Roadmap to net zero

Elia Group's vision on building a climate-neutral energy system by 2050

Agenda for today

- 10h00-10h20: general introduction
- 10h20-10h50: future energy supply and demand
  - Deep-dive on analysis (15min)
  - Questions (15min)
- 10h50-10h11h20: flexibility
  - Deep-dive on analysis (15min)
  - Questions (15min)
- 11h20-11h45: adequacy
  - Deep-dive on analysis (10min)
  - Questions (15min)
- 11h45-12h00: closing remarks

Today’s speakers

Jan Voet

- Manager System of the Future at Elia Group

Louis Magein

- Market & adequacy analyst at Elia Transmission Belgium

Carsten Bakker

- Market analyst at Elia Group

Paul Nahmmacher

- Market analyst at 50Hertz

How to interact?

The presentation is divided into 3 blocks:

- Future energy supply and demand
- Flexibility
- Adequacy

During the presentation of every block (and after during the Q&A), you will get the chance to ask questions using the slido application. You can join via **the link in the chat** or via the **code** below.

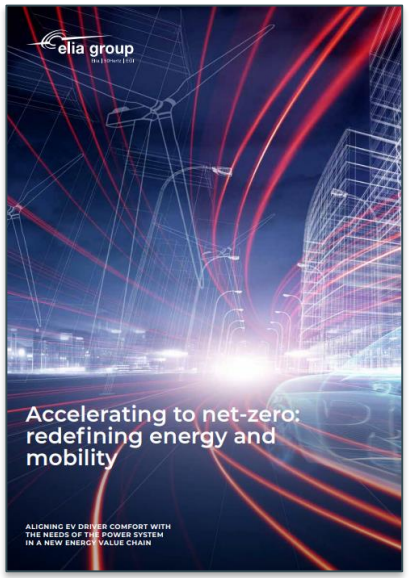
Please keep the questions on topic and focused on the dedicated block.

You can join at **slido.com** with **#193256**

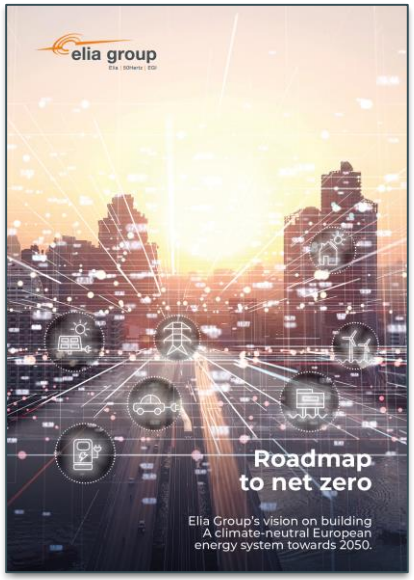
Each year, Elia Group publishes a study on its stakeholders day on a topic of great relevance to society

2018: Consumer-centricity

2019: Preparing the power system 2030



2020: E-mobility



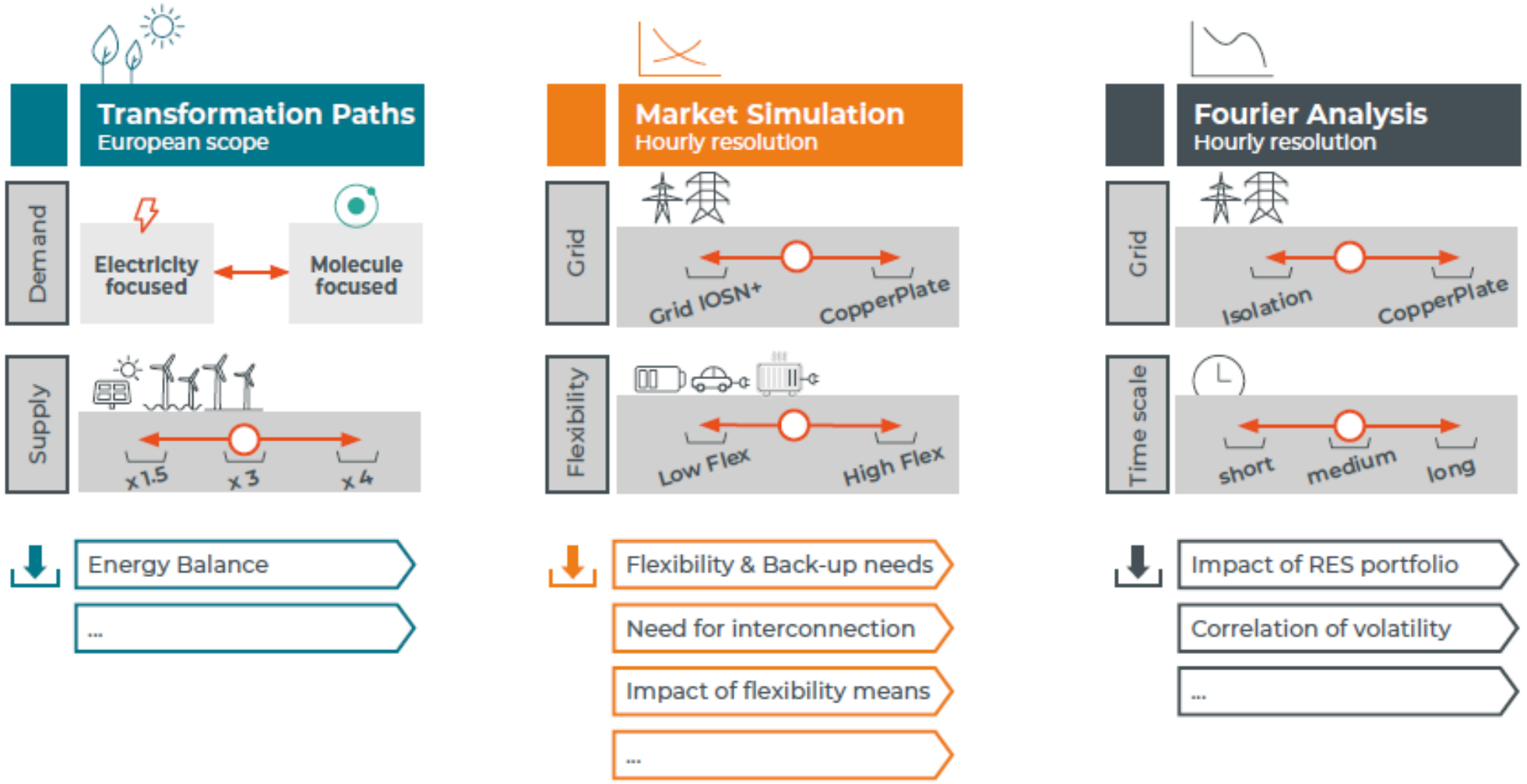
2021: Climate neutral European energy system

Making the Green Deal a reality

Dimensions of our study

Our study envisions a fully climate neutral system by 2050 in Europe with focus on Belgium and Germany.

Our study uses ‘state-of-the-art’ methodologies to simulate and analyse the energy/electricity system. Several sensitivities were performing allowing to assess the impact of key assumptions

