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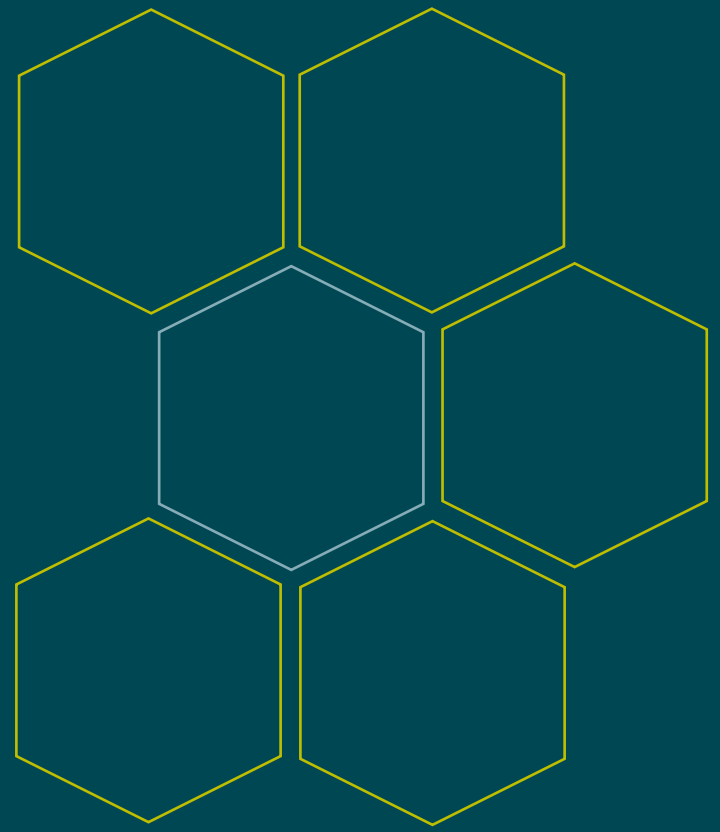
ADEQUACY 2050

Opportunities and risks of decentral flexibilities in the planning process of carbon neutral energy systems



G. SAVVIDIS, TRANSNETBW GMBH

4th Sustainable Energy Day, 12.09.2025, Copenhagen

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AGENDA

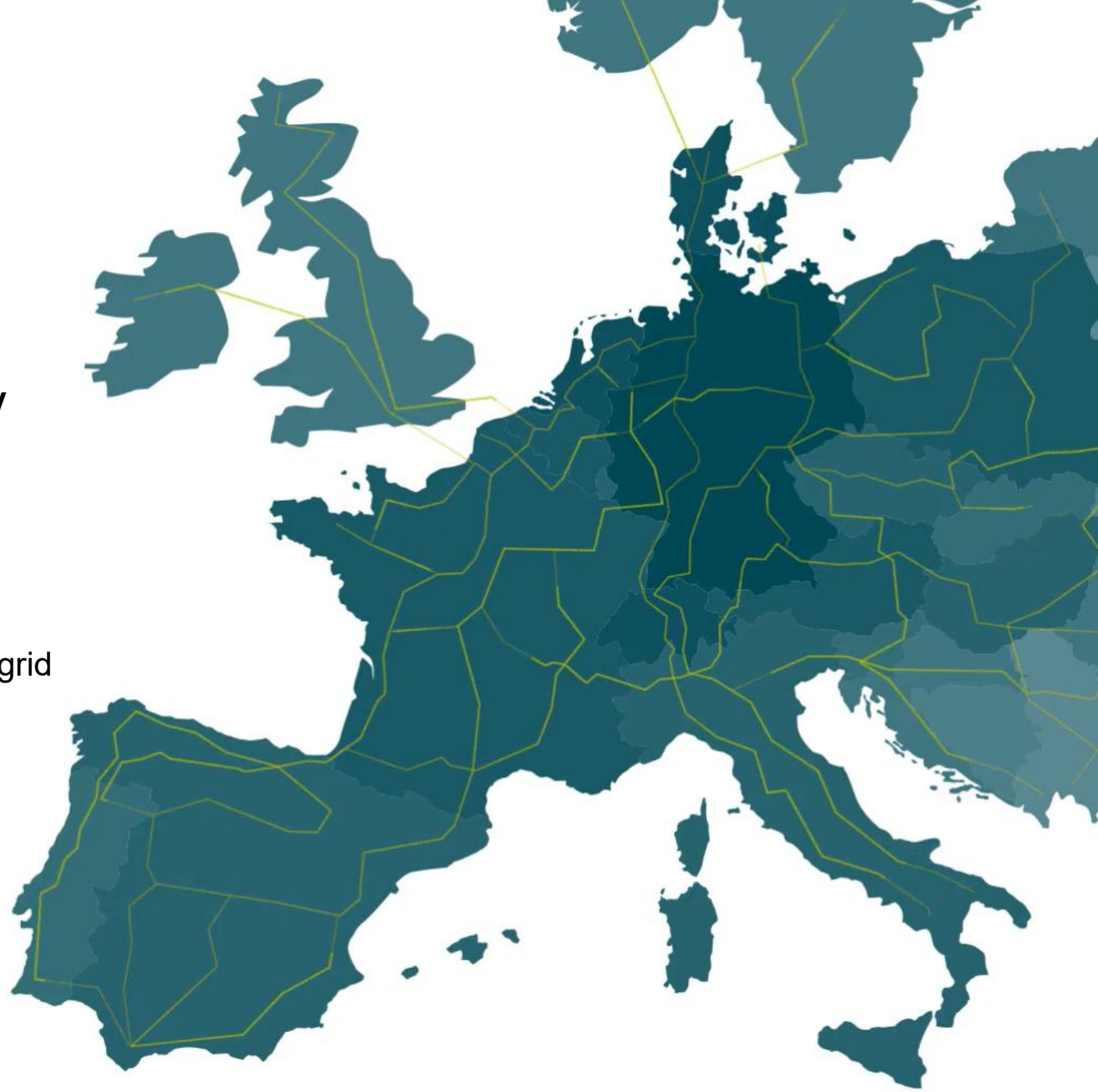
01 **Background**
On TransnetBW and our study on topics related to adequacy in the year 2050

