Challenges for the transmission system – the example set by 50Hertz

9th Swissgrid Grid Forum

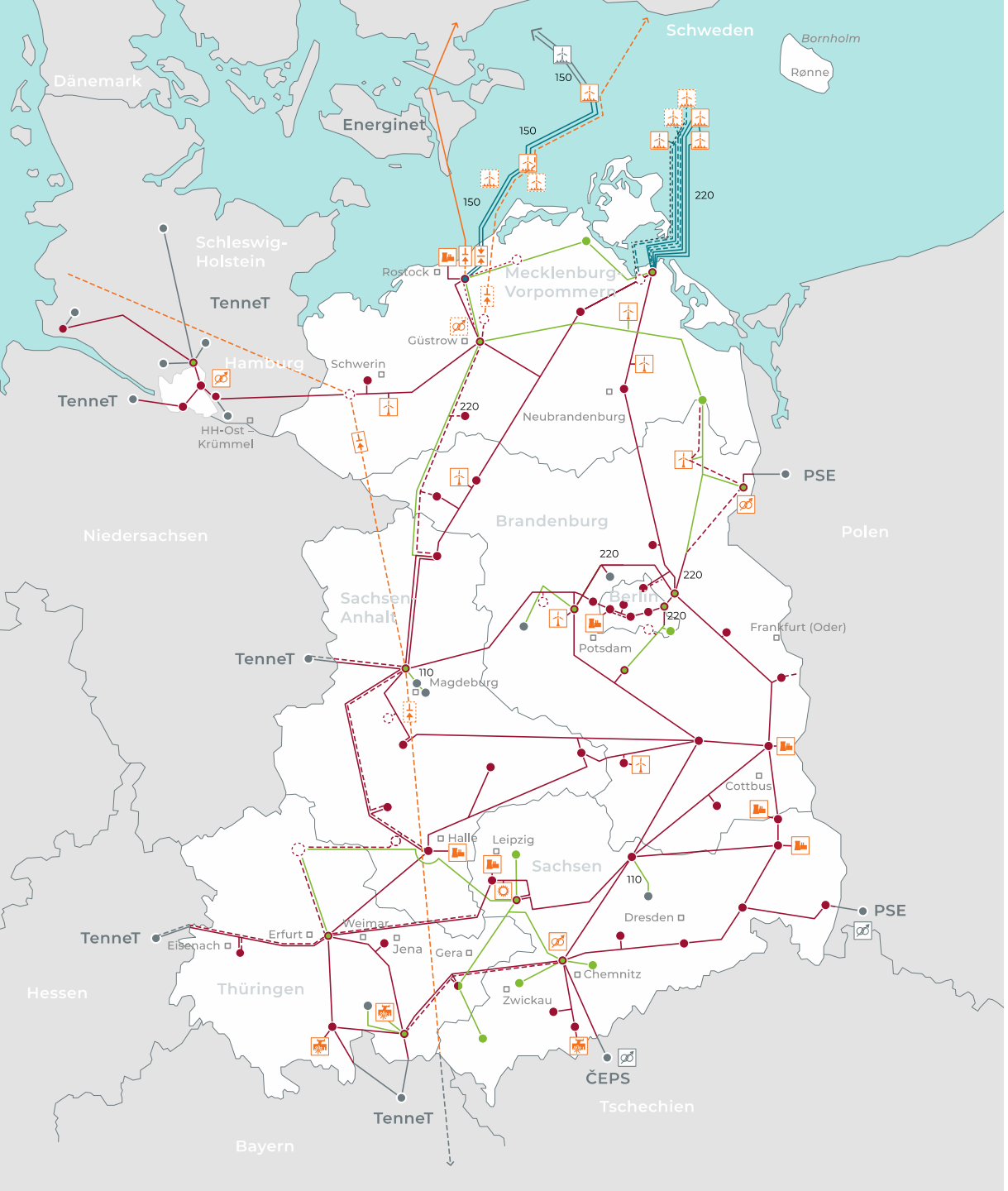
5.9.2024 | Dr. Dirk Biermann

Our strategy

100 percent by 2032

Affordable energy for a strong economy

Full details of the 50Hertz strategy are available at 50hertz.com/strategy



50hertz
Elia Group

We are making progress!

