DCA NEP Power 2037/45 (2025) general meeting and the current debate on underground cables vs. overhead lines

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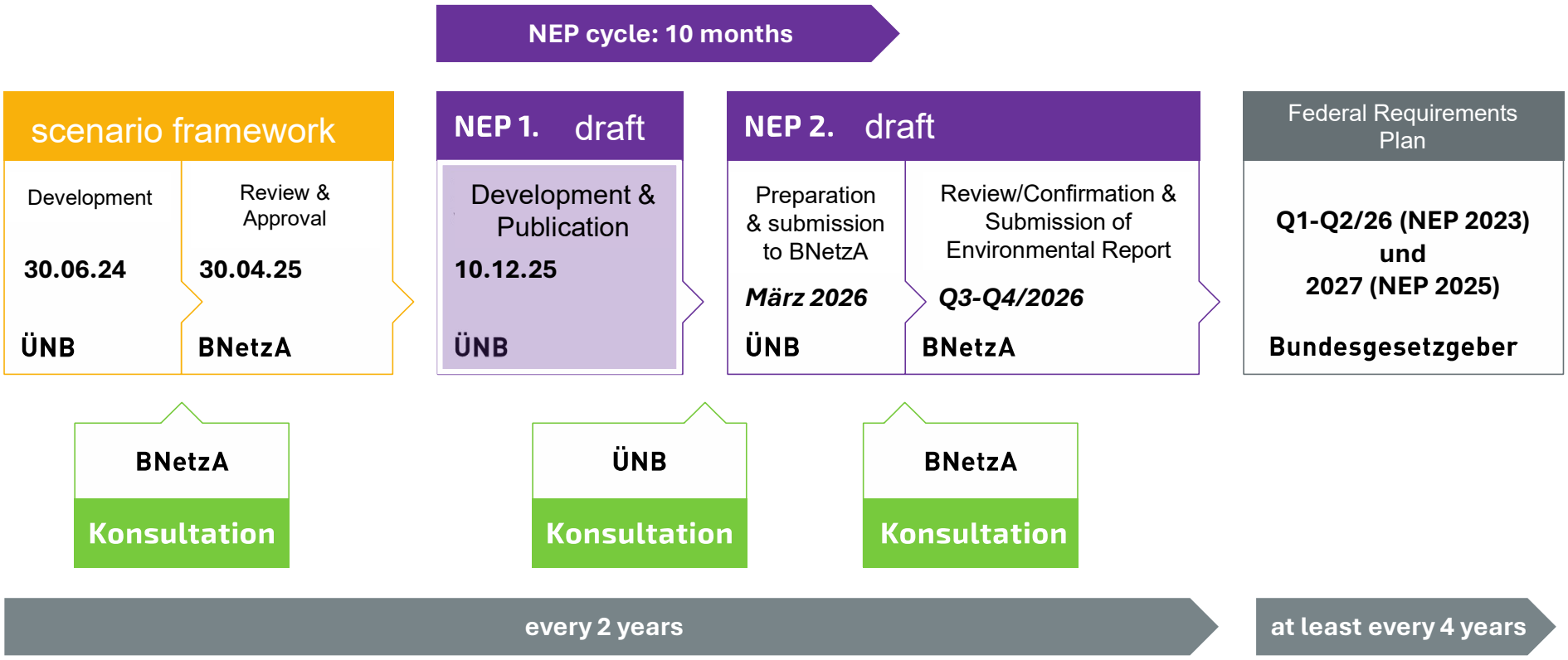
Agenda

1. Overall NEP electricity process
2. Scenario framework and market modeling
3. Target grid development offshore and onshore

1. Overall NEP electricity process

Overall NEP electricity process in accordance with Section 12a/b of the German Energy Industry Act (EnWG)



2. Scenario framework and market modeling

Overview of scenario framework
“Scenarios should be compatible with the new federal government”

Approved scenario framework revisits climate-neutral energy system for 2045

- Four scenarios for 2037 and three scenarios for 2045
- Broader scenario funnel than in NEP 2037/2045 (2023)

“Slow electrification”: Development path A

- Minimum dimensioning of the electricity system, electricity consumption below the level of NEP 2037/2045 (2023)
- Highest H2 demand, largest H2 imports
- EE expansion below political targets

