Flexibility Tracker

Indicators for Power System Flexibility

Strommarkttreffen - VKU
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The Flexibility Tracker is work in progress by Ecofys in a series of projects on power system flexibility in collaboration with Leonardo Energy.

Previous projects were:

- **Flexibility options in Electricity Systems**
  (2014; [link to report](#))

- **Power System Flexibility Strategic Roadmap**
  (2015; [link to report](#), [paper](#), [webinar](#))
Overview

Why? Arising flexibility gap

Whereby? Flexibility options

How? Flexibility tracker

Discussion
Definition of power system flexibility

> Electricity is a special good. Demand and supply have to be balanced at each moment.

> **Definition of power system flexibility**
  
  - The extent to which a power system can adapt electricity generation and consumption as needed to maintain system stability.
  
  - Flexibility is the ability of a power system to respond to changes in demand and supply

> What happens when shares of variable renewables (VRES) increase?
Residual load pushed downwards: Reduced full load hours for conventional technologies
Residual load ramps increase with higher VRES shares: Increased need for flexibility
Impact of increasing shares of VRES: a flexibility gap calls for new flexibility options

**Low VRES**

Flexibility need:
- Demand variations
- Supply uncertainty (unit loss)

Flexibility provision:
- Supply side (conv. power plants)

**High VRES**

Flexibility need:
- Higher (net) demand variations
- Supply uncertainty (unit loss)

Flexibility provision:
- Lower from supply side (conv. generators displaced by VRES)
Existing flexibility measures and signs of inflexibility

> **Existing measures to provide flexibility are mainly on the supply side**

Ramping capability, low must-run capacity, and short start-up/shut-down times are commonly used measures to provide flexibility.

> **Signs of inflexibility**: frequency excursions due to difficulties in balancing demand and supply, significant RES curtailment, balancing schedule violations, negative market prices, price volatility and price spikes

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![Costs for system services in Germany](chart)

**Costs for system services in Germany**

Sources: Bundesnetzagentur 2011-2016
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Discussion
Categorisation of flexibility options

- Storage
- Markets
- Supply
- Network

Flexibility sources
Flexibility enablers
Power System Flexibility Vision: 7 key elements

1. Exploit flexibility and energy storage inherent in demand (prosumers)
2. Enable liquid, expanded and close-to-real-time power markets
3. Control VRES generators to provide grid support services
4. Set price incentives or mechanisms that reflect diversity-related benefits in the development of variable resources.
5. Deploy bulk energy storage to cover longer periods (weeks to months) of low renewable energy supply.
6. Develop smart grids for the coordination of flexible resources across voltage levels
7. Establish new electric energy uses to capitalize on the surplus energy events
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Discussion
> 5 categories, 14 subcategories and 52 KPIs (based on factual and qualitative questions)

> The structure allows:
  - ranking each system per category/subcategory (flexibility ‘identity’)
  - obtaining comparison reports per subcategory or KPI
Example: Demand Side Contribution

> KPIs consist of a number of factual and qualitative questions, example:

<table>
<thead>
<tr>
<th>Subcategory</th>
<th>Question</th>
<th>Range and Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy Efficiency</strong></td>
<td>Are measures initiated by policy makers on track to meet the national short-/mid-term energy efficiency targets (2020)?</td>
<td>Yes/Trend/No (Scoring: Yes: 1, Trend: 0.5, No: 0)</td>
</tr>
<tr>
<td></td>
<td>Is the long-term potential of energy efficiency measures for the system being assessed?</td>
<td>Yes/Trend/No (Scoring: Yes: 1, Trend: 0.5, No: 0)</td>
</tr>
<tr>
<td><strong>Large-Scale (Industrial) Demand</strong></td>
<td>Are there significant industrial DSM programmes?</td>
<td>Yes/Trend/No (Scoring: Yes: 1, Trend: 0.5, No: 0)</td>
</tr>
<tr>
<td></td>
<td>Is industrial DSM participating in wholesale markets?</td>
<td>Yes/Trend/No (Scoring: Yes: 1, Trend: 0.5, No: 0)</td>
</tr>
<tr>
<td></td>
<td>Is industrial DSM participating in balancing markets?</td>
<td>Yes/Trend/No (Scoring: Yes: 1, Trend: 0.5, No: 0)</td>
</tr>
<tr>
<td></td>
<td>What is the theoretical potential of industrial DSM? [Industrial DSM potential / peak load]</td>
<td>Industrial DSM potential / peak load</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Scoring: ≥5%: 1, &lt;5% &amp; ≥2.5%: 0.5, &lt;2.5%: 0)</td>
</tr>
</tbody>
</table>

> The answers are provided by official sources and reviewed by country experts
Scoring: rating against the 100% RES goal

> **Score individual questions:**
  - Clear guidelines on how to interpret results
  - Scale Low/Medium/High = 0/0.5/1
    - Provision of ranges for interpretation of achieved goals
    - Medium for Y/N answers where plans are not fully set in action

> **Total scoring: weighted average of all answers**
  - Weighting factors are applied allowing some questions to have more significance: achieved goals (e.g. VRES penetrations) rate higher than plans
  - Final score presented in a range 0-5 on a red-green colour code:
    - 0-1: dark red (insufficient-very low readiness)
    - 1-2: red (insufficient-low readiness)
    - 2-3: orange (medium readiness)
    - 3-4: light green (medium-high readiness)
    - 4-5: green (high readiness)
Functionalities

> **Flexibility ‘identity’** of each country: assessment across all options

> **Overview across all countries**: comparison and combined plots

> **Country reports:**
  - Country factsheets: VRES targets, key info on system & flex options
  - Highlights of key factors affecting the rating
  - Action plans on flexibility

> **Category/subcategory reports**: which countries are better on a specific actions and why?

> Identification of **best practices**, enable exchange of policies

> **Periodical updates**, tracking of developments
Preliminary results

Comparative scoring per subcategory for three countries in Central Western Europe

- Retail Markets
- Conventional Generation
- Distributed Generation & Variable Renewables
- Balancing Markets
- Energy Efficiency
- Wholesale Markets
- Large-Scale (Industrial) Demand Side Management
- Large-Scale/Bulk Storage
- Small-Scale Demand Side Management
- Transmission Grid
- Interconnections

Countries are nearby

Countries are far apart

Work in progress
Conclusions from the preliminary results

> **Structural challenges.** There are areas where all assessed countries score equally low and need to improve, e.g.:
  - Increase flexibility of conventional generation
  - Deployment of small-scale demand side flexibility

> **Individual challenges.** There are also areas where certain countries rank significantly higher than others. Besides possible explanations by structural differences, these are areas for the identification of best practices, e.g.:
  - Deployment of industrial demand side management
  - Interconnections
  - Wholesale markets
  - Retail markets

> A detailed report with results for Belgium, Germany, the Netherlands, Poland and Spain will be available in autumn.
Thank you for your attention!

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