50Hertz line construction

Distance completed in 2023 compared to 2022

+184 km

Construction measures in 2023 compared to 2022

+316 km

Additional kilometres of line approved on land and at sea in 2023

+500 km

Draft scenario framework for the Network Development Plan (NDP) 2037/2045 (2025)

Scenario A

- Lowest electricity consumption
- System transformation delayed in the medium term
- High proportion of hydrogen and synthetic energy sources
- High imports of hydrogen
- Failure to achieve the expansion path for renewable energies

Scenario B

- Average electricity consumption
- Relatively efficient system transformation
- High degree of electrification
- Average import quota of hydrogen
- Renewable energies along the statutory expansion path

Scenario C

- Highest electricity consumption
- High degree of electrification
- High level of sovereignty for Germany in terms of hydrogen production
- Expansion path for renewable energies exceeded
- Additional interconnectors

Source: Scenario framework for the Network Development Plan 2037/2045, 2025 version, draft by the transmission system operators, June 2024

Draft scenario framework for the NDP 2025 – electricity consumption

	2022 / 2023	A 2037	B 2037	C 2037	A 2045	B 2045	C 2045
Gross electricity consumption [TWh]	***535***	**844**	**1,008**	**1,073**	**967**	**1,179**	**1,351**
Electric vehicles [million]	2.5	23.6	31.6	37.8	32.5	37.2	44.8
Heat pumps [million]	**1.8**	**6.8**	**10.8**	**12.6**	**10.4**	**15.4**	**18.0**
Large heat pumps (district heating) [GW]	0	3.2	3.9	3.9	5.3	5.7	5.7
Electric boilers (district heating) [GW]	0.8	6.3	7.5	7.5	11.1	12.1	12.1
Electrolysers [GW]	**-**	**26**	**35**	**40**	**46**	**60**	**80**
Small-scale battery storage [GW]	6.3	40	55	60	50	70	75
Large-scale battery storage [GW]	1.3	18	32	36	21	36	44

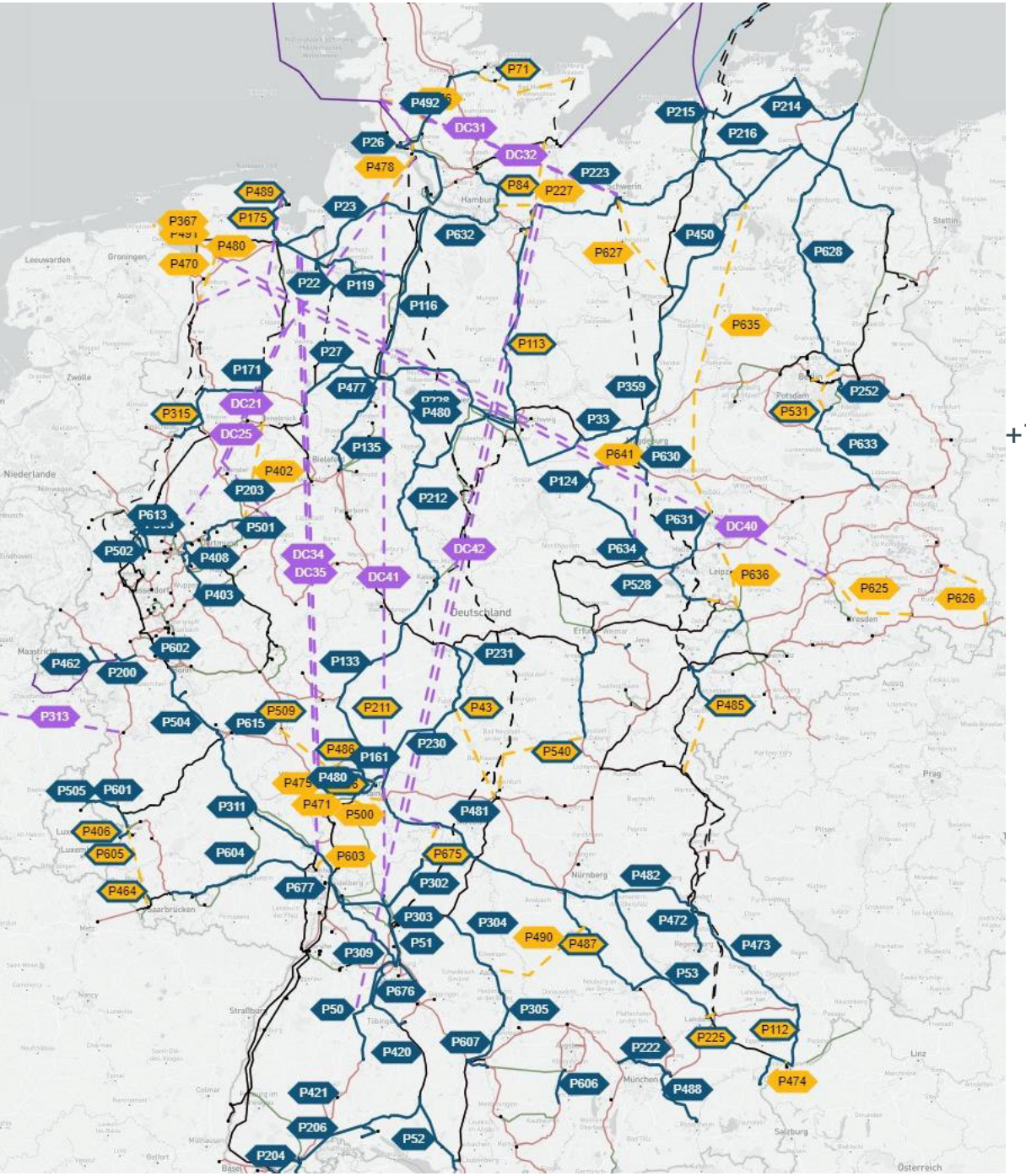
Source: Scenario framework for the Network Development Plan 2037/2045, 2025 version, draft by the transmission system operators, June 2024

