

German Energy Transition – Joint Efforts for Ambitious Goals

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Agenda

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Tracing the Path of German Energy Transition



The German Grid Transformation – A Fundamental Change



Role of Hydrogen: Solution or Distraction?

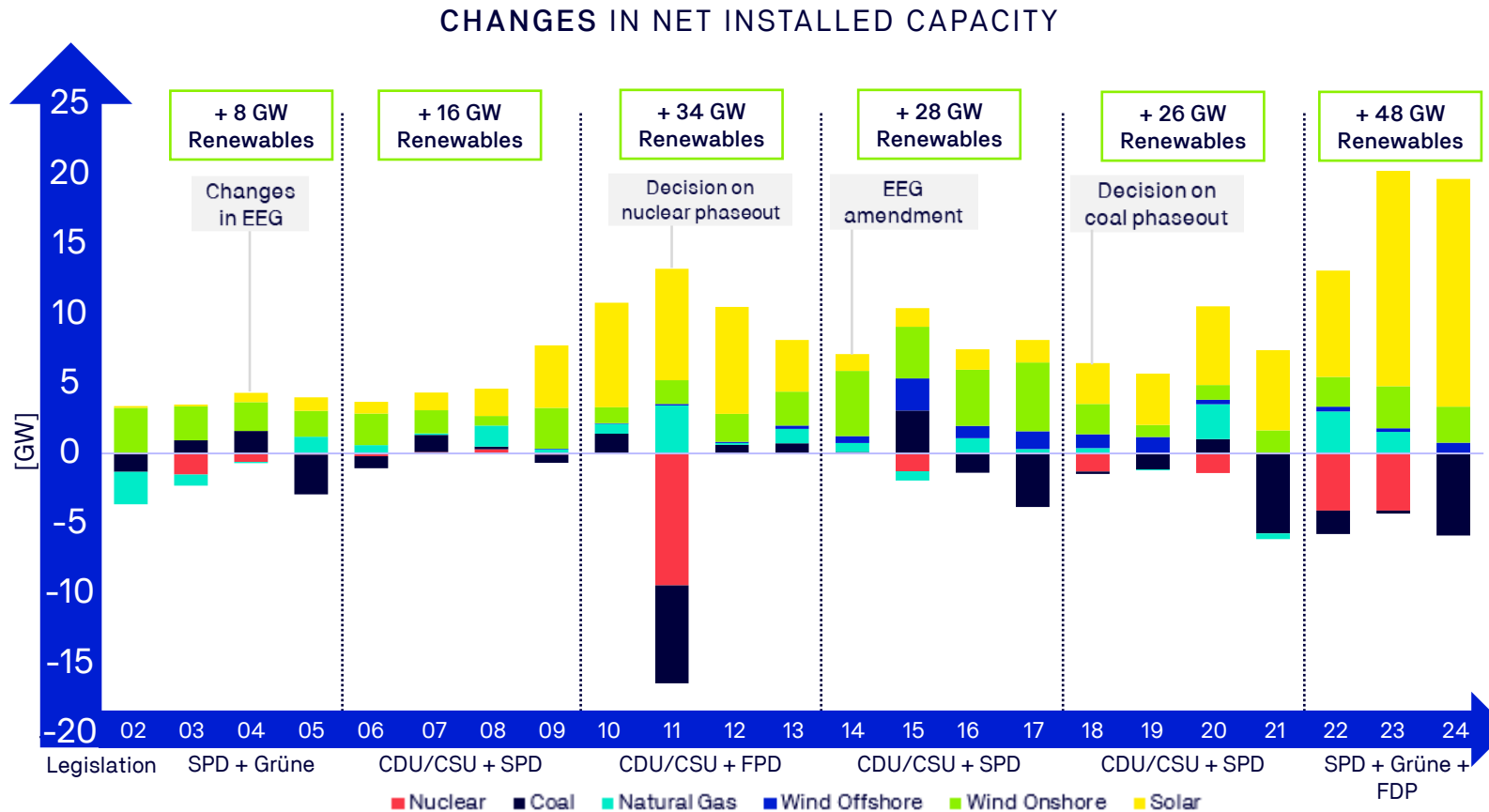


Building Trust: TÜV NORD Services for the Energy Transition

Tracing the Path of German Energy Transition

Retrospective on the German Energy Transition

The energy transition is a long-term commitment and steadily progressing amidst political dynamics