“Cross-sector scenario”: Development path B

Coordinated overall figures for electricity and gas/H2
Consistent with the system development strategy, focus on electrification
Expansion of renewable energies in line with political goals

Other European countries reflect current energy policy developments in neighboring countries

- “National Trends+” scenario from TYNDP 2024 as the basis for foreign countries and prices
- Implementation of a flow-based market coupling approach in 2037

Overview of scenario framework
Selected scenario parameters

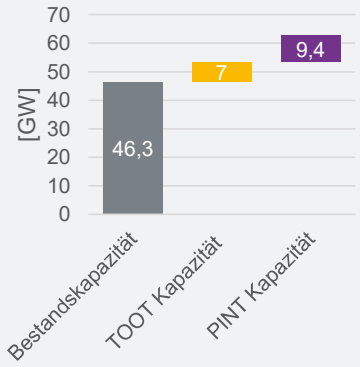
	Key scenario indicators	inventory 2024	*NEP 2037/2045 (2023)* B 2037	*NEP 2037/2045 (2023)* B 2045	*NEP 2037/2045 (2025)* A 2037	*NEP 2037/2045 (2025)* A 2045	*NEP 2037/2045 (2025)* B 2037	*NEP 2037/2045 (2025)* B 2045
Last	**Gross electricity consumption [in TWh]**	518	961	1.106	845	948,2	1027,4	1.181,9
	large-scale consumer		"100% planning"		"Advanced planning"		"Advanced planning" + 25% "Planning"	
Stromerzeugung	**Onshore wind** [in GW]	63,5	158,2	160	126,6	143,5	158,2	160
	Offshore wind [in GW]	9,2	58,5	70	50	60	56	70
	Photovoltaics [in GW]	99,8	345,4	400	270	315	345,4	400
	Thermal power plants [in GW]	75,8	39,4	35,6	48,2	62,5	64,2	83,5
Flexi-bilitäten	**Battery storage [in GW]** (of which large-scale battery storage [in GW])	11,6 (1,7)	91,1 (23,7)	141 (43,3)	87,8 (41,1)	100,8 (41,1)	127,1 (67,6)	141,3 (67,6)
	Electrolyzers [in GW]	0,2	26	50	20	31,6	42	58,5
Sektoren-kopplung	**Heat pumps [number in millions]**	2	14,3	16,3	7,7	11,3	8,7	13,3
	Electric mobility [number in millions]	2,4	31,7	37,3	27,8	36,8	33,6	44,5

Interconnectors
Increasing interconnection between Germany and its neighbors

Cross-border projects	Concept	North Sea/Baltic Sea	partner country	Connection in DE	Planned capacity [MW]	TYNDP Project number	Regionale AG
UK – DE Hybrid Interconnector Scotland-Germany Phase I	Hybrid	Nordsee	UK	Onshore	2.000	P1192	OTC
UK – DE Hybrid Interconnector Scotland-Germany Phase II	Hybrid	Nordsee	UK	NN	0*	P1193	-
NL-DE Offshore Hybrid Interconnector	Hybrid	Nordsee	NL	Offshore	2.000	P1213	OTC
Baltic WindConnector	Hybrid	Ostsee	EE, LV	Onshore	2000	P1211	BOGI
TYSDAN Hybrid Interconnector	Hybrid	Nordsee	DK	Onshore	2.000	P1214	OTC
Hybrid Interconnector Norway Windfarm-Continent	Hybrid	Nordsee	NO	On- oder Offshore	1.400 bzw. 2.000**	P1200	OTC
Green Agean	Punkt-zu-Punkt	-	GR	Onshore	3.000	P1231	-
Netzausbau 2. Interkonnektor Deutschland – Belgien	Punkt-zu-Punkt	-	BE	Onshore	2000**	P225	-
Hansa PowerBridge 1	Punkt-zu-Punkt	Ostsee	SE	Onshore	700	P176	BOGI
Hansa PowerBridge 2	Punkt-zu-Punkt	Ostsee	SE	Onshore	700	P267	BOGI
DC-Interkonnektor Deutschland – Schweiz	Punkt-zu-Punkt	-	CH	Onshore	2.000	P1058	-

