



Measures towards Zero Emissions in the European Power Sector – Policies and actual status

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1 Actual gas and electricity situation in Europe

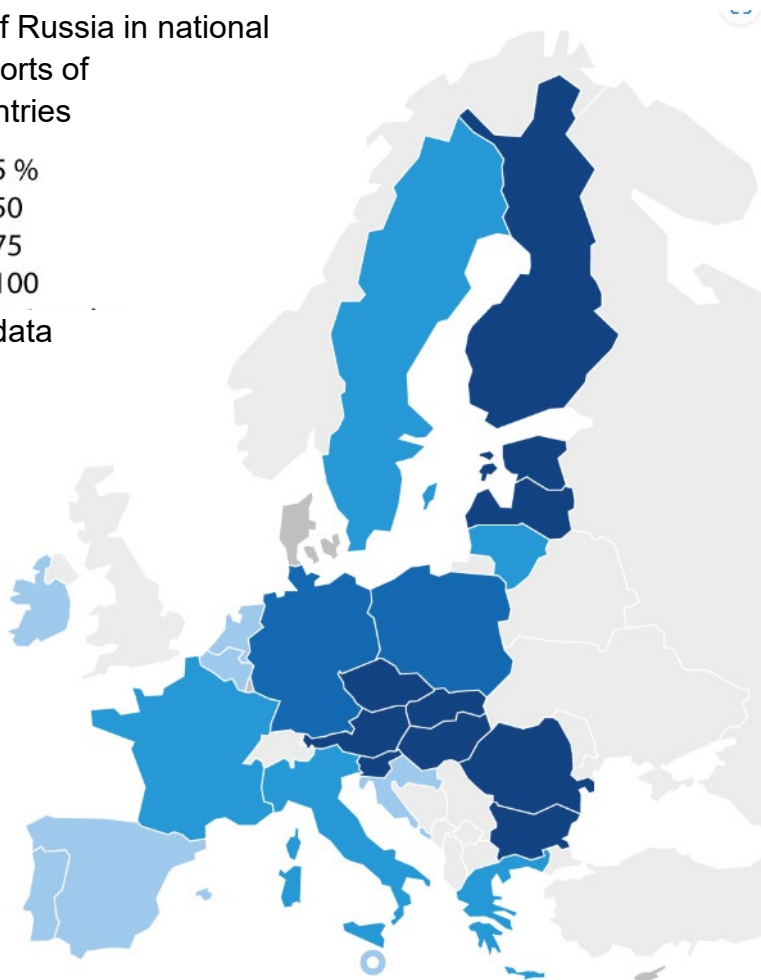


In 2021 EU has imported 83 % of natural gas -
 Russia was by far the biggest supplier for natural gas –
 Power sector used 30%