Draft scenario framework for the NDP 2037/2045 (2025) – renewable energies

	2023	2037	2045
Photovoltaics ▪ Equal proportions of ground-mounted/building-integrated PV on expansion ▪ Growing orientation of modules to the west and east	82 GW	280 – 380 GW	330 – 500 GW
Offshore wind energy ▪ Focus of expansion on the North Sea, also outside the German EEZ* ▪ High impact of building density and shading on yields	9 GW	54 – 60 GW	65 – 82 GW
Onshore wind energy ▪ Extension mainly geared towards space potential ▪ Increase in full load hours due to technological development	61 GW	105 – 159 GW	125 – 180 GW
Biomass ▪ Decline in generation capacity ▪ Utilisation of biomass preferably in other sectors	9 GW	5 GW	3 GW

* German Exclusive Economic Zone

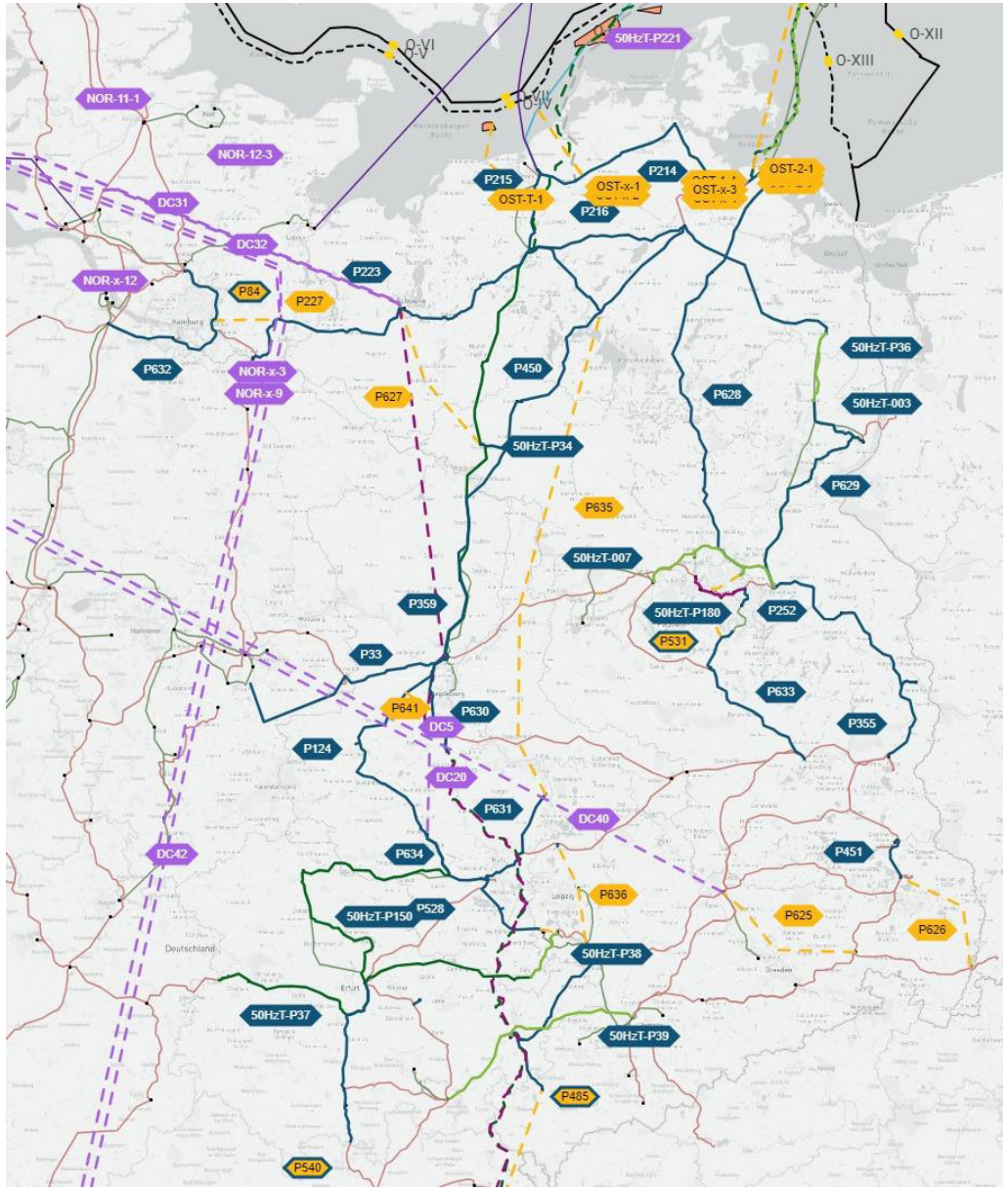
Source: Scenario framework for the Network Development Plan 2037/2045, 2025 version, draft by the transmission system operators, June 2024