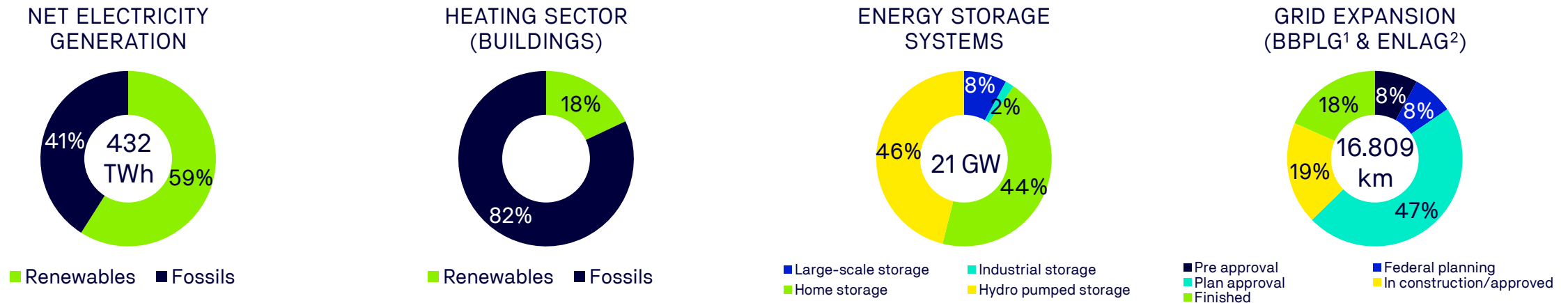


- Germany has a **total installed capacity of 262 GW in 2024**, with **~71%** attributed to renewables
- Main additions come from **solar energy**
- First full year **without nuclear power** in 2024

Sources: Energy Charts

2024 Status of Energy Transition in Germany

Status quo of electricity generation, heating sector, energy storage and grid expansion in Germany