Trading capacities in NEPv25

- Assumption of 53 GW of trading capacity (including TOOT projects) to Germany for 2045 in NEPv25
- **Assessment of 16.4 GW** of new trading capacity in this NEP
- First-time examination of more hybrid **interconnectors than point-to-point projects**

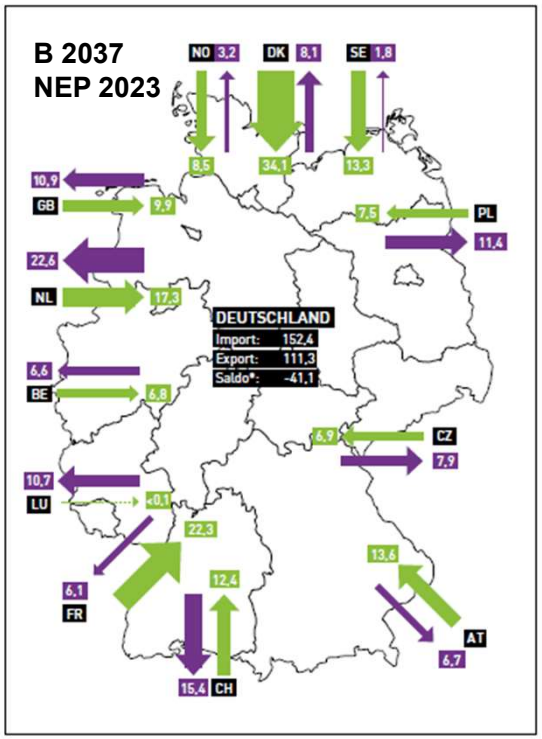


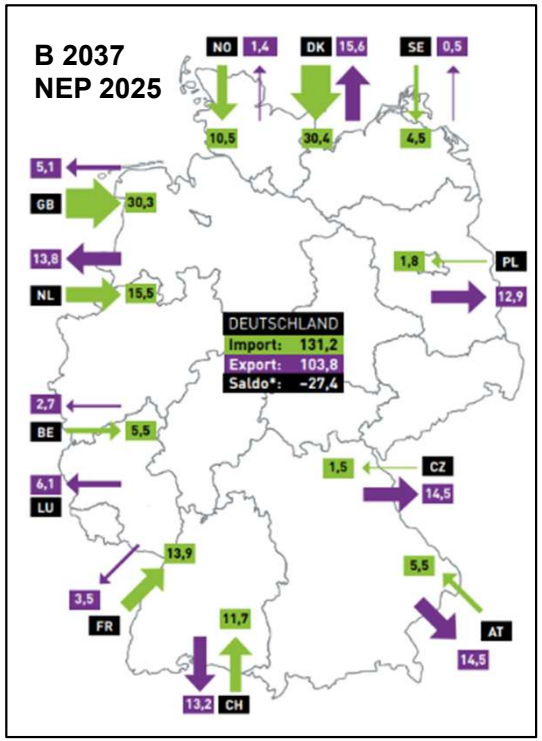
- System development strategy forecasts a need for trading capacity in the order of 92.4 GW for Germany based on long-term scenarios (however, the forecast for battery storage requirements is lower than in NEP 2025).
- There is a difference of 29.7 GW between the model calculations of the BMWE experts and the TSO planning.

* Phase II is described as a planned expansion of generation capacity by a Scottish wind farm of 2 GW and is planned without increasing interconnector capacity.
** Connection of the wind farm to Norway with 1.4 GW, connection to Germany with 2 GW