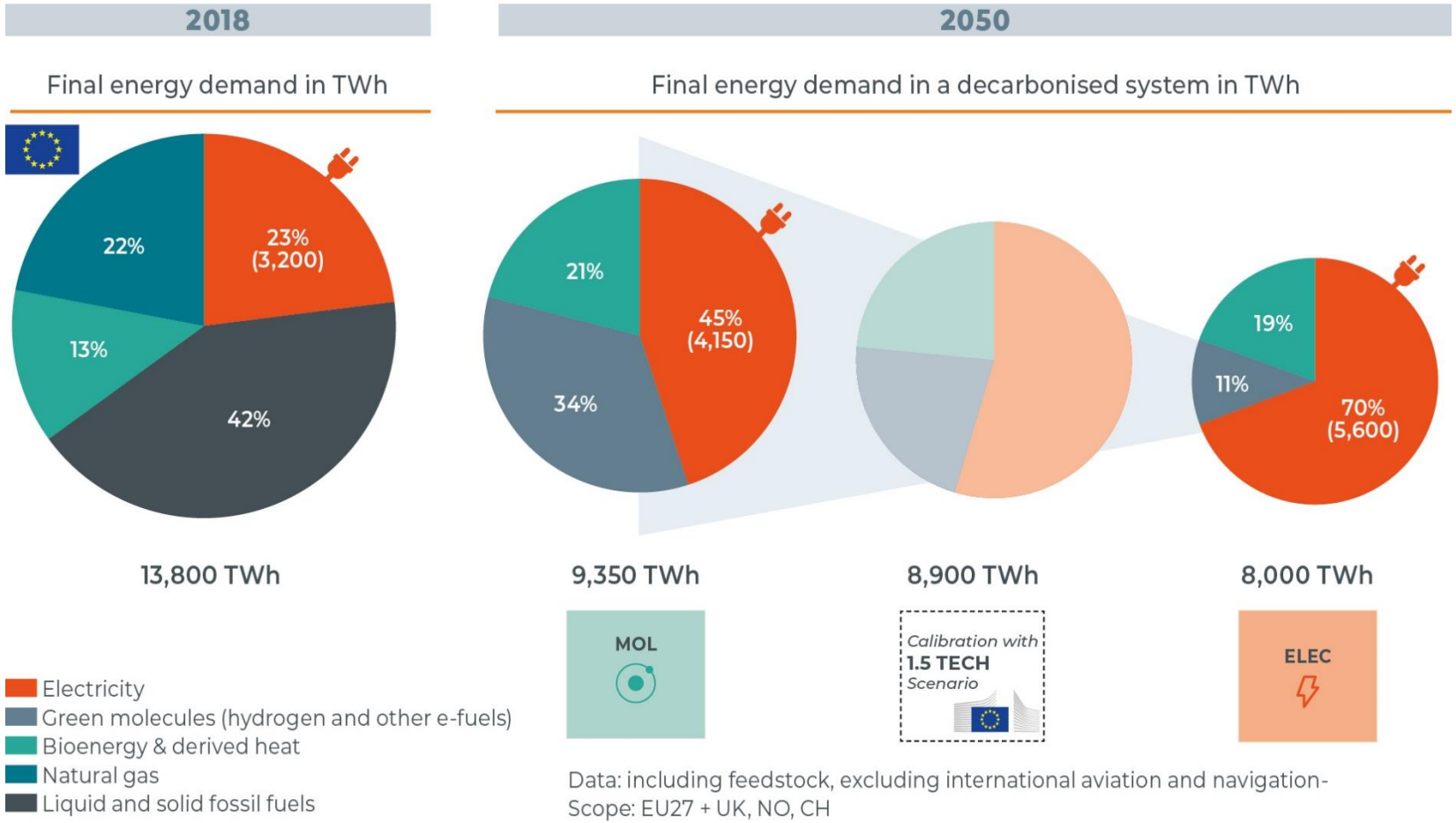


Key Insights on the Energy Balance

Europe is short on the renewables it needs to achieve net zero by 2050

- Sufficient RES to cover direct electrification needs.
- Imports of green molecules from other continents will be required.

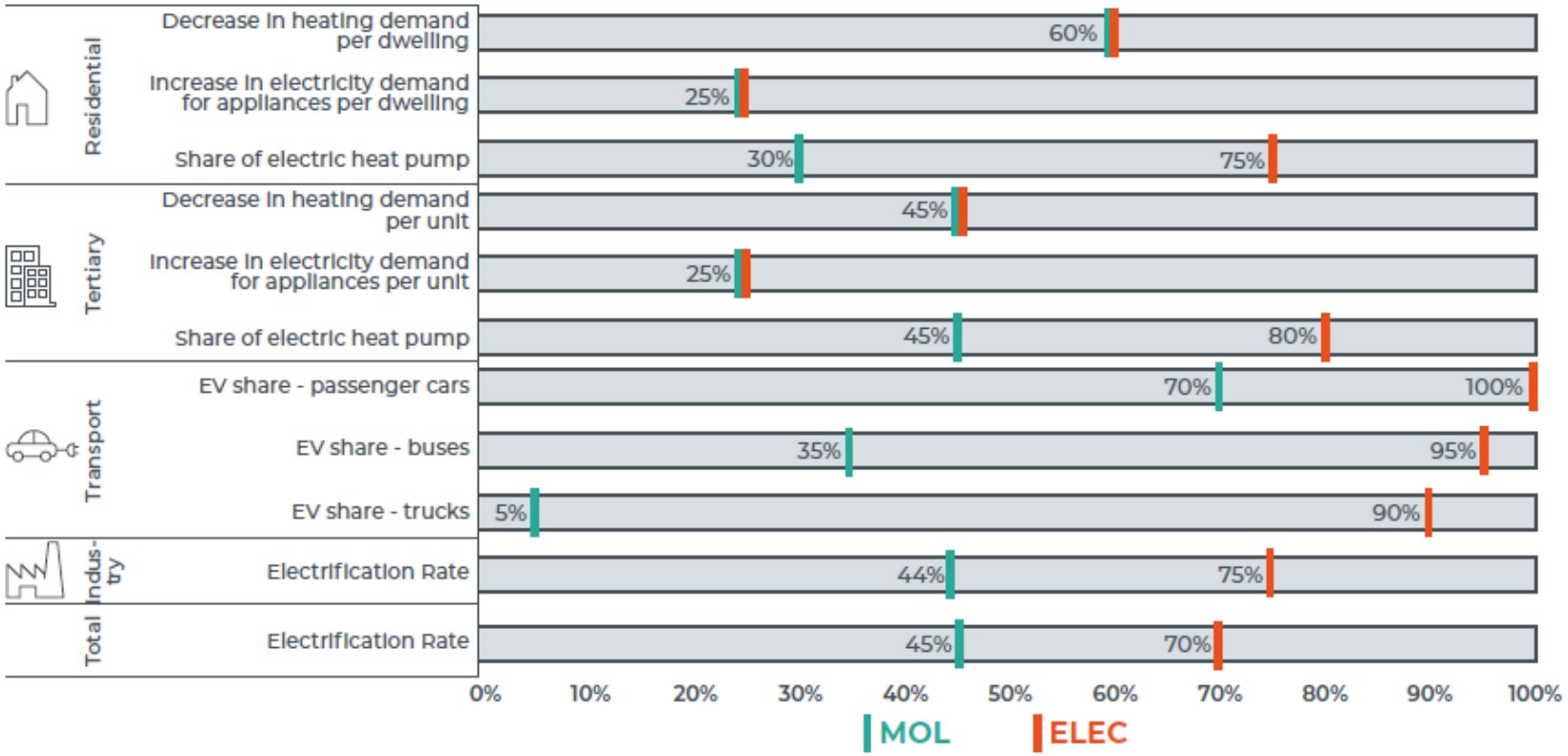
Direct electrification is the most efficient way to cover final energy demand.



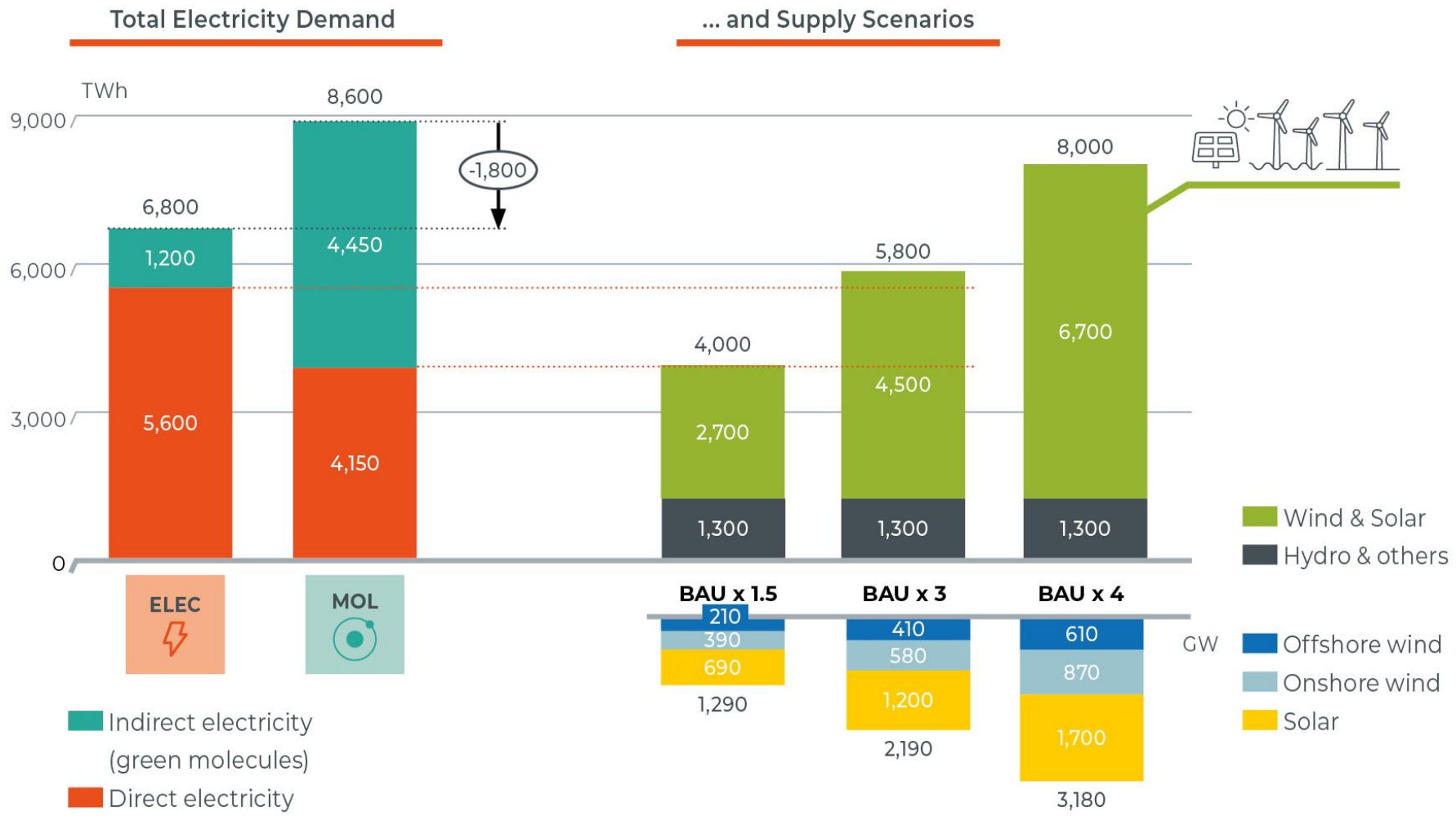
Data: including feedstock, excluding international aviation and navigation
Scope: EU27 + UK, NO, CH