Results of the NDP 2037/2045 (2023): confirmed grid expansion projects in Germany

The climate neutrality grid requires 20,755 km of onshore and 15,400 km of offshore projects.

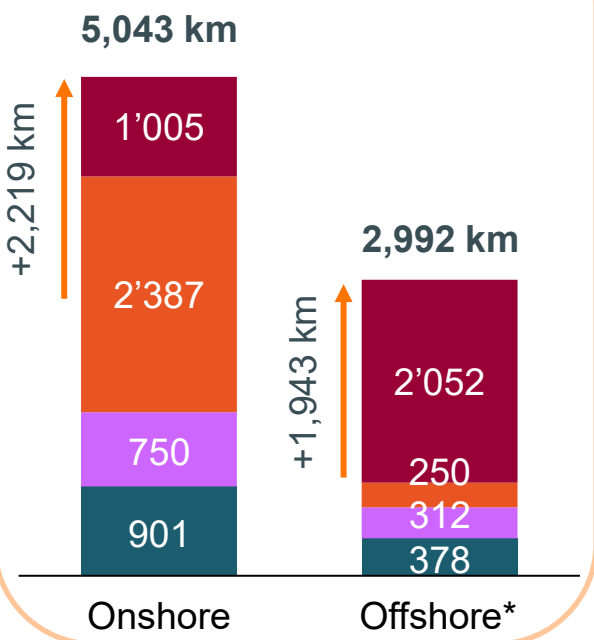
→ = increase in relation to confirmed grid from NDP21



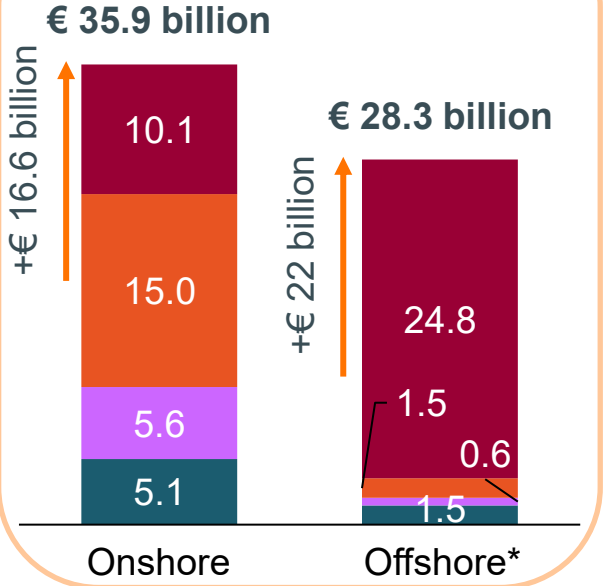
Results of the NDP 2037/2045 (2023) 50Hertz grid expansion project

Extension grid DC
Extension grid AC
Start grid DC
Start grid AC

Line length



Costs



50Hertz is responsible for around 8,000 kilometres of onshore and offshore projects representing an investment volume of around € 64 billion.