02 **Decentral Flexibility**
Its role and impact on the planning of climate neutral energy systems

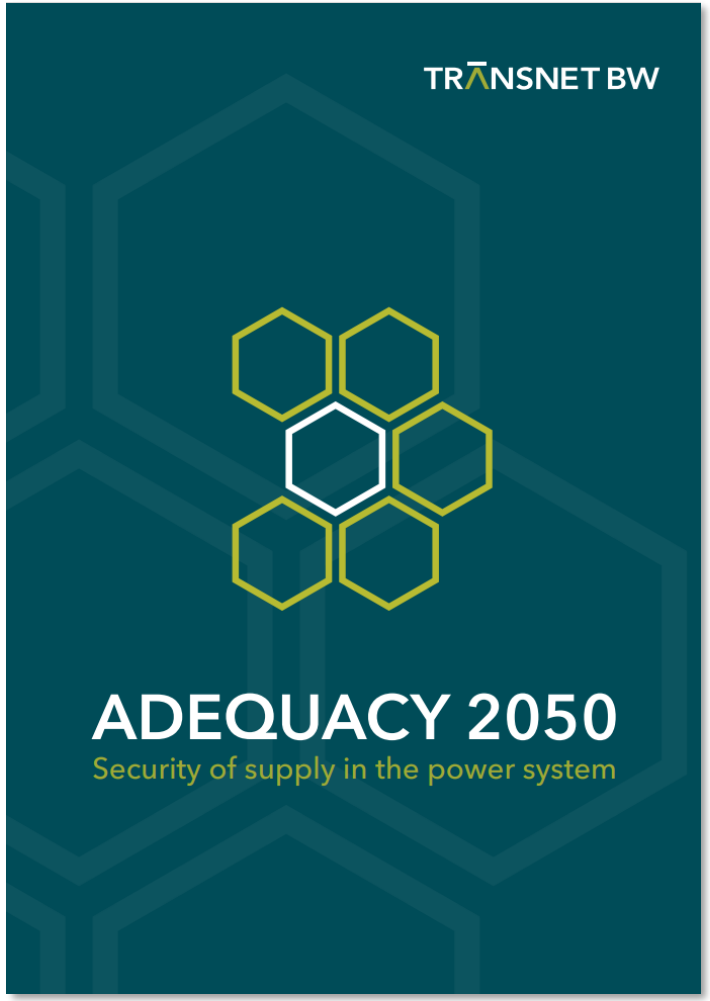
COMPANY PROFILE

- As transmission system operators for Baden-Württemberg, we ensure the **transmission of energy** across state and international borders.
- We **integrate renewables** into the electricity system.
- Numerous interconnectors integrate the TransnetBW grid into the **German and European interconnected transmission system**.