Market simulation results

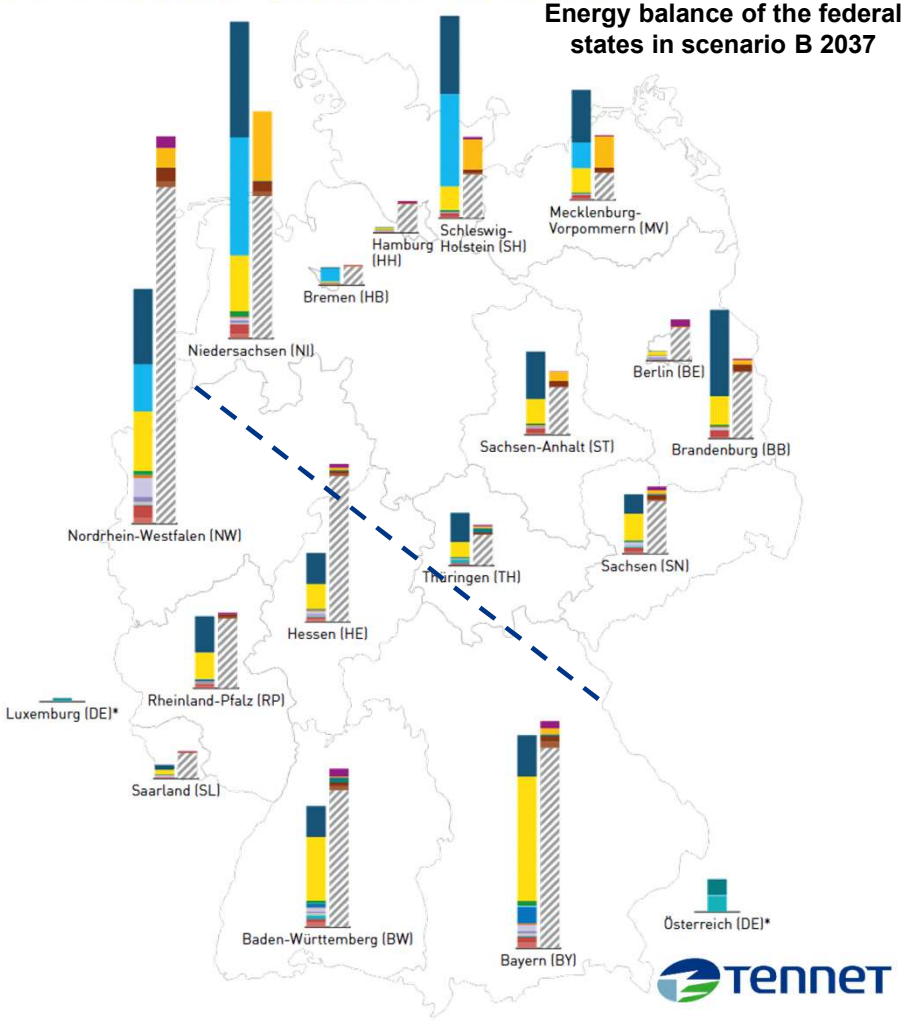
Germany remains a net electricity importer / North-South divide





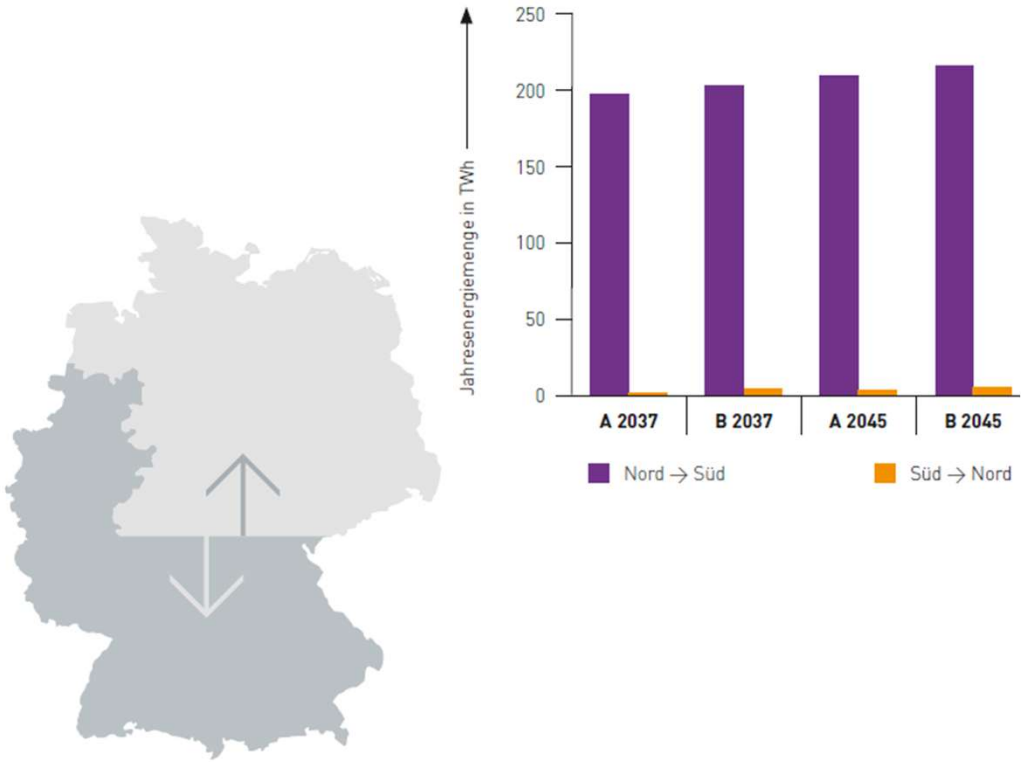
Trade exchange energy volumes in scenario B 2037 (NEP 2023 and NEP 2025)