Overview of key scenario assumptions regarding direct electrification

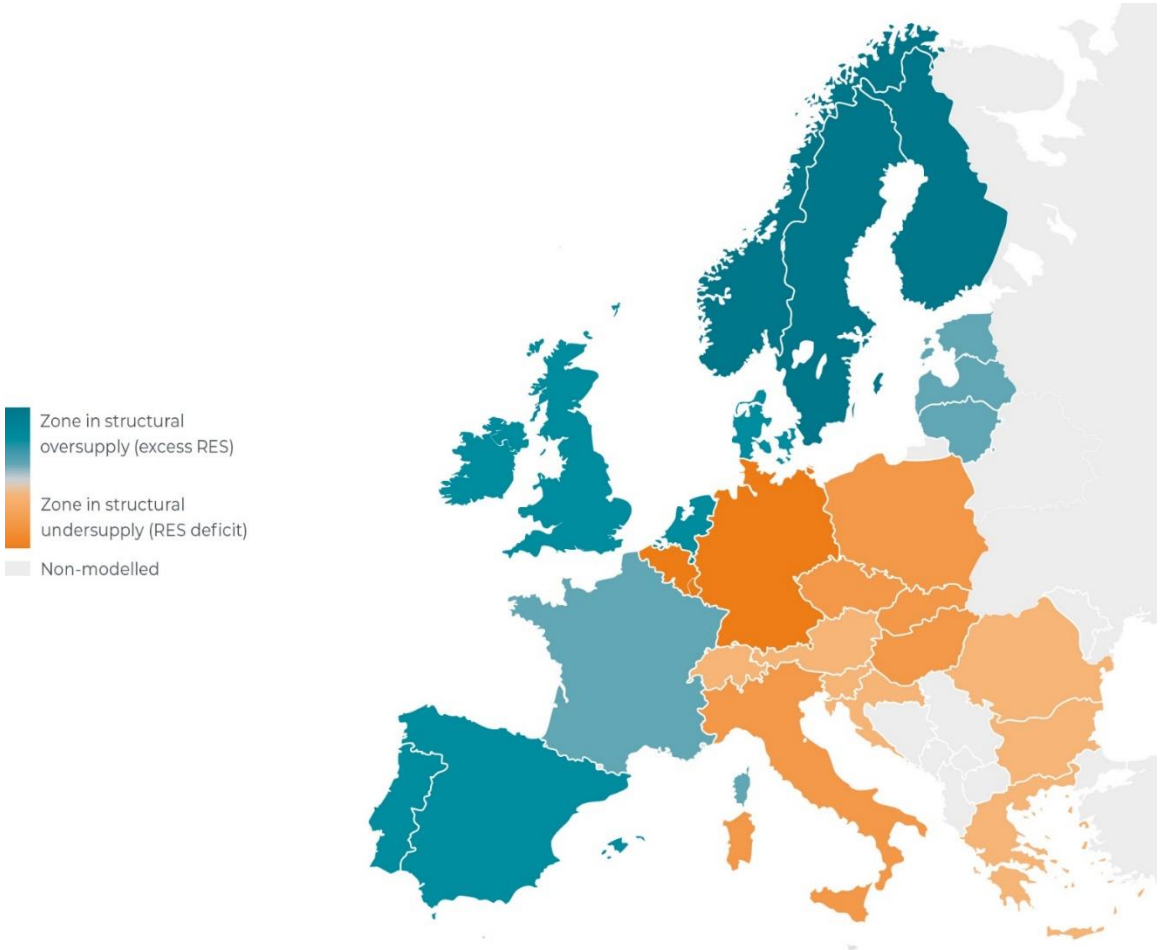
FIGURE 3: EVOLUTION OF THE DIFFERENT DEMAND SECTORS IN EUROPE TOWARDS 2050 FOR BOTH TRANSFORMATION PATHWAYS



Europe has sufficient RES potential, but deployment of renewables needs to accelerate for the next three decades to decarbonize energy supply



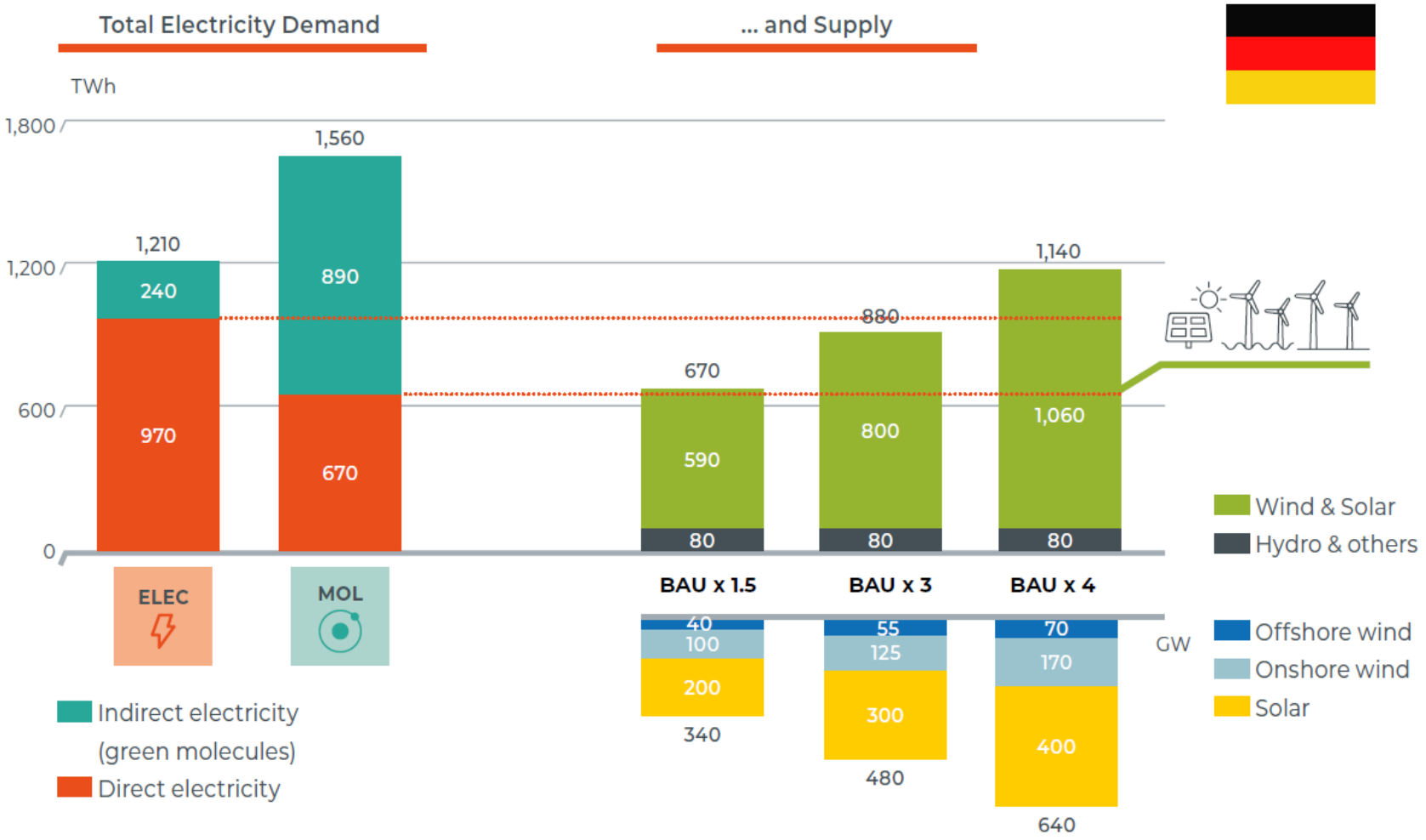
The uneven distribution of renewable energy across Europe make interconnectors essential tools for electrification and decarbonisation.



- The over- and undersupply of direct electricity using regional resources and demand.
- The renewable energy potential is **unevenly distributed over Europe**.
- Largest potentials are in the **Nordics** and along the **west coast of Europe**
- Undersupply for both Belgium and Germany.

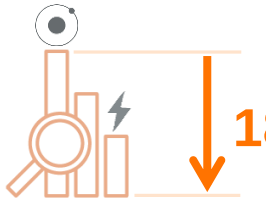
Scenario: demand ELEC + supply RES 3xBAU

Only with very ambitious RES expansion, Germany will be able to cover its direct electricity demand with domestic resources.



Energy balance: Key figures

Direct Electrification
is most efficient to meet final energy demand.



1800 TWh

Difference in annual electricity needs (incl. indirect needs to generate green molecules) between electricity vs molecule focused transformation pathway

A large increase in the speed of RES exploitation is needed in order to supply all the energy by 2050

RES expansion
needs accelerate quickly.

