage and demand curtailment.

References

- ECN and Alliander (2017a): The demand for flexibility of the power system in the Netherlands, 2015-2050, Report of phase 1 of the FLEXNET project;
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- ECN and Alliander (2017c): Demand and supply of flexibility in the power system of the Netherlands, 2015-2050, Summary report of the FLEXNET project.