Energy balance of the federal states in scenario B 2037



Market simulation results
Reduced north-south transport demand in A scenarios

North-South transport requirements



- The need for **north-south transport** is considerable and highlights the need for expansion along the north-south axes.
  Explanation:
  - Generation surplus in northern Germany with high levels of renewable energy, generation deficit in the south with high load
  - TYNDP scenario for other countries (NT+) with current plans of EU countries leads to trade from northern Europe to southern Europe (frequent imports to Germany from the northwest and exports to the southeast)
  - Lower north-south transport demand in path A compared to path B due to reduced electricity demand
- Few hours with **south-north transport** requirements, as surplus PV power is only transported to the north for a few hours.

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3. Target grid development offshore and onshore

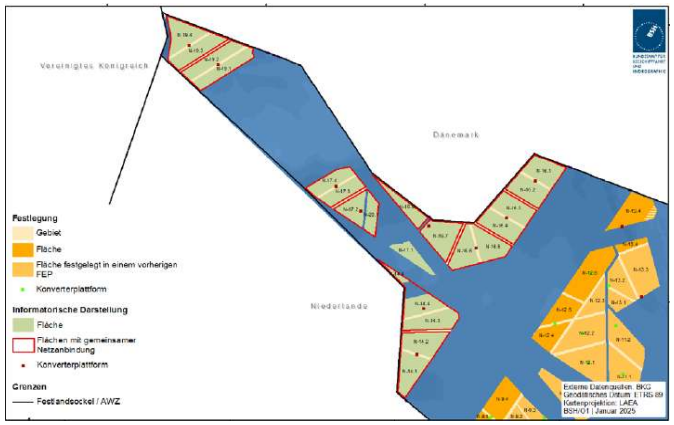
TenneT

Offshore optimization

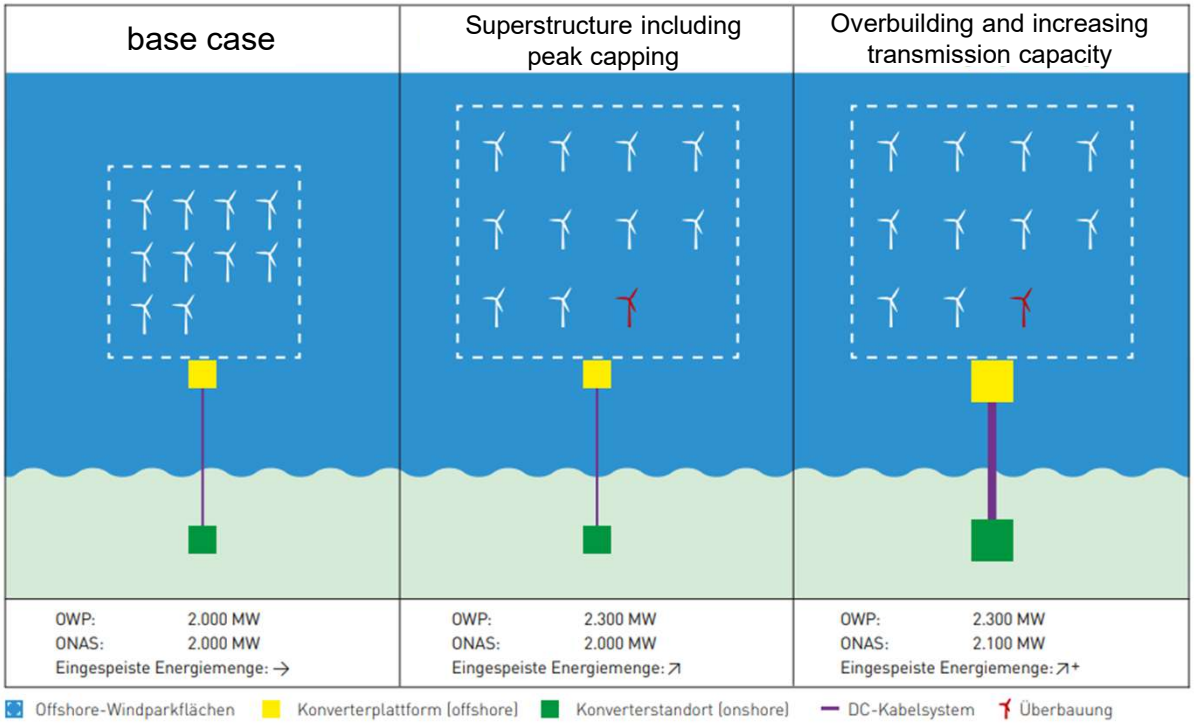
FEPv25 forms the basis for approval in the scenario framework

Key points of the BNetzA approval:

- Increased energy yield per plant through re-cutting of OWP areas
- Overbuilding of wind farms in relation to connection capacity
- Higher utilization of 2 GW-ONAS by up to 10% (= 2.2 GW)

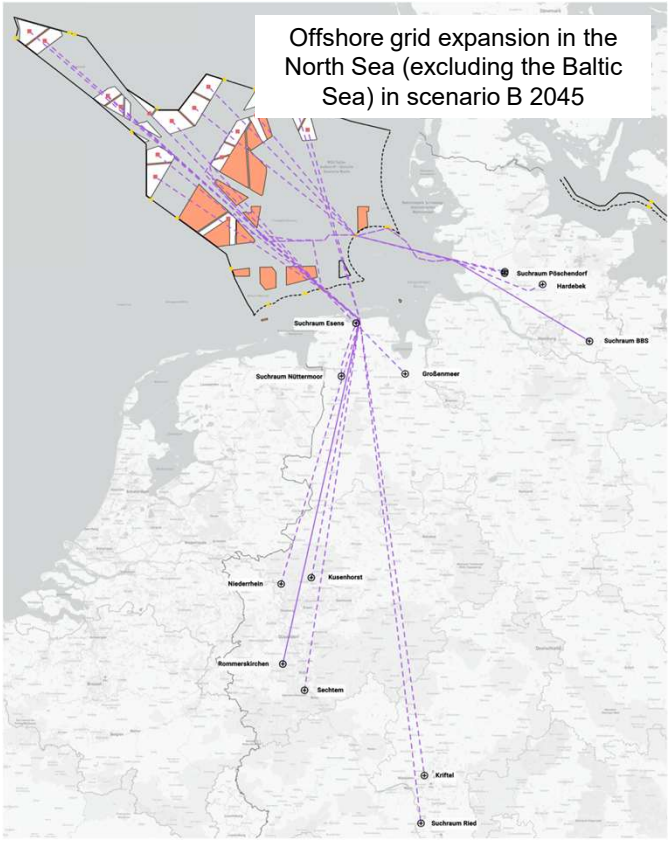


Application of TSOs in the NEP based on FH IWES study:



NEP Electricity 2037/2045 (2025), First Draft

DC offshore grid expansion by 2045: 4-7 ONAS of the NEP 2023 omitted



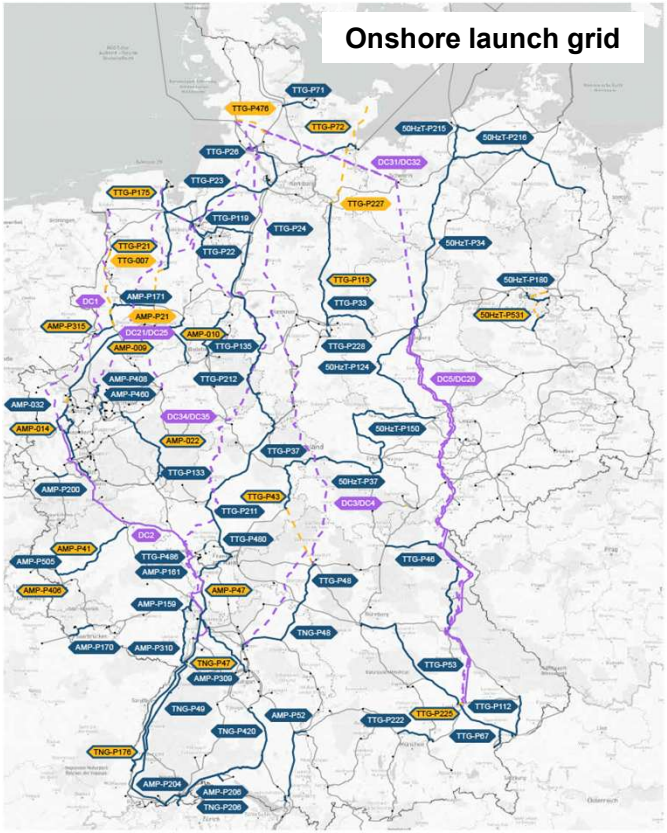
Offshore grid expansion in the North Sea (excluding the Baltic Sea) in scenario B 2045

ONAS	NVP	ÜNB	Scenario A	Scenario B
NOR-6-4	Kusenhorst	Amprion	2034	2034
NOR-9-4	Werderland	TenneT	2032	2032
NOR-12-3	Suchraum Pöschendorf	50Hertz	2034	2034
NOR-12-4	Suchraum Pöschendorf	TenneT	2034	2034
NOR-14-2	Rommerskirchen	Amprion	2036	2036
NOR-16-1	Hardebek	TenneT	2036	2036
NOR-16-2	Sahms/Nord	50Hertz	2037	2037
NOR-16-3	Rommerskirchen2	Amprion	2038	2037
NOR-14-1	Großenmeer2	TenneT	2038	2037
NOR-16-4	Kriftel	Amprion	2039	2038
NOR-17-2	Nüttermoor	TenneT	2040	2039
NOR-17-1	Ried	Amprion	2040	2039
NOR-13-2	Sahms2	50Hertz	2041	2040
NOR-5-2	Niederrhein	Amprion	2042	2041
NOR-19-1	Esens1	TenneT	-	2042
NOR-19-2	Esens2*	Amprion	-	2043
NOR-5-3	Sechtem	Amprion	-	2044

* Restructuring of ONAS NOR-19-2 with NVP in Oberzier: Construction of a multi-terminal DC hub in SR Esens together with NOR-19-1 (formerly Nüttermoor2) and continuation of a 2GW HVDC line from SR Esens to Oberzier as part of the Windader West project.

NEP Electricity 2037/2045 (2025): Onshore Start Grid

Area grows by 3,100 km compared to NEP 2037/2045 (2023)



The starting grid consists of:

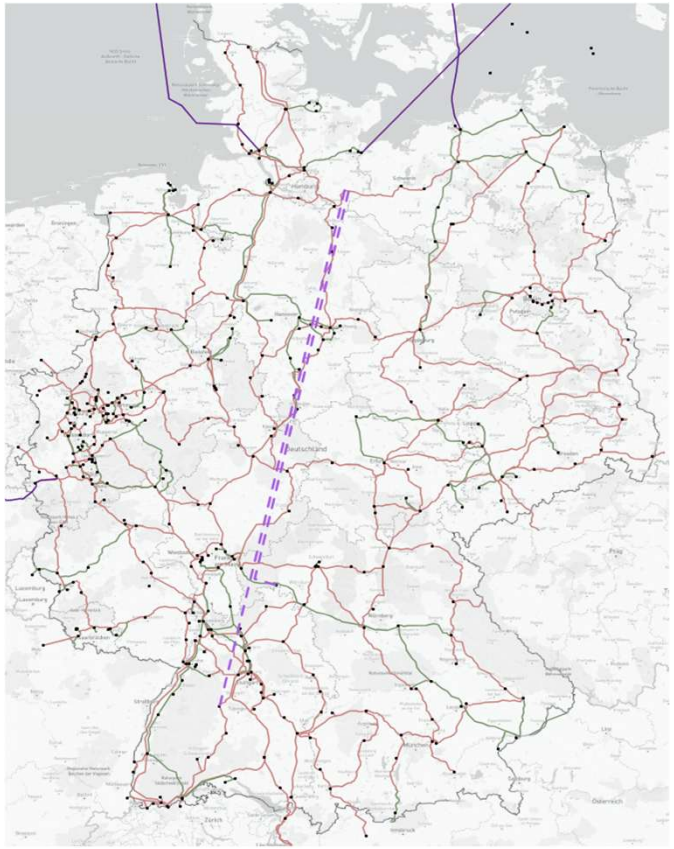
- Actual grid (as of end of 2025)
- EnLAG measures
- Measures currently being implemented (at least ongoing planning approval procedures)Measures based on other obligations (KraftNAV or industry)

480 km	4.225 km	4.289 km	1.055 km	114 Mrd. €
New AC line construction	**AC grid reinforcement and new construction in existing route**	**DC line construction**	**DC grid reinforcement and new construction on existing route**	**Investment volume***

* Investitionskosten gemäß 4ÜNB-NEP-Standardkosten

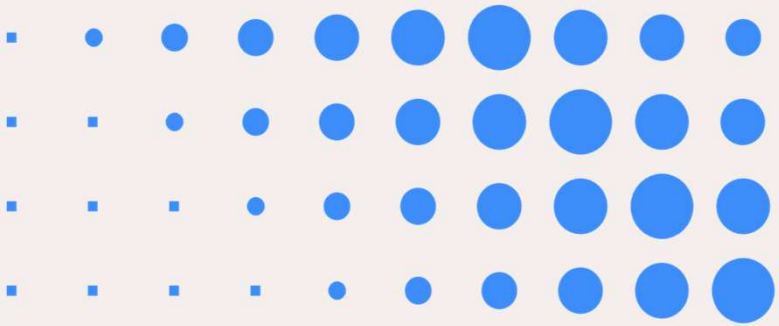
NEP Electricity 2037/2045 (2025), First Draft

Expansion network by 2045: DC expansion reduced compared to NEP 2023



- Two confirmed HVDC projects from the 2023 NEP, each with a capacity of 2 GW, are still necessary and are included in the cost calculation for the 2025 NEP as overhead lines rather than cables:
  - **DC42 Sahms/Nord – Jettingen (SuedWestLink; 707 km) in all scenarios of the first draft**
  - **DC42plus Sahms/Nord – Search area Markt Triefenstein (531 km)**
- Three confirmed HVDC projects in the NEP 2023, each with a transmission capacity of 2 GW, are no longer part of an economically viable target grid:
  - **DC40 SR Nüttermoor – Streumen (East-West Link; 560 km)**
  - **DC40plus Dörpen/West – Klostermansfeld (402 km)**
  - **DC41 SR Alfstedt – Obrigheim (North-West Link; 628 km)**
- Aufgrund des Entfalls von DC40 voraussichtlich keine Weiterverfolgung eines Multiterminal-DC-Hubs in Nüttermoor

Thank you for your attention



TenneT Germany is the largest transmission system operator in Germany (in terms of circuit length, installed capacity, and control area size; as of December 31, 2024). The company operates critical infrastructure for access to a reliable, sustainable, and affordable electricity supply. TenneT Germany employs around 5,000 people and is one of the largest investors in onshore and offshore electricity grids in Germany. Located at the energy hub of northwestern Europe, TenneT Germany connects: North and South. Offshore and onshore. Germany and Europe. Our growth is driven by rapidly developing electricity demand, which requires a flexible and growing grid architecture. TenneT Germany is part of the TenneT Group, the European market leader in cross-border grid expansion and a pioneer in connecting the European mainland to one of the world's largest renewableenergy sources, the North Sea.

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