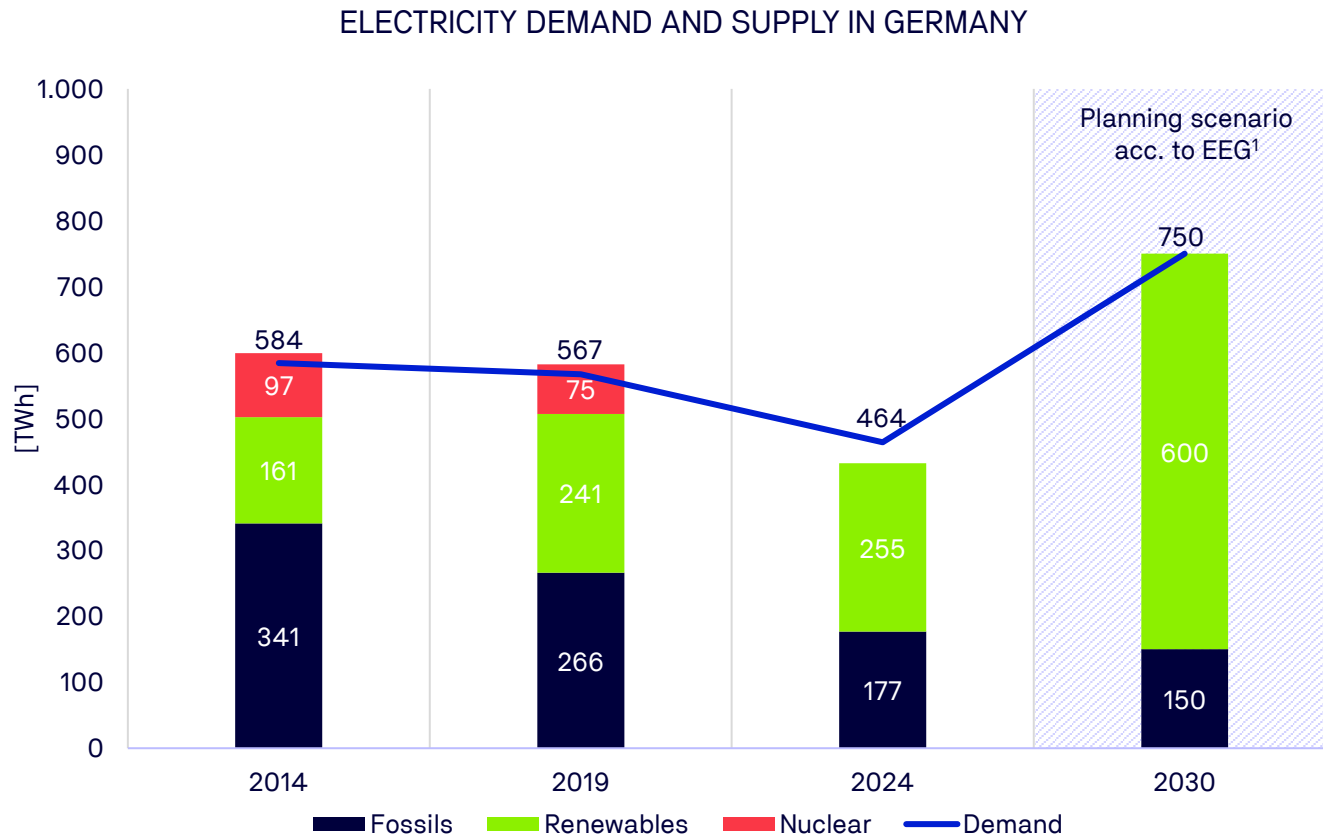


- **Renewables are the main contributor** to public net electricity generation
- The use of renewables in the **heating sector** stagnated at 18%
- **Battery storage** (11.6 GW) has **surpassed** the stable **hydro pumped storage capacity** (9.9 GW)
- **Grid expansion has accelerated** over the past three years with **3,183 km** of grids either approved or under construction

1: Bundesbedarfsplangesetz; 2: Energieleitungsausbaugesetz | Sources: Energy Charts, Agora, Battery Charts, Bundesnetzagentur