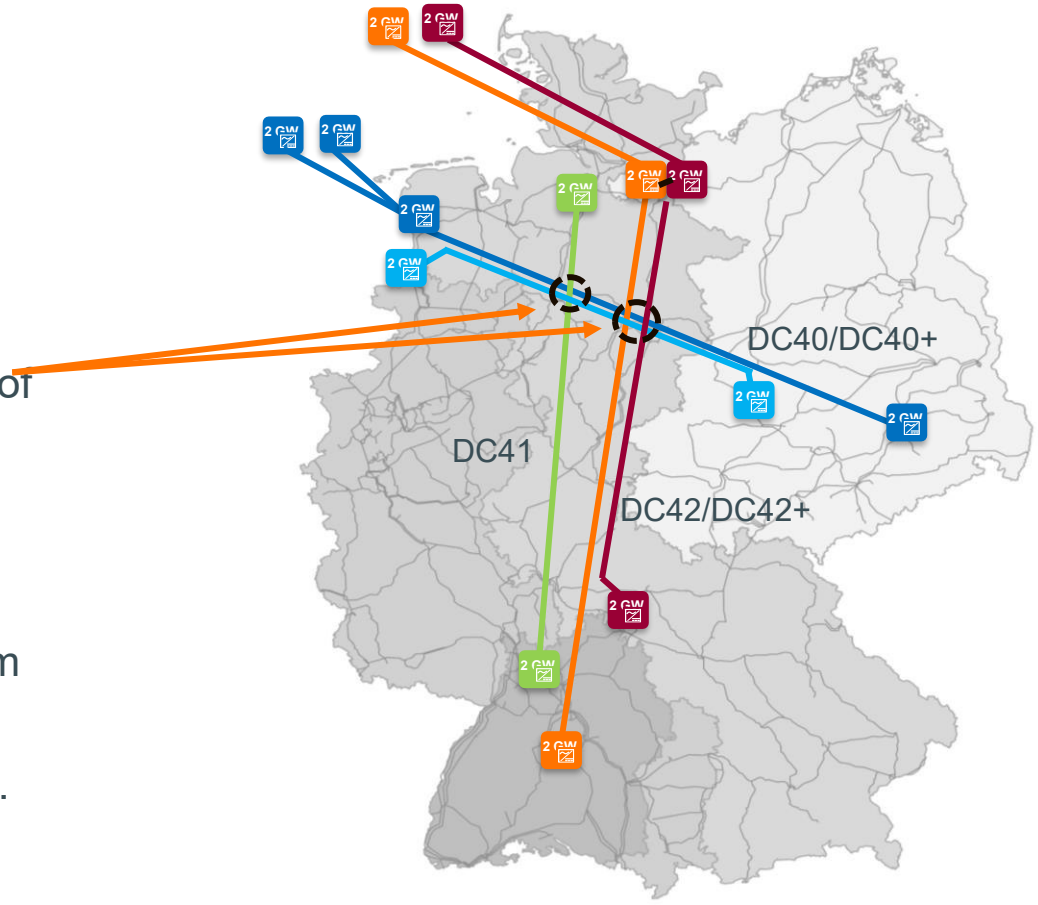
*including offshore interconnectors → = increase in relation to confirmed grid from NDP21

DC multiterminal hubs – increase in flexibility and redundancy

Point-to-point systems: DC systems to transport renewable electricity – essentially in the main load flow direction from north to south.

Crossover switchgear: DC multiterminal hubs without converters or a transformer station. Enable the switching of load flows to different lines for flexible utilisation of DC capacities in normal operation and in the event of a fault.

Multi-vendor capability: linking of converter stations from different HVDC system suppliers via DC switchgear. Prerequisite for complete networking of all DC4x systems.