AT THE HEART OF THE EUROPEAN TRANSMISSION GRID



ADEQUACY 2050 STUDY BY TRANSNETBW



Is it worth the read? The study offers:

- **Strategic Insight:** Shows how to ensure cost-efficient energy security for Germany and the EU by 2050.
- **Broad Impact:** Relevant for policymakers, planners, investors, and the public – not just engineers.
- **Data-Driven Decisions:** Provides concrete figures on risks like costs, energy not served (ENS) and Loss of Load (LoL) hours.

DOWNLOAD IT HERE

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02 DECENTRAL FLEXIBILITY

THE ROLE AND IMPACT IN GRID PLANNING

Energy System in 2050

- The national Grid Development Plan (GDP) is based on **scenarios** developed in close observation of the regulating agency (BNetzA)
- Elements such as **installed capacities** of renewable energy sources, **load assumptions** and **hydrogen expansion** pathways are defined
- This forms the input for the target **ENERGY SYSTEM** which then is analysed to calculate grid expansion needs

GDP

THE ROLE AND IMPACT IN GRID PLANNING

Framework Conditions

- The NEP23 B 2045 scenario assumes **100%** of households to react to **dynamic price tariffs**
- The meteorological data of **2012** is used to calculate electricity generation from **renewables and electric load**:
  - 2012 is **average** regarding renewables generation
  - 2012 has a **cold peak in February**, which also results in load peaks → great for expansion planning

GDP

THE ROLE AND IMPACT IN GRID PLANNING

Adequacy Assessment

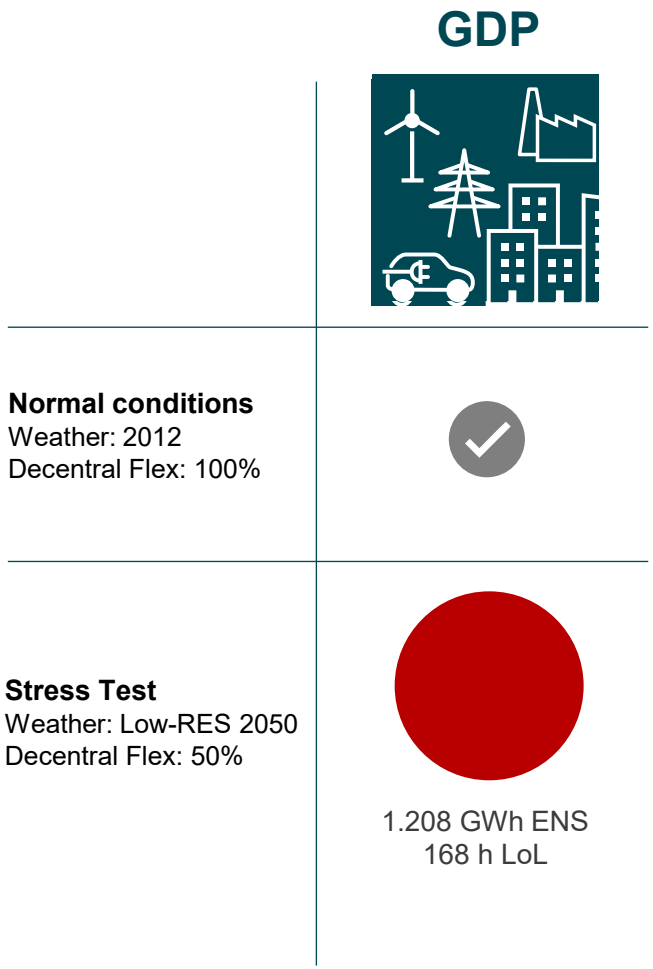
- We analysed the NEP23 B 2045 scenario under "**standard conditions**": weather year 2012 and 100% flexible households
- We used our **newly developed model chain** to reproduce the GDP scenario
- Even under standard conditions, resource adequacy KPIs **indicate 39 GWh ENS**
- This indicates, that the energy system used for planning the **grid is already at the edge of feasibility**

	GDP
Normal conditions Weather: 2012 Decentral Flex: 100%	✓

THE ROLE AND IMPACT IN GRID PLANNING

Reality Check

- Is the participation of ALL households as decentral flexibilities a **realistic assumption**?
- Should we rely on analysing **only average weather conditions**?
- The energy system of the GDP is already at the edge of feasibility, what would happen if we put **more stress** to it?
  - Weather data with an **overall low renewables generation** outcome (EU)
  - **Only 50% decentral flexibility** (e. g. 50% households do not react to dynamic pricing)