Changes in Demand and Supply

How to meet future electricity needs? The 2023 EEG¹ planning scenario

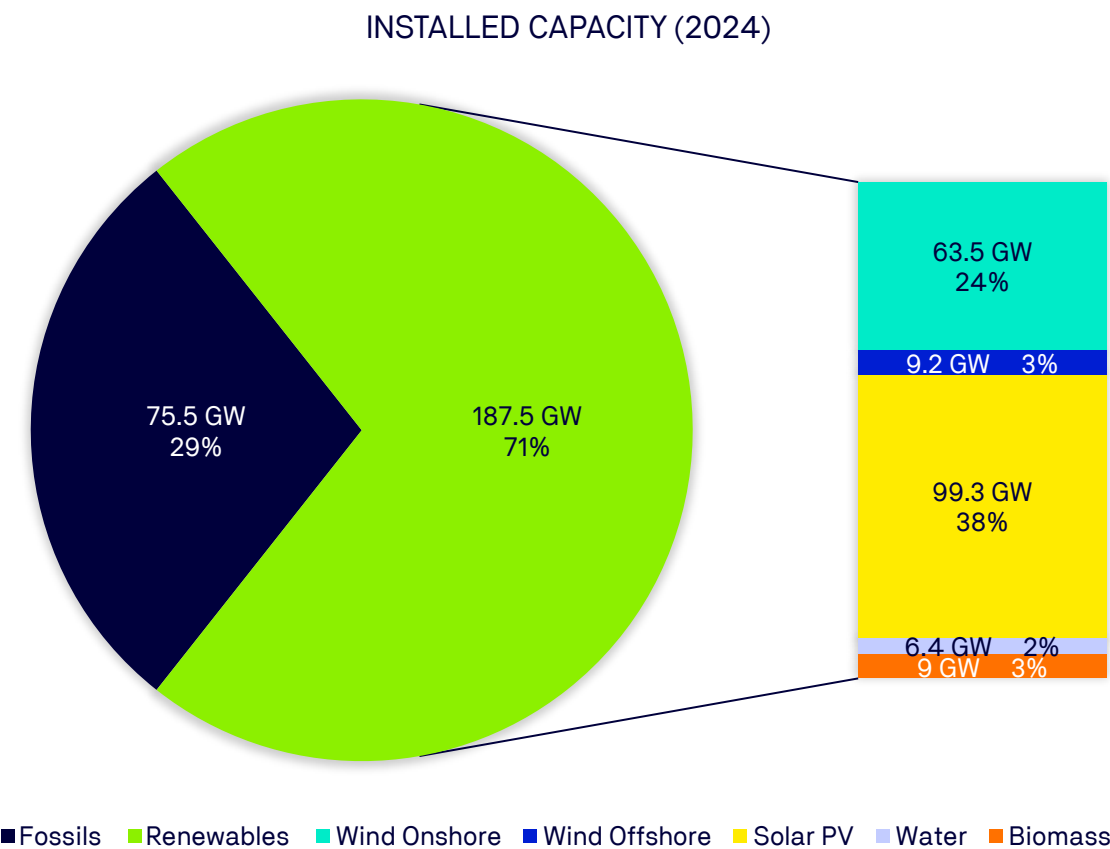


- Increasing electricity demand of **up to 750 TWh in 2030** due to progressing electrification, e.g. in mobility
- Rising demand shall be met primarily by **electricity from renewables**
- In 2023, Germany has gone **from being a net exporter to an importer** of electricity