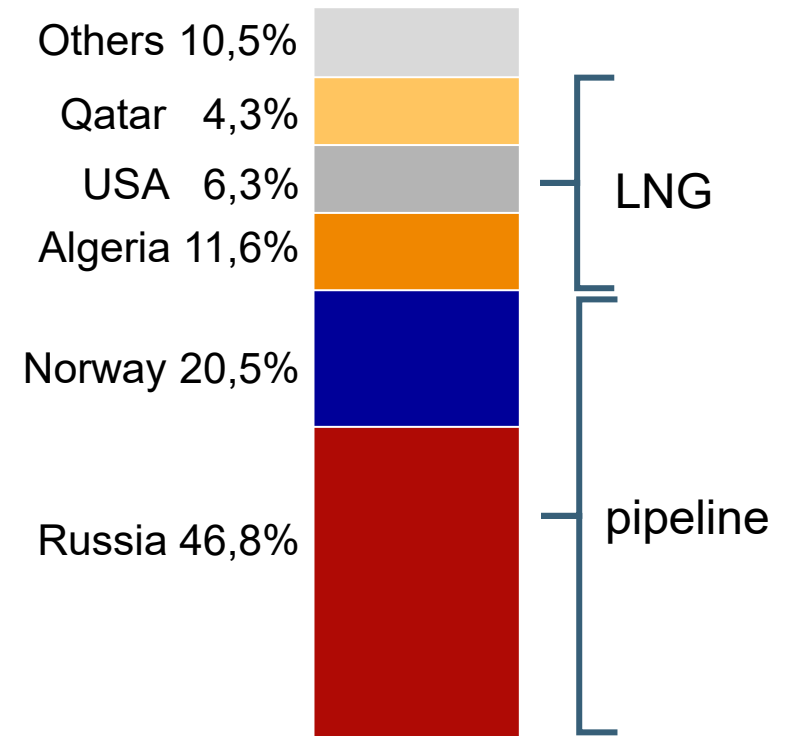


Share of Russia in national gas imports of EU countries

- 0–25 %
- 25–50
- 50–75
- 75–100
- No data



In average approx. 47% of EU's gas imports came from Russia in 2021



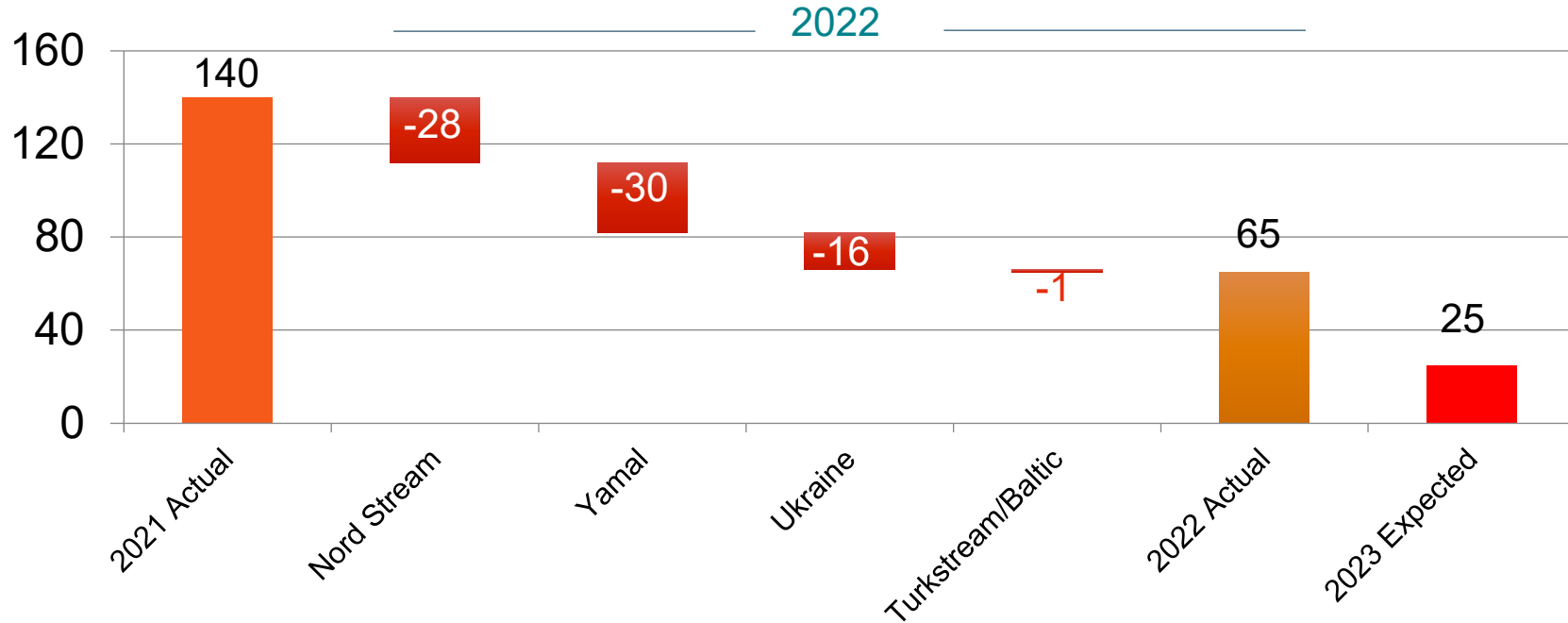
2021

In 2022 Russia gradually stopped gas supplies via Jamal and North Stream 1 pipelines