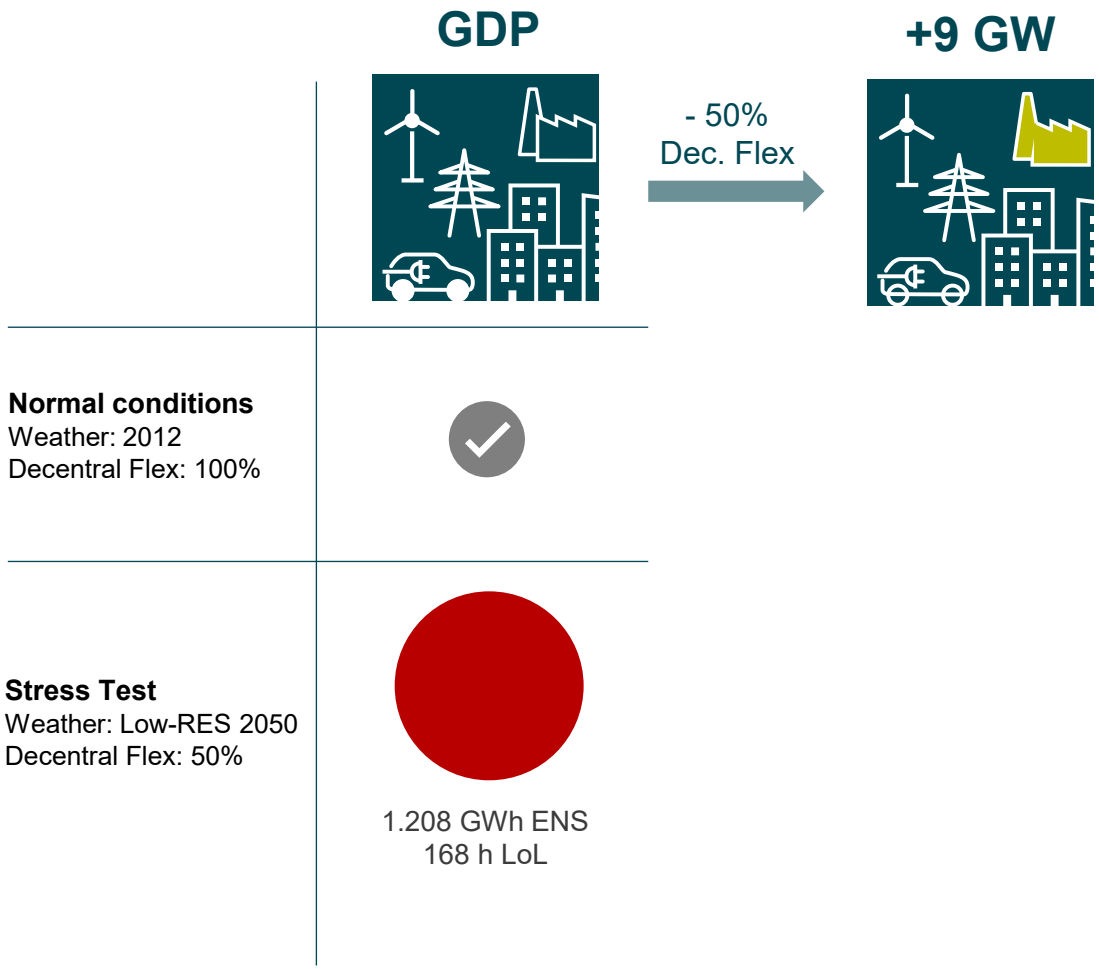


THE ROLE AND IMPACT IN GRID PLANNING

System trade-offs of decentral flexibility

- Change of model-setting: instead of measuring supply gaps, model chain is now configured for **investment planning**
- We **reduce** the participation rate of **decentral flexibilities** (e. g. housholds) to 50% and **allow investment of central flexibilities** in form of hydrogen power plants

This creates the need of **additional 9 GW** hydrogen power plants costing **additional 1.5 Bn € / year** in DE in 2050 (11 Bn. € for EU)



