

Executive Summary

Flexibility needs and potentials in 2030, 2040 and 2050

Flexibility is needed to balance electricity demand and supply at any moment and to ensure a stable and reliable power system. It is becoming increasingly important in view of the ongoing and planned expansion of variable renewable energies, in particular solar PV and wind energy, and the cost-efficient integration of new electricity uses. Flexibility is required at different timeframes: sub-hourly, daily (within the hours of a day), weekly (within the days of a week) and seasonal. Flexibility can be valorised explicitly, through the procurement of flexibility products such as balancing services, or implicitly through price differentials in the wholesale electricity markets.

Flexibility needs are expected to increase significantly in the Penta region, at all timeframes. At the sub-hourly timeframe, the large-scale integration of renewables will increase the need of flexibility to maintain grid stability against unforeseen events, such as forced outages due to the reduced inertia of the power system, and to maintain system balance against uncertainties in forecasts, due to renewable generation forecast errors. These flexibility needs are largely satisfied explicitly through balancing reserves. New products, such as faster reserves or inertia, or increasing volumes of reserves could be required in the future.

Flexibility needs at the daily, weekly and seasonal timeframes were assessed quantitatively based on the results of the Ember study for a decarbonised European electricity system by 2035¹. They represent the variability of the **residual demand** (the total system demand less the non-dispatchable generation, such as variable renewables) that has to be met with flexible solutions at various timescales. **Flexibility needs at the daily and weekly timeframes**, driven by the integration of solar PV and wind energy generation respectively, **will be most impacted, increasing by up to 2 times by 2030 and up to 6 times by 2050 compared to today**, as shown in Figure 0-1. Seasonal flexibility needs are expected to increase at a lower rate, by a factor of 3 by 2050 compared to today, due to complementarities in different drivers of flexibility needs.

The flexibility needs will be met by existing and additionally required resources. The composition of flexibility portfolios will drastically change, shifting from dispatchable conventional thermal power plants (which are subject to phase-out strategies in several countries) to a major role of cross-border exchanges, storage and demand side flexibility as shown in Figure 0-2. Significant investments will be needed in low-carbon flexibility assets, including flexible electrolysers, demand-side response (industrial demand, smart charging and V2G-capable electric vehicles), storage assets and hydrogen-based power generation (coupled with hydrogen storage).

¹ Ember (2022) New Generation: Building a clean European electricity system by 2035

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Figure 0-1: Cumulated flexibility needs of Penta countries for the three different scenarios of the Ember study, 2020 to 2050 (without regional cooperation)