Close Cooperation in Europe
to pool excess with shortage regions.

40-60%
0-20%

BE to employ non-domestic RES for half of its direct electricity demand. DE only self sufficient in most ambitious RES expansion scenario. Limited potential for domestic hydrogen production.

Key insights

Note: Numbers still preliminary

Questions

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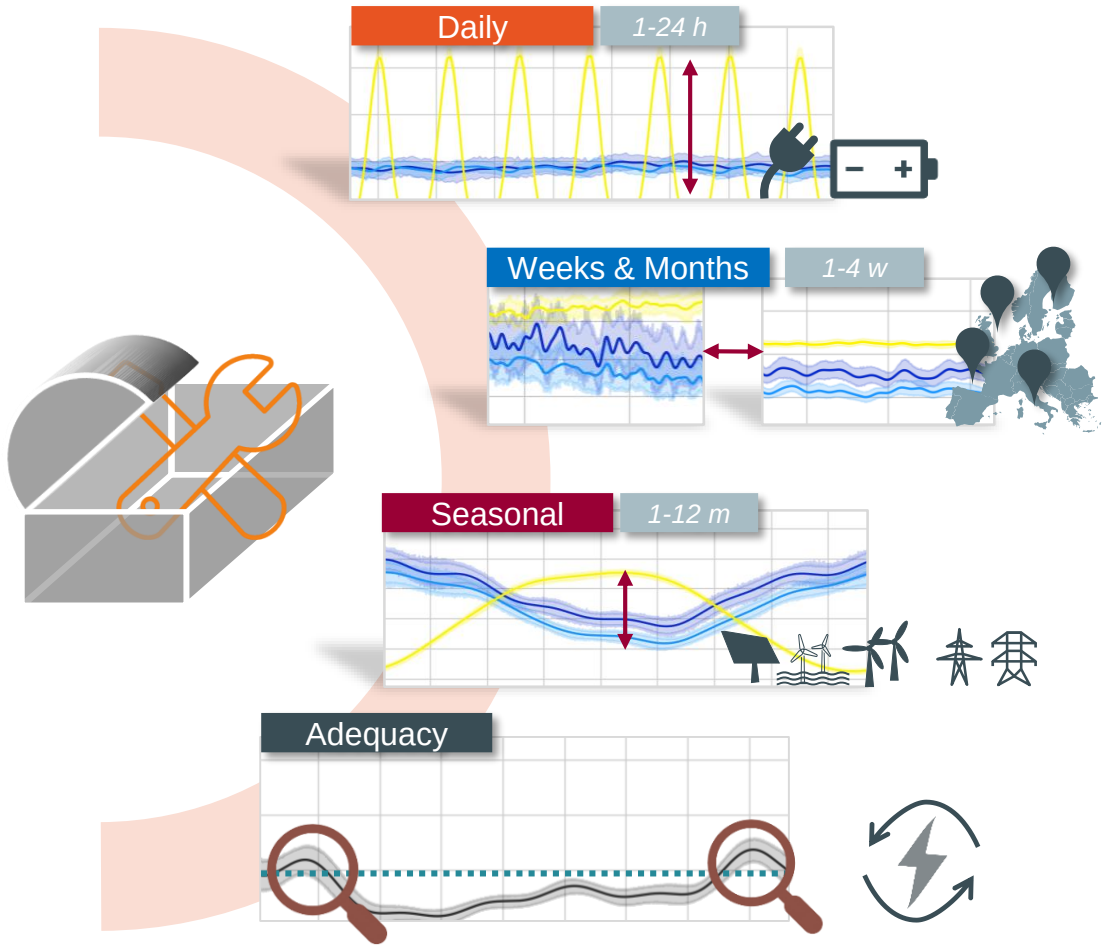
Key Insights on Flexibility

A well-designed RES system will be able to manage the fluctuations in an efficient way:

- Seasonality → well balanced RES mix
- Mid-term fluctuations → more interconnectors
- Daily fluctuations → electrification of end use

Our flexibility toolbox contains 4 elements to balance the future power system

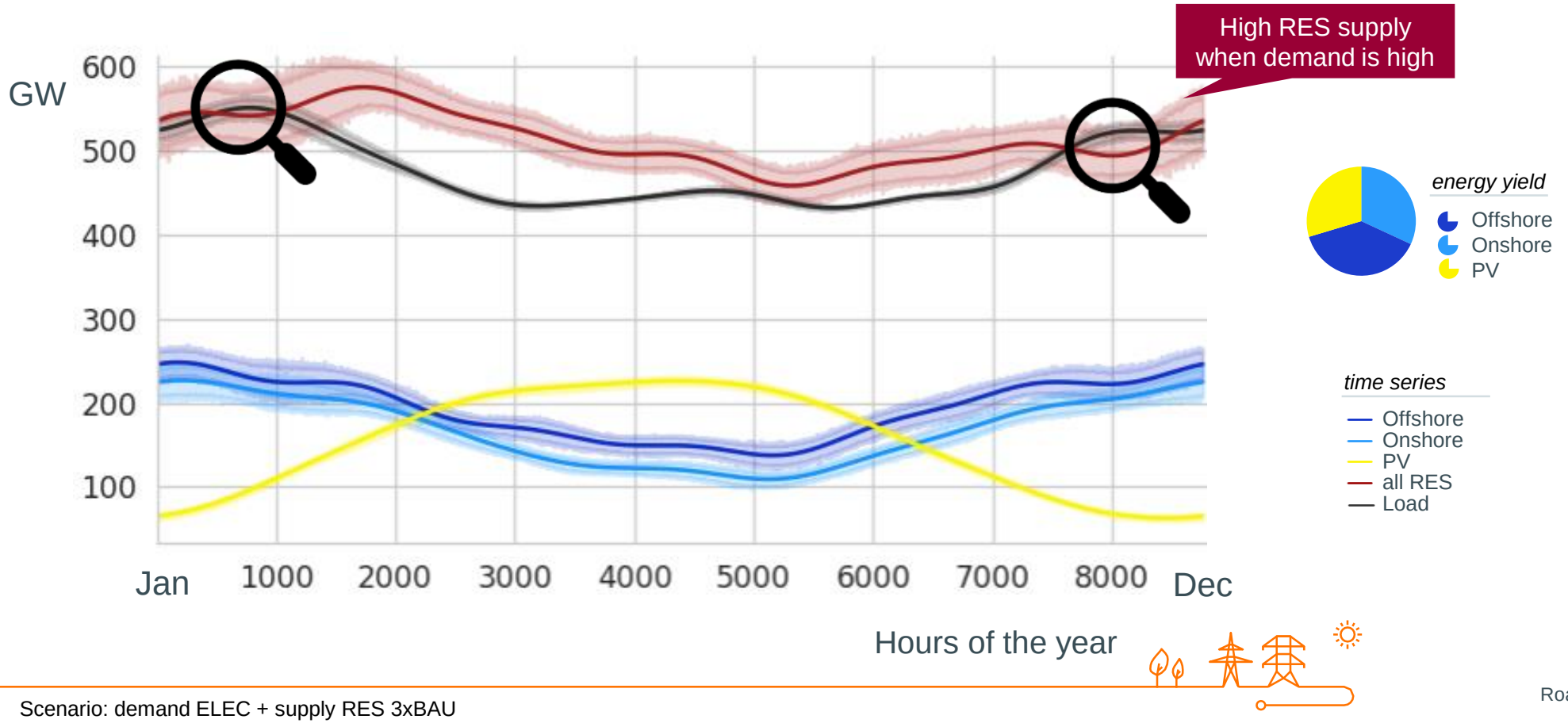


- Daily volatility is mainly driven by PV and addressed with High End-user flexibility.
- Weekly & Monthly variations of wind are mitigated via geographical distribution
- Seasonality of residual load can be addressed by a good balanced RES mix and interconnection.
- Backup capacity to cover limited periods of low RES infeed. No season long need in European mix/ system.

Mix matters: a balanced RES mix reduces seasonality to a minimum.