System stability as another key challenge

Current and future developments

- Increase in the transmission task by shifting generation centres
- Reduction of power plants on the grid due to phase-out of coal & strong RE expansion

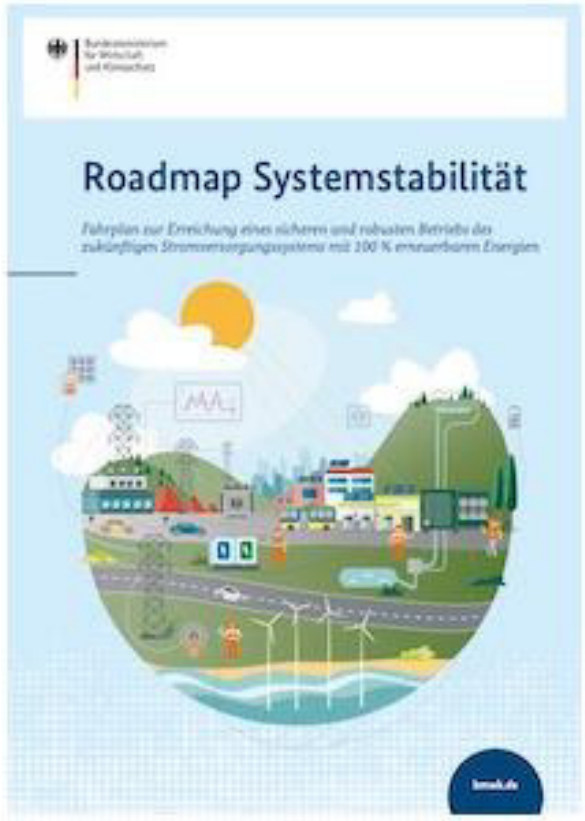
Objectives

- Optimum use of transmission infrastructure, e.g. via higher capacity utilisation
- Cost-efficient operation of the transmission system

...whilst **ensuring secure and stable grid operation**

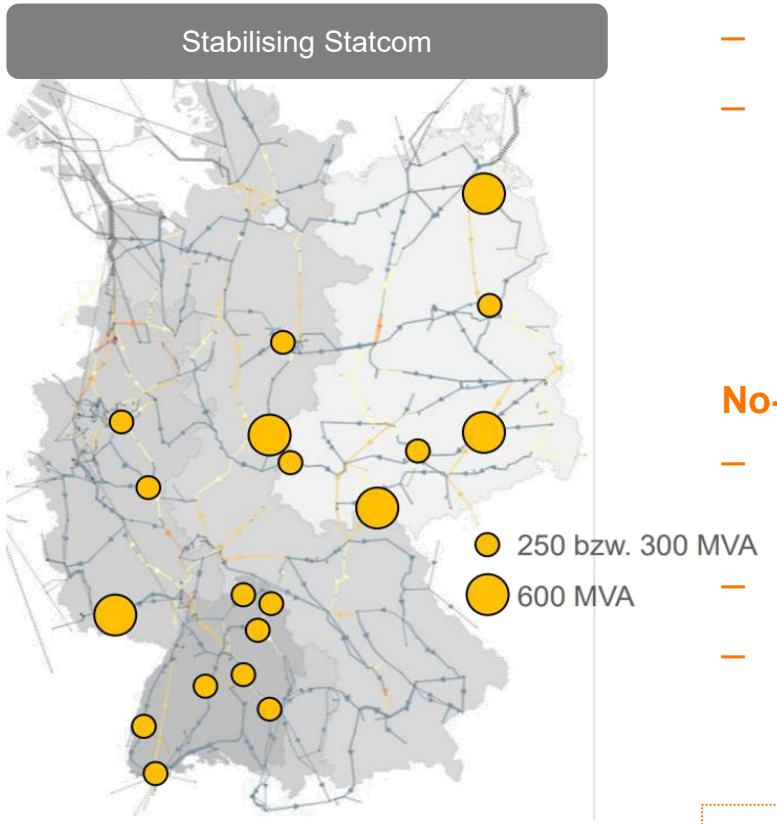
Challenges of system stability

- Higher capacity utilisation partially restricted by stability limit
- Future lack of stabilisation by conventional power plants
- «New» stability phenomena due to strong RE expansion and power electronics



BMWK system stability roadmap: who has to implement **what** by **what date**?

2023 stability report 2023 by 50Hertz, Amprion, TenneT and TransnetBW



Core contents:

- System requirements categorised and partially quantified
- Elements needed to meet demand:
  1. Minimum requirements vis-à-vis grid connection customers
  2. Market-based procurement of ancillary services and
  3. Additional TSO assets

No-regret measures:

- Linking of extended grid-friendly **requirements for electrolysers** to funding, as TCR implementation takes too long
- Legal instrument for **converting power plants** to rotating phase shifters
- Technical **requirements for new (gas) power plants** (e.g. with regard to the power plant strategy)

Further quantification of system requirements in the future stability report of the TSOs and in accordance with the system stability roadmap

Thank you!