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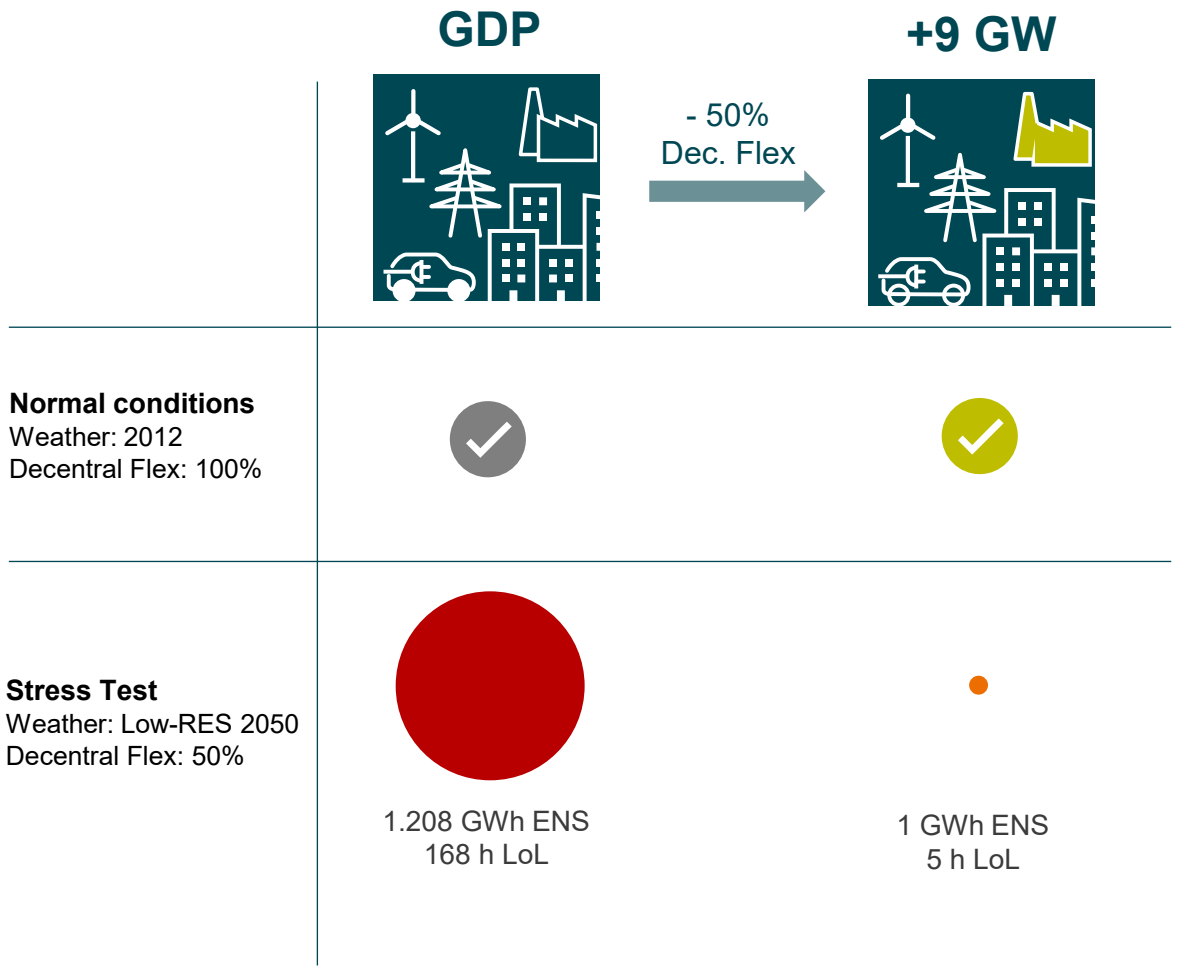
THE ROLE AND IMPACT IN GRID PLANNING

Resilience of "+9 GW system"

- We did not test standard conditions, as we can safely assume that KPIs will be good
- We tested the same stress factors:
  - Low renewable yield weather
  - 50% reduced decentral flexibility

Only 1 GWh of ENS and only 5 hours loss of load is a **remarkably better result**. Taking lesser decentral flexibility as given, leads also to a **better resilience against weather extremes**.



CONCLUSION

/ **Do we still need 100% participation rate of decentral flexibility?**

Yes, decentral flexibility is a key driver to lower costs. Smart meter rollout and a market design that embraces new business models and allows direct participation lays the groundwork for a cost-efficient, decarbonised energy system!

/ **What are then the risks?**

Participation rate of decentral flexibilities is highly uncertain. For planning purposes, enough variation should be considered.

/ **The presentation only covered “resource adequacy”, why is it so relevant for transmission grid planning?**

Decentral flexibilities, like household technologies, are distributed over large surfaces, while power plants are located at specific locations. Geographic scope strongly impacts grid planning. Also does interconnection between European member states. Knowing the path to a secure energy supply allows for better grid planning.

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THANK YOU FOR YOUR ATTENTION

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