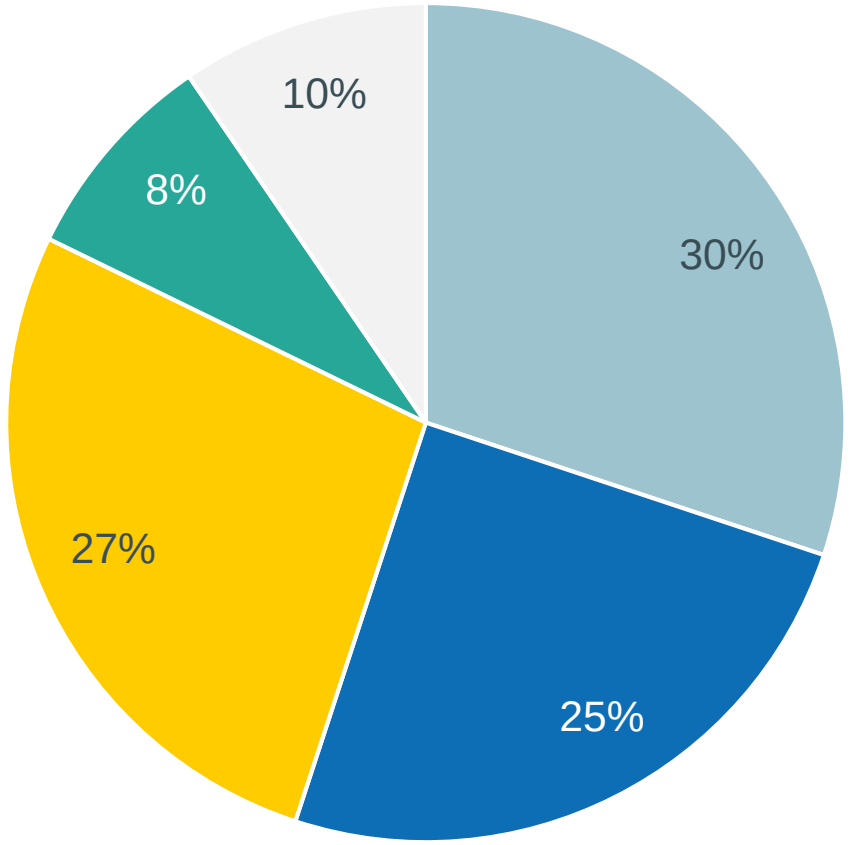
Seasonal RES-availability with a balanced RES mix

Lines show mean, shades show variability of climate years



Scenario: demand ELEC + supply RES 3xBAU
Scope: EU27 + UK, NO, CH

Electricity supply in 2050 in Germany

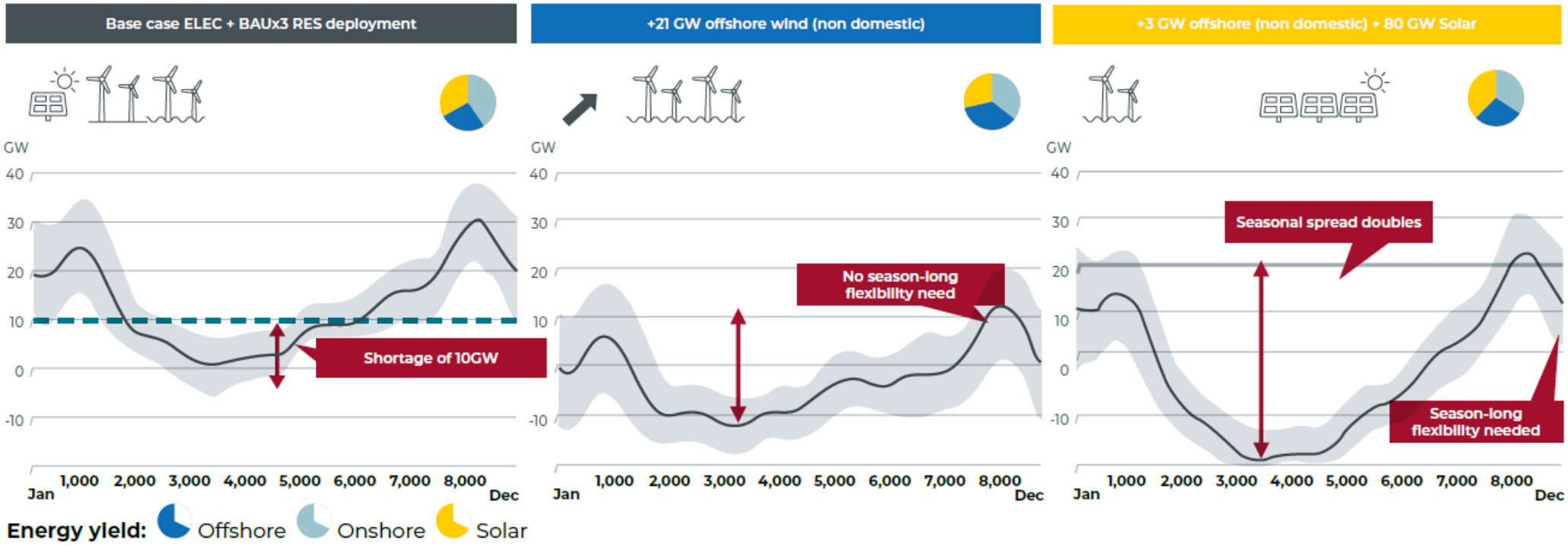


Wind onshore | Wind offshore | Solar | Other RES | Non-domestic

Two theoretical scenarios to cover Germany's gap for direct electricity demand: wind energy aligns best with needs.

Long term residual load volatility

Lines show mean, shades show variability of climate years

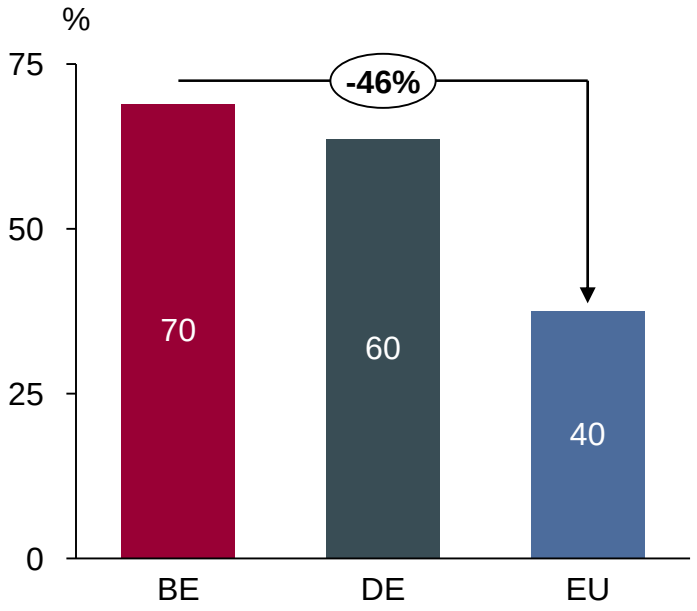


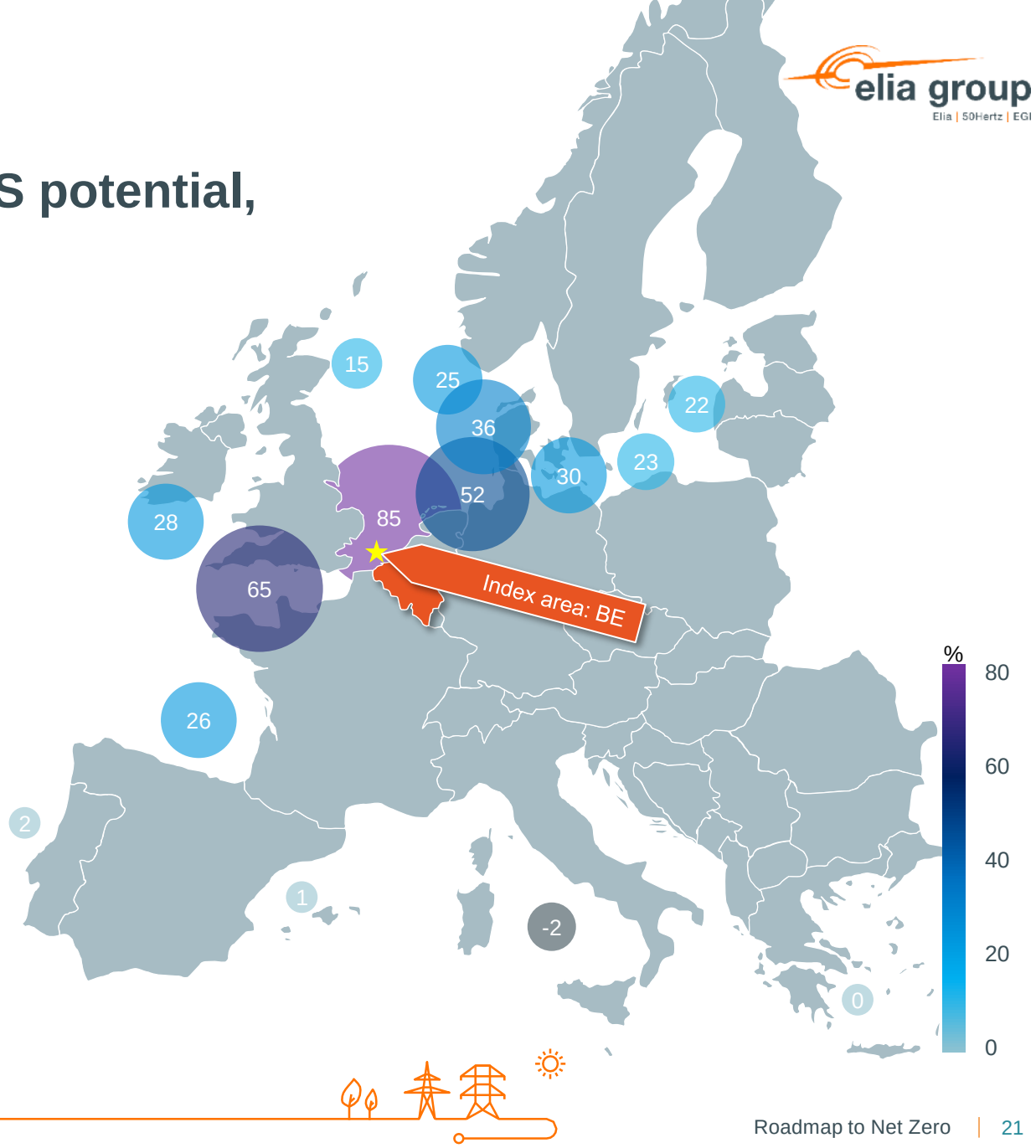
Scenario: demand ELEC + supply RES 3xBAU
Note: For this calculation, DE is analyzed as an island with no other interconnection apart of the imported offshore wind.