- **Future predictions** are **depending** on the ramp up of **new electricity consumers** (mobility, industry, heating)

1: Erneuerbare Energien Gesetz 2023 | Sources: bdew, Bundesnetzagentur

2024 Steps for Electricity Transition

The electricity transition is the foundation for a successful energy transition



Sources: Bundesnetzagentur

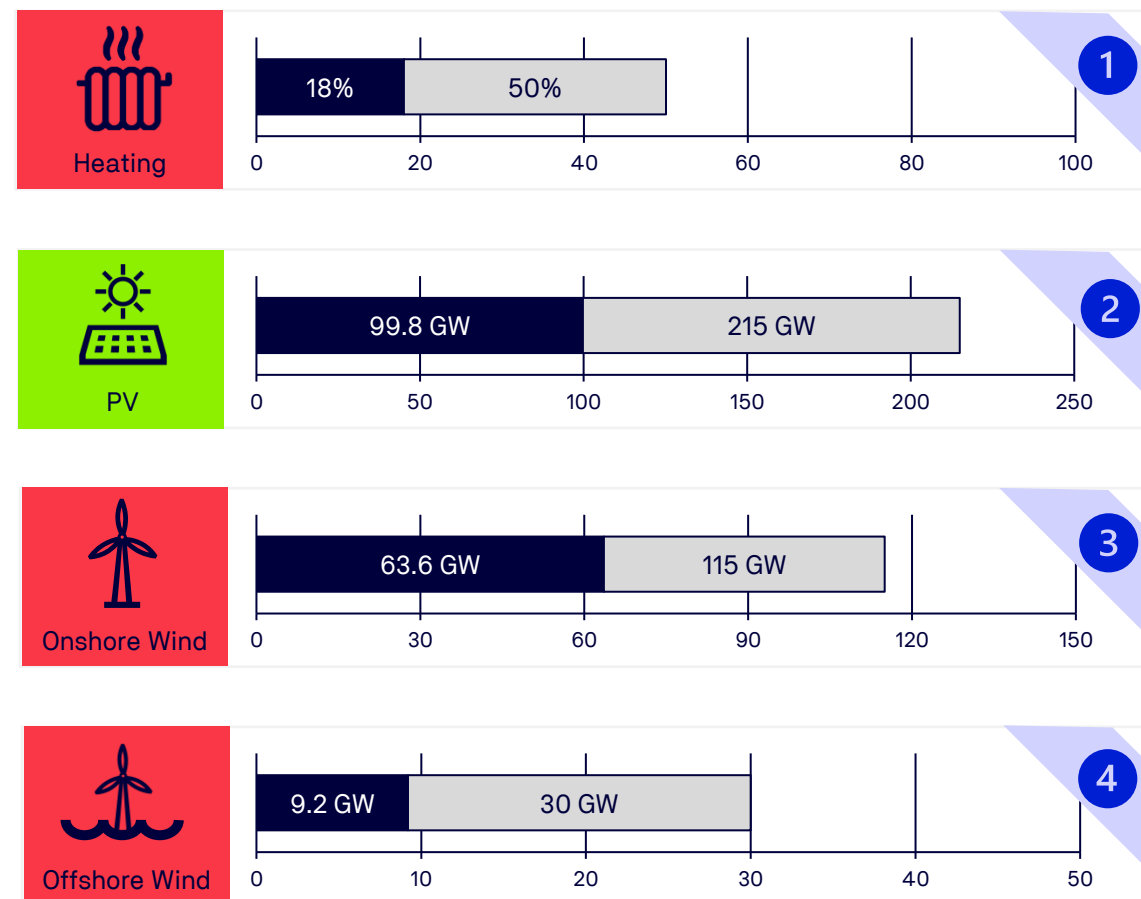
Germany's Energy Transition path is focused on **three key technologies**:



German Energy Transition

“Ampel” coalition from 2021 to 2024: On or off path?

- German Government announced ambitious goals to achieve **climate neutrality by 2045**
- 2030 targets:**
 - 80% of electricity from renewables
 - 50% climate neutral heating **1**
 - 215 GW PV **2**, 115 GW onshore wind **3** and 30 GW offshore wind **4**
 - Coal phase out
- Expansion of renewables is progressing, but **only PV reaches** targeted level. **Heating** actuals are **far behind plan**



“Ampel” Coalition Plans

Where we are today

- Ramp up of **renewables, grid** and **hydrogen** under “Ampel” coalition – despite missing many of the capacity targets, an **increase in permits in all three areas was achieved**
- **Grid stabilizing technologies** and **short-term storage** (e.g. battery systems) **have not been key** in the “Ampel” coalition plans
- To compensate for volatile renewables, **regulatable capacity** is needed for stable energy supply
- Therefore, **H₂-ready gas power plants** have been the balancing capacity in the target scenario to achieve climate neutrality by 2045

Sources: Leopoldina, BMWK



Renewables

Under the “Ampel” coalition, renewables projects were the focus technology for electricity generation



Energy Storage

Whereas hydrogen has been formed into a comprehensive strategy, short-term storage technologies have not been intensively promoted



H₂-ready Gas Power Plant

Germany's „Power Plant Strategy“ stipulates new built (H₂-ready) gas power plants to balance fluctuating renewables generation

The German Grid Transformation

A Fundamental Change



Germany's Grids Today

From centralized to decentralized; but how fast?



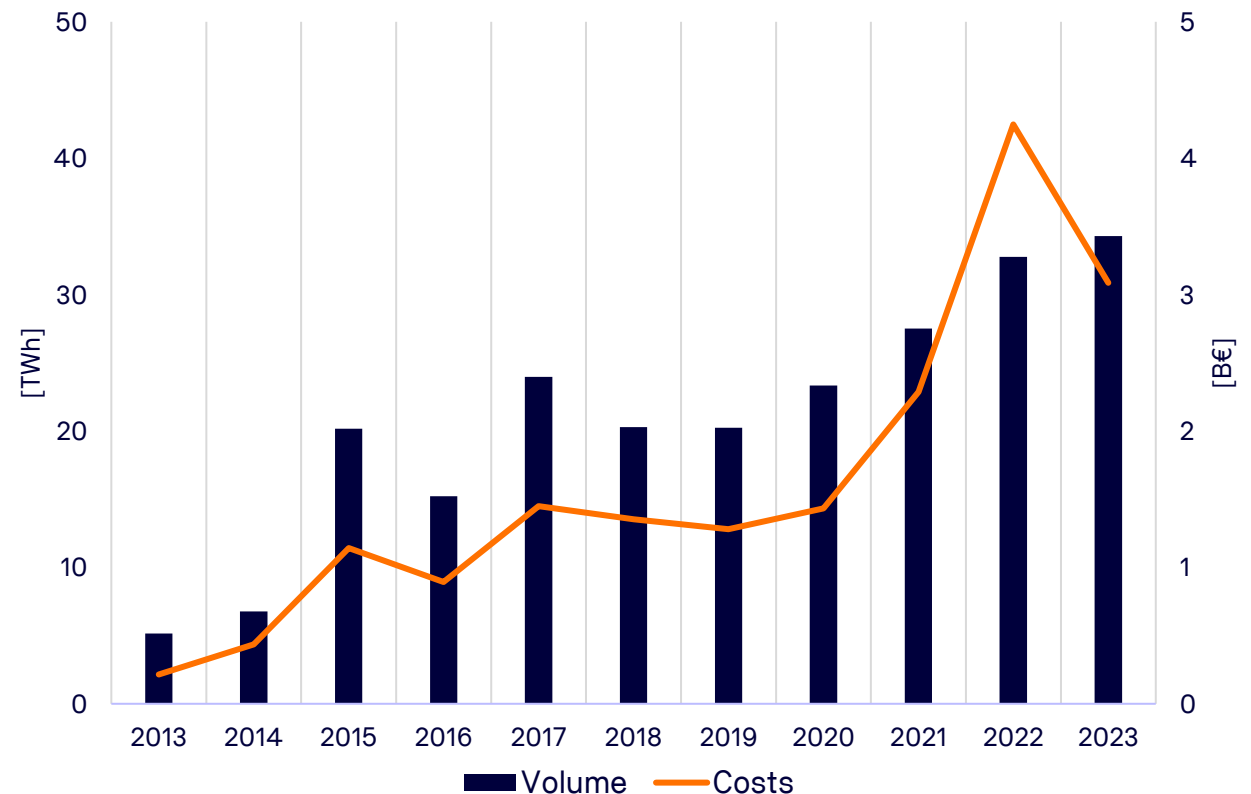
- With the **nuclear phase-out** and **planned coal phase-out**, the German grid needs to further and faster expand
- ~95% of renewables power is fed into **low and medium voltage grids** which adds further complexity
- Major electrical power generation in Northern part of Germany, while major consumption in Western and Southern parts. This leads to a **strong demand for new transmission capacities**