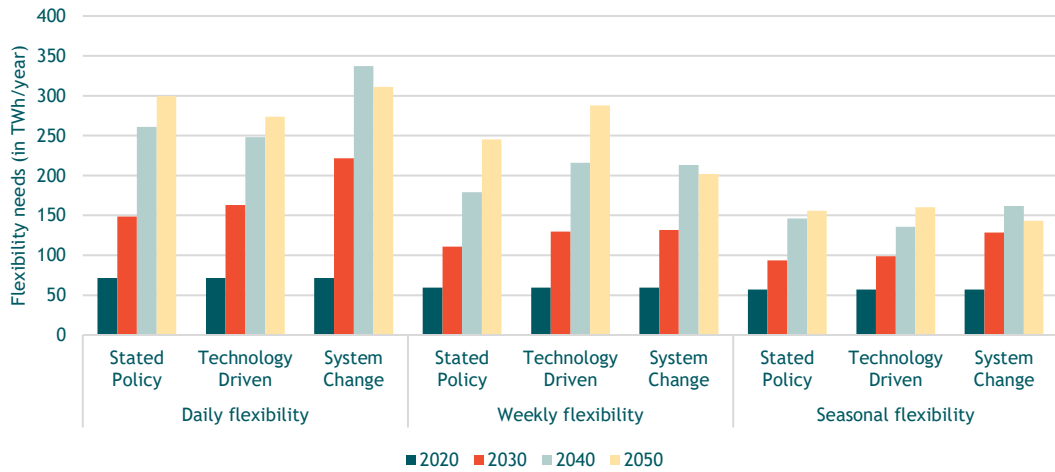
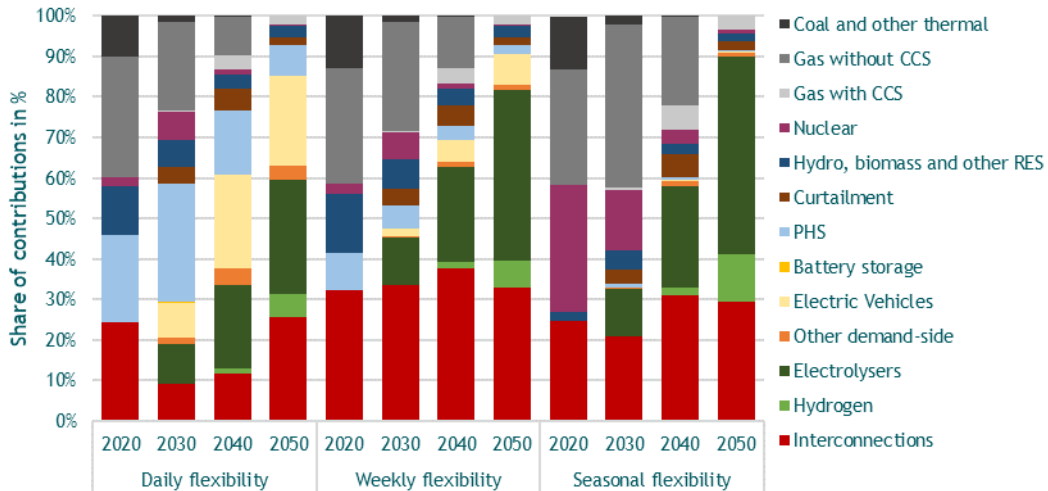


Figure 0-2: Share of technologies providing system flexibility in the Penta countries for daily, weekly and seasonal timeframes, Technology Driven scenario.



Regional cooperation is a key enabler for a cost-efficient integration of renewable energy, with interconnections enabling to reduce flexibility needs across states and market coupling facilitating liquidity and efficiency of markets, allowing to fully use the potential of local assets such as hydropower in the Alps region. Consequently, significant investments will be needed, with total cross-border interconnection capacities in the Penta region almost tripling by 2050 compared to 2020 in the scenarios of the Ember study.

To identify potential policy measures to facilitate the development and efficient utilisation of flexibility resources in the region, the present study identifies and compares existing as well as planned regulations enabling or hindering the deployment of flexibility solutions in the electricity sector in the Penta countries. The following topics are analysed in detail in chapter 4:

- ✓ Day-ahead and intraday markets;
- ✓ Electricity balancing;
- ✓ Congestion management;
- ✓ Network tariffs and contracts;

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- ✓ Independent aggregators;
- ✓ Network planning;
- ✓ Value stacking;
- ✓ Collective self-consumption.

The Pentalateral Energy Forum can play an important role in facilitating and stimulating cross-border coordination and cooperation, including by exchanging information on good practices on how to activate and integrate flexibility, in particular from small electricity generators, demand side response and storage. Improving market design and rules, facilitating investments in flexibility assets and empowering prosumers/consumers will be required to cost-efficiently meet the increasing flexibility needs.

Based on our analysis, we have identified potential domains for enhanced cooperation at the Penta level and formulated concrete recommendations to steer the transformation of the concerned countries' energy systems. The recommendations are presented in chapter 5 per main topic: governance of the energy system, electricity market design, and network aspects. They cover various regulatory and non-regulatory measures to identify and address flexibility needs, foster the integration of regional electricity markets and exchange best practices across Penta countries, remove barriers for participation of and provide adequate signals to flexibility resources, and ensure electricity networks facilitate the integration of flexibility resources with network operators procuring flexibility whenever necessary in a non-discriminatory manner.