Interconnection not only to share RES potential, but also to reduce flexibility needs.

Weekly volatility of **offshore** wind in % of installed capacity

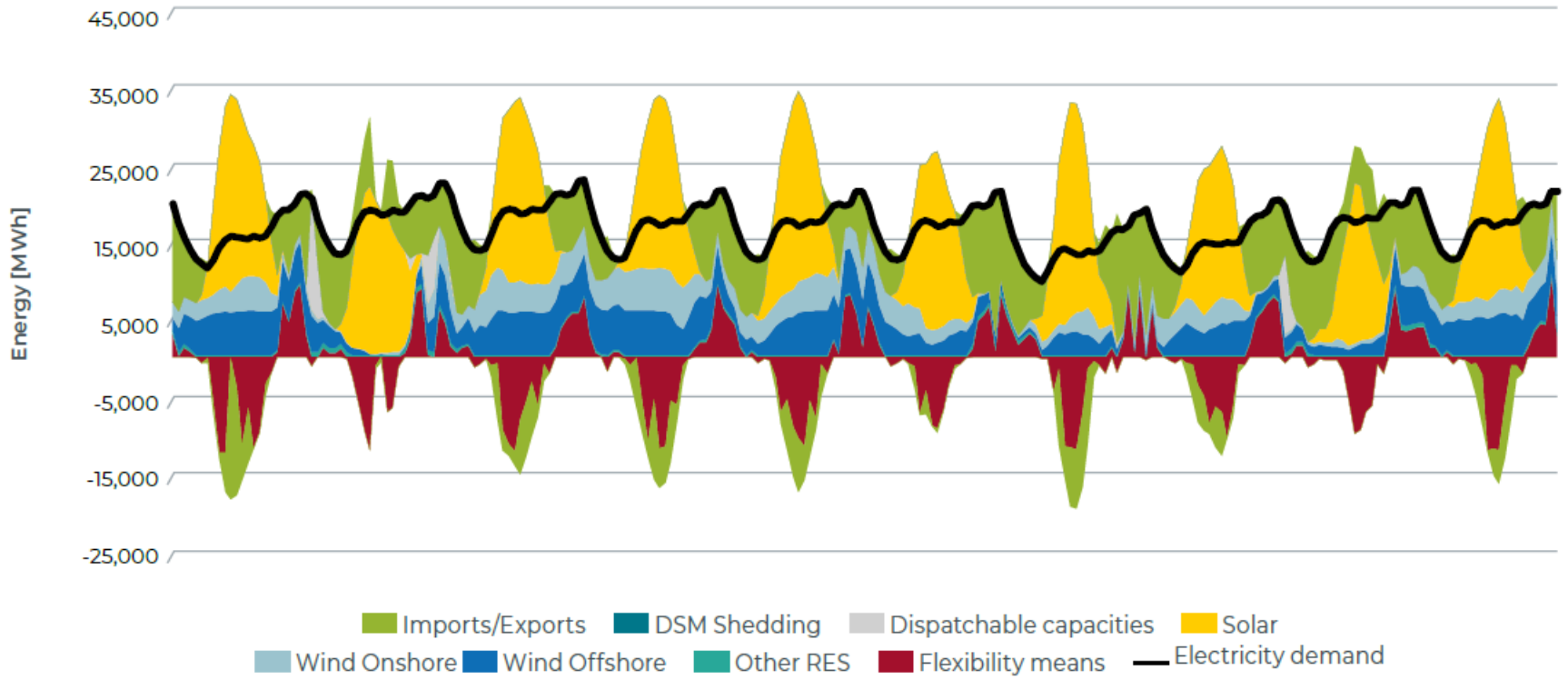
Covering p99.97



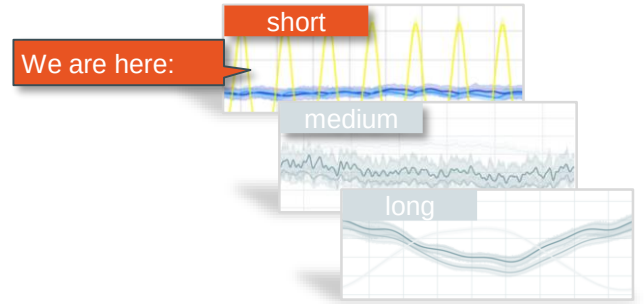


Scenario: demand ELEC + supply RES 3xBAU

Short-term flexibility allows to better integrate solar generation, mainly in summer and interseason.

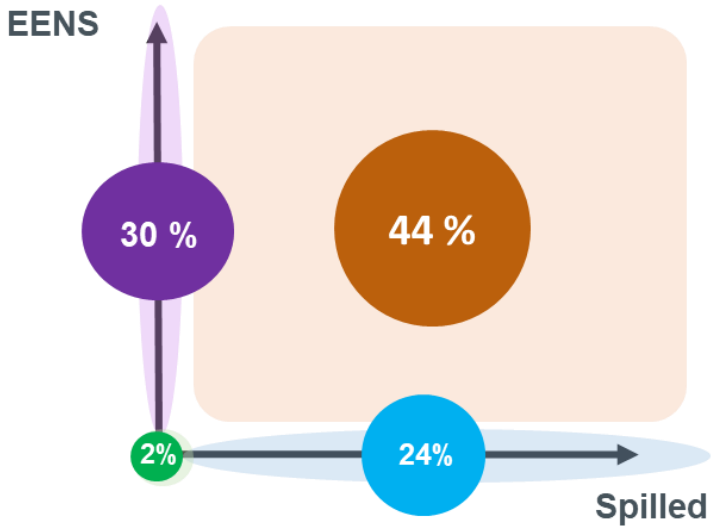


Electrified end-use provides valuable flexibility to the system. Digitalisation to unlock this potential.

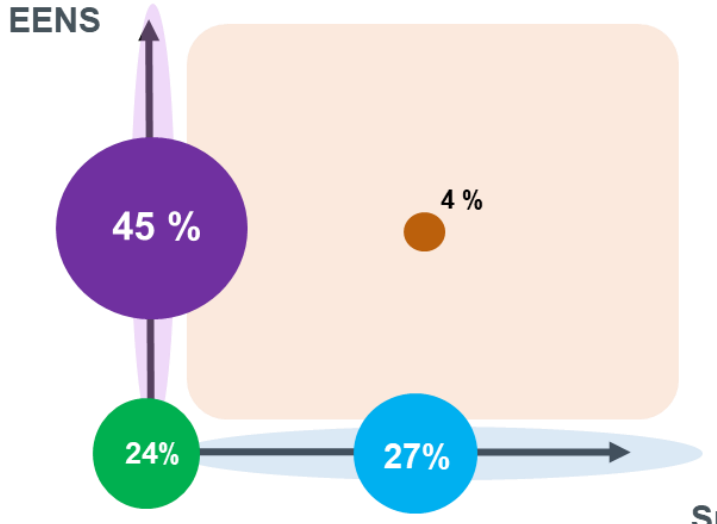


Distribution of days across the year in Germany

Low FLEX



High FLEX



- Days with over and under supply
- Days with over supply but no under supply
- Days with neither over nor under supply
- Days with under supply but no over supply