Challenges for the German Electricity Grid

Grid stabilisation interventions increase with rising share of renewables

- Increasing share of fluctuating renewable power contribution leads to an **increase in grid interventions**
- Interventions include temporary curtailments, shutdowns and start ups of reserve power plants
- The **costs for grid interventions** was at **~3.1 B€ in 2023** – compared to **~215 M€ in 2013**
- Increases in decentralized units require a **robust grid management and grid architecture** for stable operations

GRID INTERVENTIONS BY CONGESTION MANAGEMENT



Source: Bundesnetzagentur, bdew

Role of Hydrogen

Solution or Distraction?

Changes in German Hydrogen Strategy

The National Hydrogen Strategy – plans and status quo for electrolysis capacity and core network

	"GroKo" 2020 First Publication	"Ampel" 2022 Update	Status Quo
Planned electrolysis capacity	5 GW installed electrolysis by 2030	10 GW installed electrolysis by 2030	0.15 GW installed electrolysis today
Planned infrastructure	Core H ₂ network mentioned, but no specific parameters	Initial network with 1,800 km by 2027/28; core network by 2030	0 km new pipelines put into operation

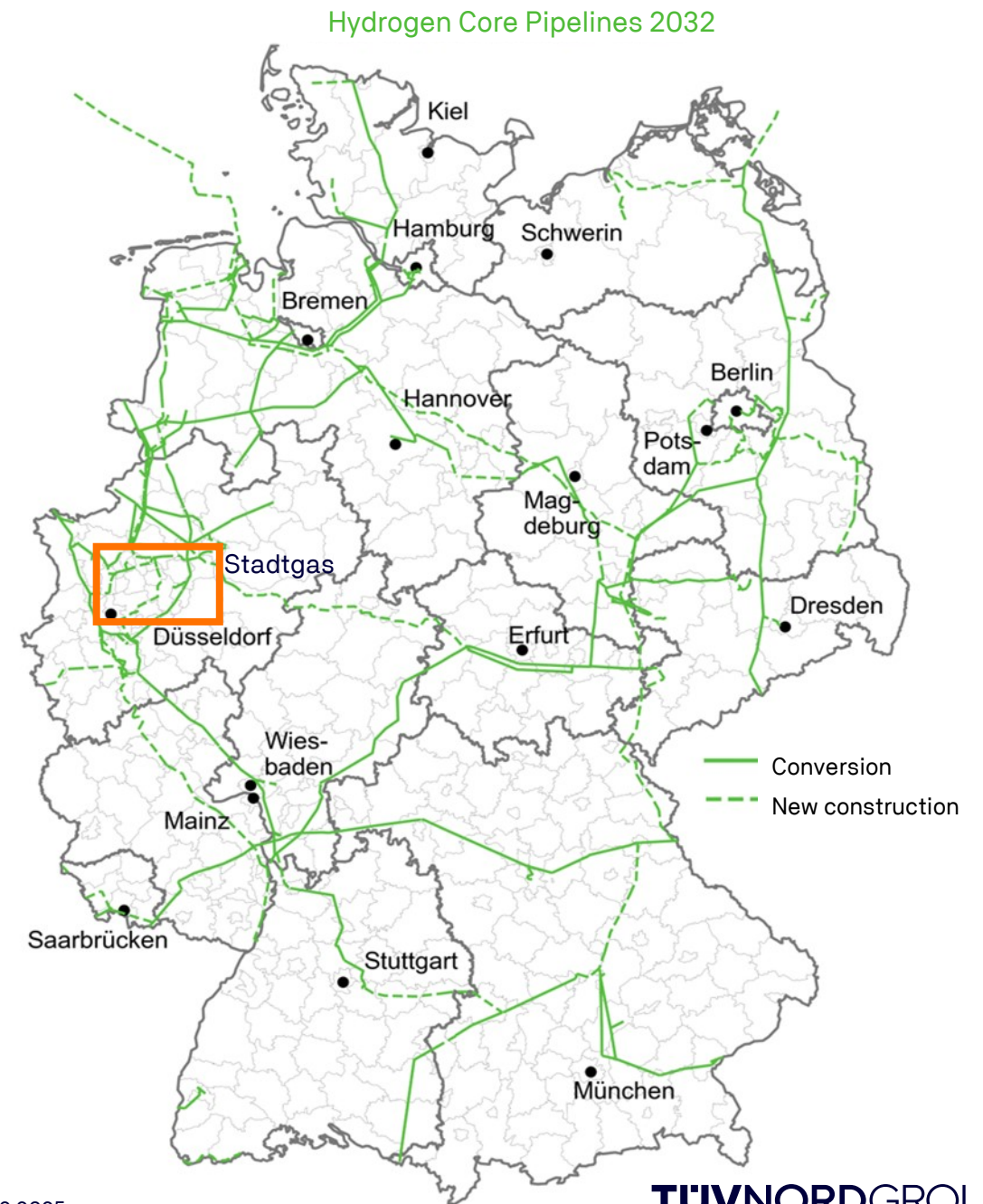
The use of hydrogen was a core element of the “Ampel” coalition for the 2045 goal of carbon neutrality!

H₂ Core Pipelines 2032 in Germany

Big efforts for big plans

- The core of the National Hydrogen Strategy is a **dedicated German H₂ pipeline network**
- With a planned **import share of 50-70%**, this network should also connect **European hydrogen producers** and **import terminals**
- **9,040 km** of pipelines are **approved**, full-scale use is targeted for 2037
- The future of these pipelines depends on the **electricity strategy of new governmental coalition**

Sources: FNB Gas



Building Trust

TÜV NORD Services for the Energy Transition

Recognizing the energy transition as a **global challenge** is essential for its success.

TÜV NORD is represented internationally with **dedicated renewables teams** and a **worldwide network**.



Our experts for NUCLEAR TECHNOLOGIES ensure compliance with highest safety standards for dismantling and in waste management.



