Analysing flexibility of the power system in the Netherlands – practical solutions for linking models of different time and spatial scales

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FLEXNET Project

- Project title: **FLEXibility of a more sustainable, low-carbon power system in the NETherlands, 2015-2050 (FLEXNET)**

- **Objective**: to analyse (quantitatively) demand and supply of flexibility of the power system in the Netherlands up to 2050 at the national and regional (grid) level

- **Duration**: April 2015 – November 2017

- **Consortium**: ECN and TSOs/DSOs in the Netherlands

- **More information** (including all project deliverables):
  - [https://www.ecn.nl/flexnet/](https://www.ecn.nl/flexnet/)
# Summary overview of methodology & tools

<table>
<thead>
<tr>
<th>Phase</th>
<th>National level (ECN)</th>
<th>Regional grid level (Alliander)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phase 1</strong> (Flex demand)</td>
<td>- Annual power demand &amp; supply profiles on hourly basis</td>
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<td></td>
<td>- Excel static simulation modelling tool</td>
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<tr>
<td><strong>Phase 2</strong> (Flex supply)</td>
<td>- EU28+ electricity market model COMPETES;</td>
<td>Liander regional network model ANDES</td>
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<td>- NL energy system model OPERA;</td>
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<td></td>
<td>- Review of recent studies</td>
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<td><strong>Phase 3</strong> (Framework)</td>
<td>- Literature review; experts’ expertise; interviews</td>
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Linking energy system models

- **COMPETES:**
  - EU28+ electricity market model (optimisation)
  - Advantage:
    - Includes interconnection/trade links across EU28+ countries
    - Runs on an hourly basis
  - Disadvantage: does not include demand response

- **OPERA:**
  - NL integrated energy system model (optimisation)
  - Advantage: Covers integrated, details technology options (including demand response, storage, etc.)
  - Disadvantage:
    - No external (‘trading’) links
    - Hourly input is grouped into and analysed by means of ‘time slices’
Model linking – practical approach

- Run several FLEXNET scenario cases by means of COMPETES to determine demand and supply of flexibility by the Dutch power system, 2015-2050 (excluding demand response, but including different 2050 interconnection assumptions)
- Include NL hourly power trade outcomes (from COMPETES) exogenously into OPERA
- Model demand response in OPERA for several technologies (P2G, P2H, P2A and EV)
- Estimate mix of flexibility options by OPERA
- Correct underestimation of flexibility by OPERA (‘time slice effect’) by means of COMPETES outcomes (‘hourly flexibility results’)
COMPETES: total annual supply of flexibility options, 2015-2050 (in TWh)
Comparison of COMPETES versus OPERA: total annual flexibility supply (in TWh)
Future modelling steps/challenges

- New project: Integrated Energy System Analysis (IESA, 2018-2021), including ECN-TNO and EAE/Groningen University (ESTRAC)

- COMPETES model development:
  - Include demand response (and more – domestic/seasonal – storage options)
  - Address computational issues
  - Include flexibility issues at the balancing/intraday market
  - Include North Sea area as a separate hub

- OPERA model development:
  - Include/focus on specific regions (within the Netherlands; North Sea; NEW)
  - Include/upgrade sectoral and technology specific data for demand response
  - Include/upgrade specific technologies (P2X, heat storage, EV, etc.)