Scenario: demand ELEC + supply RES 3xBAU
Scope: EU27 + UK, NO, CH

Questions

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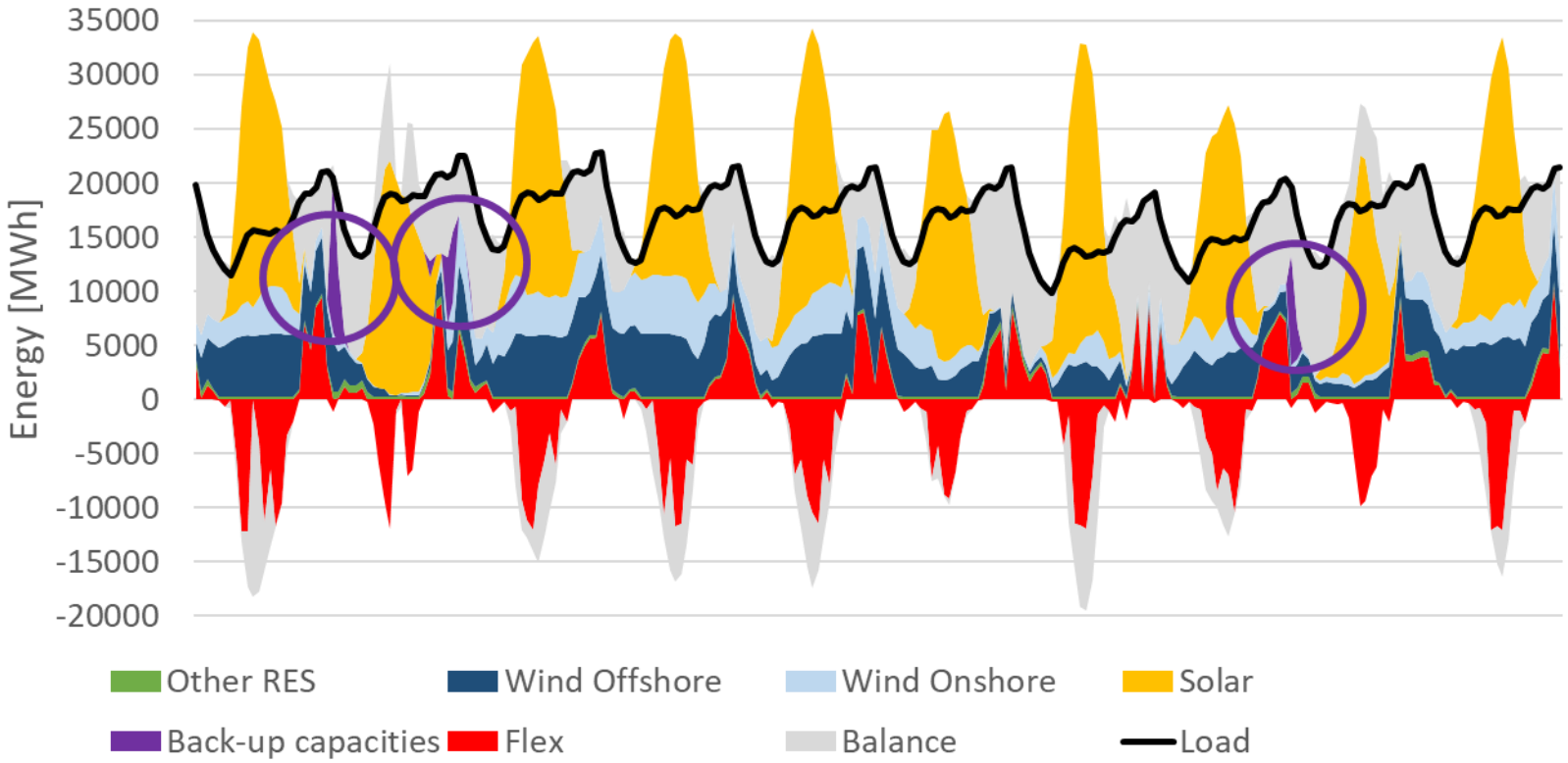
Key Insights on Adequacy

A significant volume of ‘dispatchable’ capacity will be needed in 2050 to cover long periods with low RES supply and high demand.

Dispatchable capacities are needed to cover sustained periods of low RES infeed.

Load filling – summer period



During periods with lower RES infeed with grid IoSN+, imports are more limited and flexibility provides less added value.

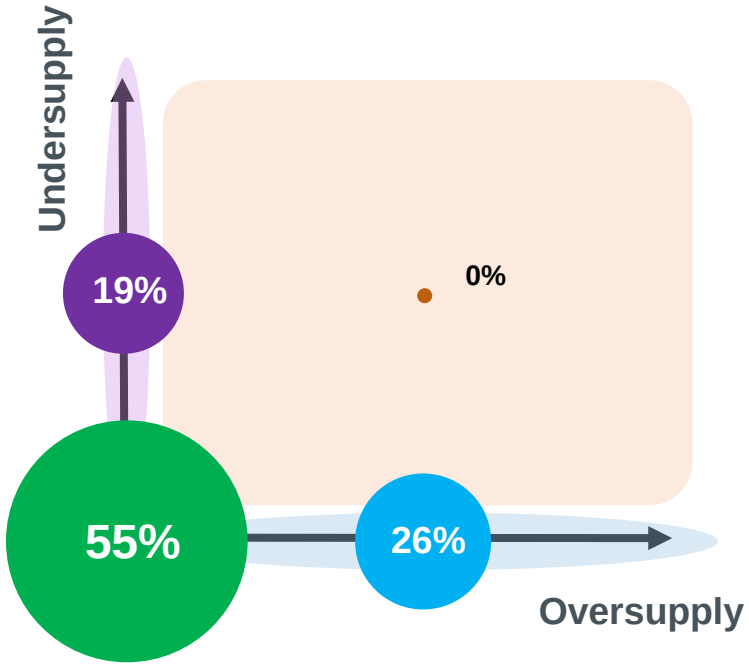
Back-up capacity are therefore needed in order to ensure an adequate system.

Scenario: demand ELEC + supply RES 3xBAU + grid IoSN+ + High Flex
Summer period in Belgium

Both different levels of end-use flexibility and interconnection reduce the need for back-up capacity.

Distribution of days across the year in Germany

High FLEX + **Copper Plate**



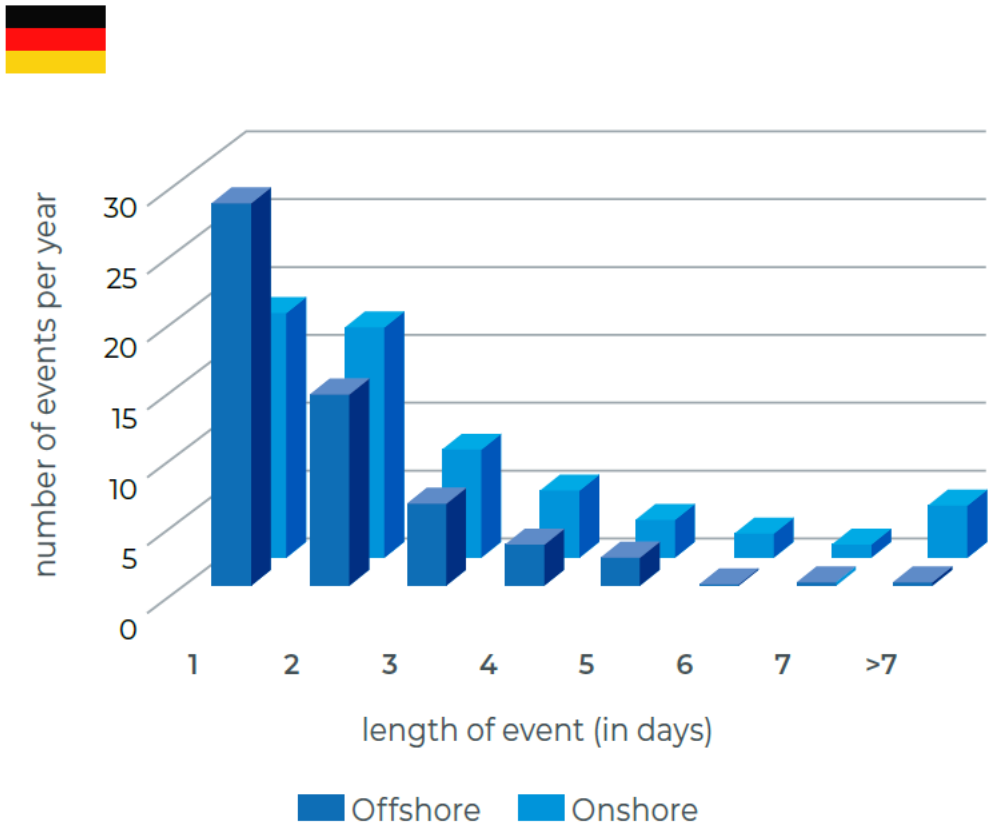
High flexibility and strong European interconnection reduces most of intraday variations and part of weekly variations.

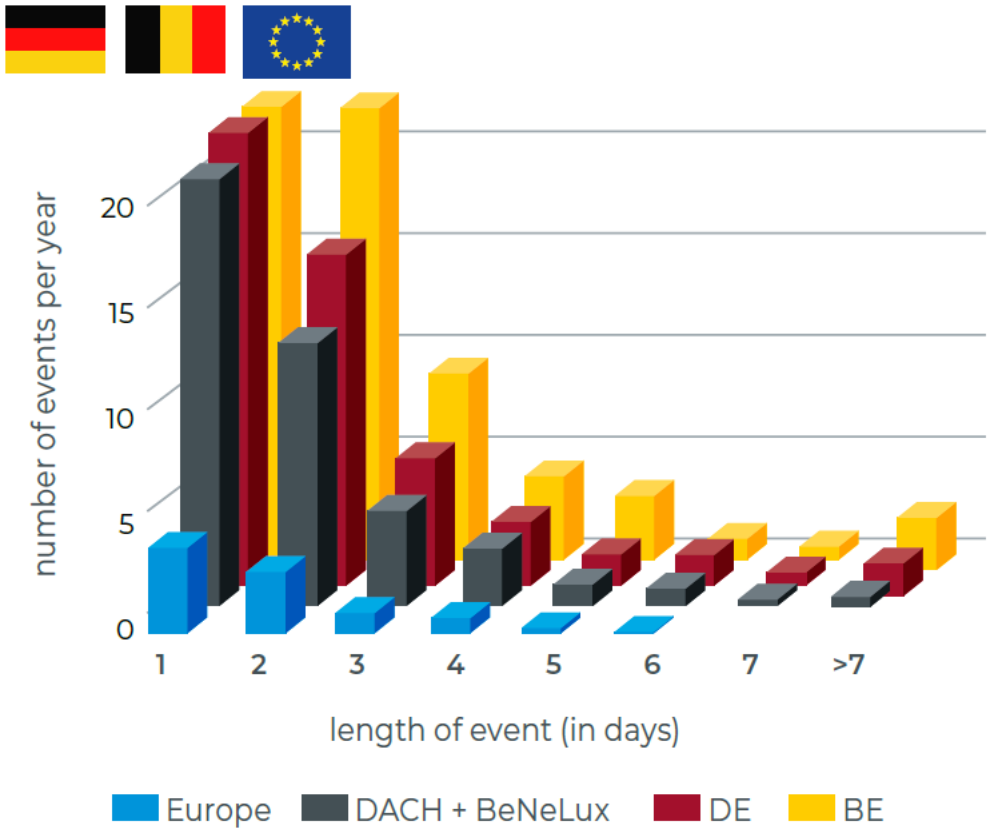
However, undersupply periods (at least 1 hour) are still observed during 19% of the days.