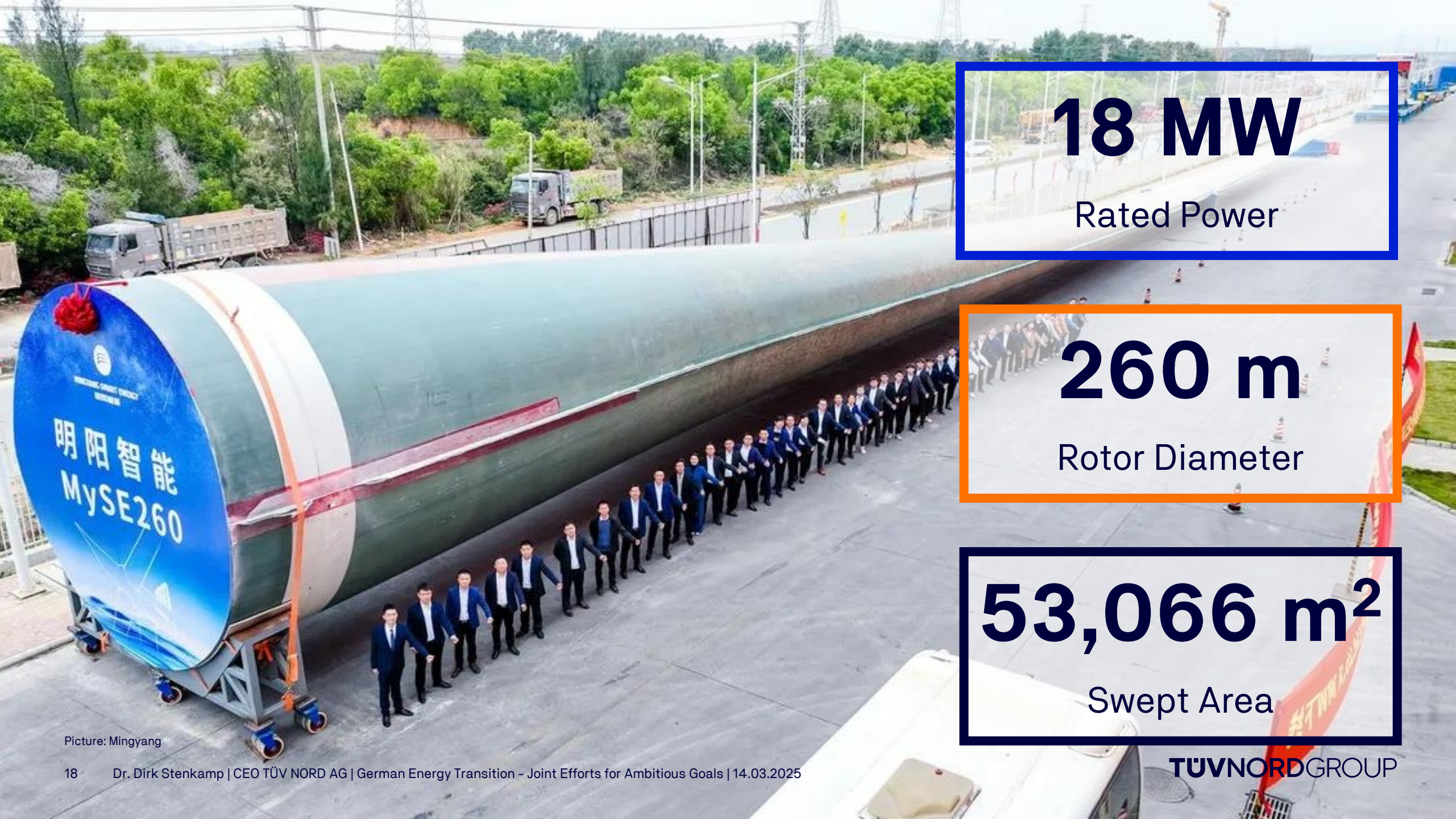
With own LIDAR DEVICES, our site assessment experts measure wind speeds in up to 300m height.



In our PV LABS, we perform testing services on PV modules.



Our WIND ENERGY team certifies and inspects wind turbines everywhere in the world – also offshore.



18 MW

Rated Power

260 m

Rotor Diameter

53,066 m²

Swept Area

Picture: Mingyang

Energy Transition Project Highlights

1. Testing and certification for JA Solar **offshore PV modules**
2. Assessment of structural loads and tower integrity for **high-altitude wind turbine**
3. Design review for Türkiye's **first floating PV project**



Pictures: 1: Tractebel Engie/ DEME NV/Jan De Nul Group 2: GICON

Outlook



Future German Energy Transition – Quo Vadis?

Continuity or disruption: What's the new government aiming for?

- “Ampel” coalition has raised the goals towards climate neutrality in 2045 and set a clear focus on renewables and hydrogen technology
- With a changing government, certain discussion points can be re-opened:
 1. The goal of climate neutrality by 2045 – Will this be confirmed?
 2. Maintaining stability of a fast-growing grid infrastructure – How much storage capacity and balancing power do we really need?
 3. Is hydrogen the only technology for balancing power of renewables or do we see a comeback of natural gas usage which has become widely unpopular given CO₂ climate targets?
 4. New technologies, new opportunities – e.g. small modular nuclear reactors, nuclear fusion

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