Back-up capacity are required to ensure adequacy during those periods.

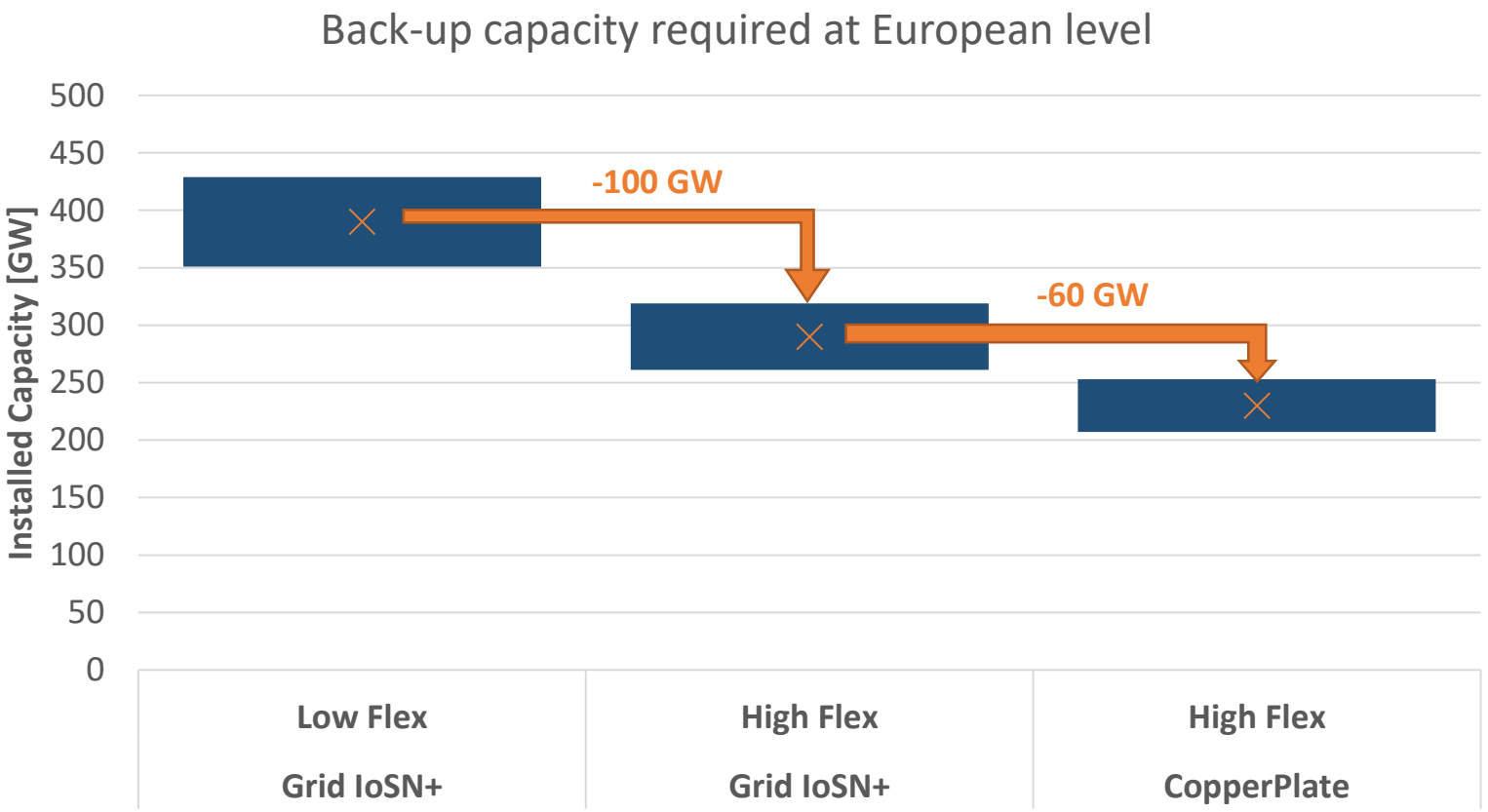
Scenario: demand ELEC + supply RES 3xBAU

Prolonged situations of low RES generation are characterised by local wind fluctuations during winter





The need for operating dispatchable back-up capacities can be strongly reduced by a balanced RES mix, sufficient interconnection and the availability of short term flexibility.

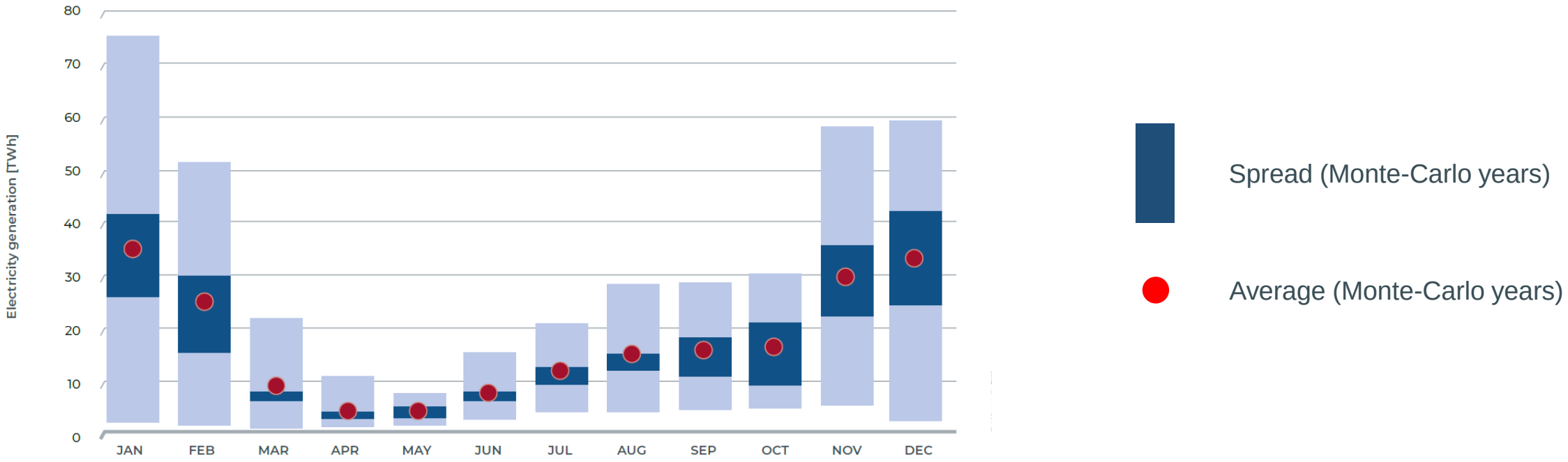


Capacity need can be reduced by about 40% in case of strong European interconnection and high end-user flexibility.

Estimated required back-up capacity: 40 - 70 GW

Backup capacity is needed to cover periods of RES shortage that may last for several days, but there is no need for them to run continuously throughout all winter

Back-up generation on European level



Scenario: demand ELEC + supply RES 3xBAU

Questions

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Focus Points

Based on these insights, where do we need to put the focus?

Focus points for the coming years

To make optimal use of the continent's scarce capacity of RES, Europe needs to set up frameworks for partnerships between countries with different levels of RES potential

Policymakers at all institutional levels need to focus on measures that create the right investment framework and reduce the throughput time of RES expansion projects and the realisation of the necessary grid infrastructure

The electrification of mobility, heating and end-use appliances should be prioritised, as it is key for reaching climate neutrality. Electrification unlocks flexibility to facilitate the further integration of RES and reduces the final energy demand

The use of green molecules to replace grey hydrogen and decarbonise sectors where electrification is not an option is a priority

Questions

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What is next?

Next year Elia Group will do a zoom in on the energy transition of industry. There are three different use cases in focus:

1. **Energy intensive industries**
   What is needed for the energy transition?
2. **Data centers**
   How can these centers to become carbon-neutral at any time?
3. **Service/logistics centers**
   How can they optimise all of their assets in order to decrease carbon emissions?

This is also an invitation to contact us at:

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info@50hertz.com

Thank you to everyone who gave feedback and contributed!

And many more…