European gas imports from Russia

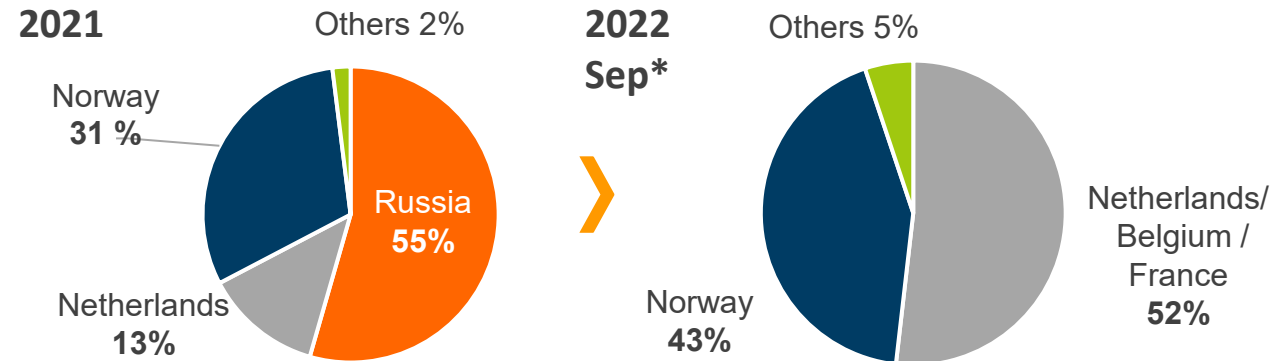
in million cubic meter



-84%
(cto 2021)

Germany had to replace Russian gas imports in a few month time:

- increasing **LNG imports** (via Netherlands, Belgium and France)
- slightly higher **pipeline supplies** from Norway

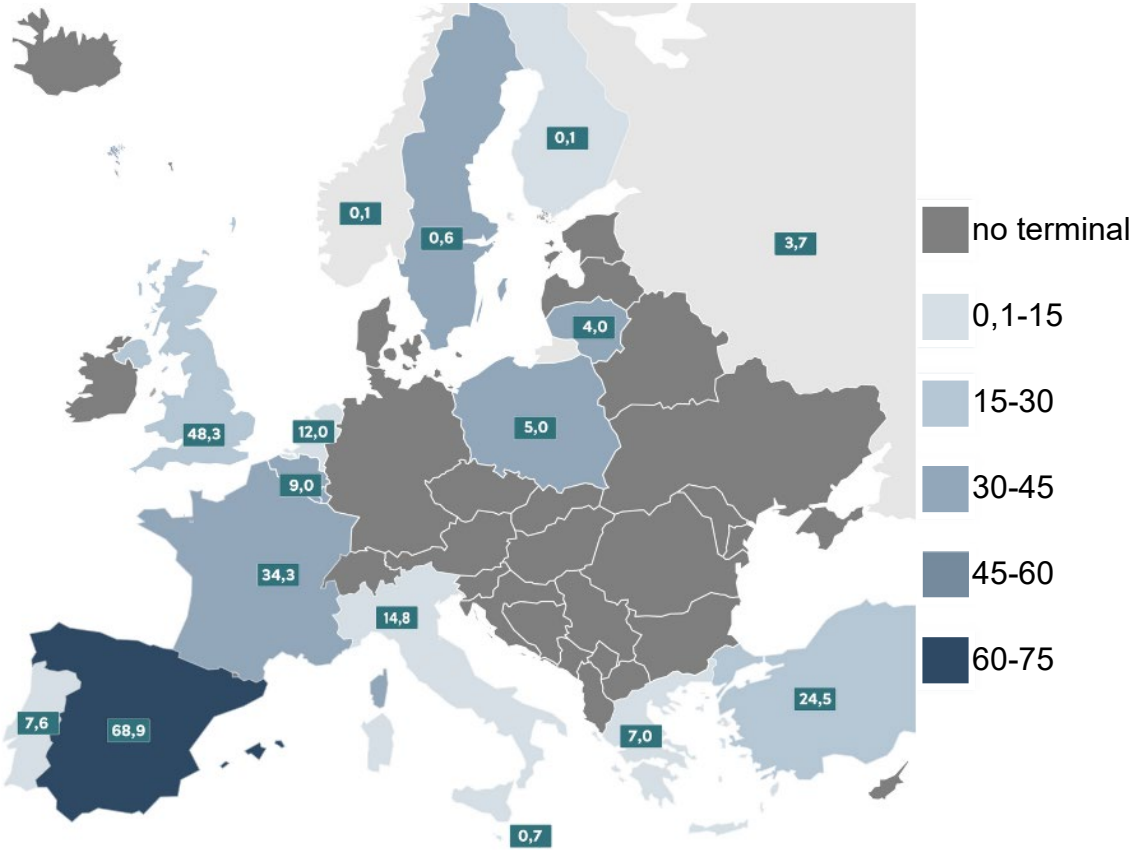


Potential of LNG as a replacement for Russian pipeline gas



Import capacities for LNG in Europe 2021

In billion cubic meters



The European LNG infrastructure

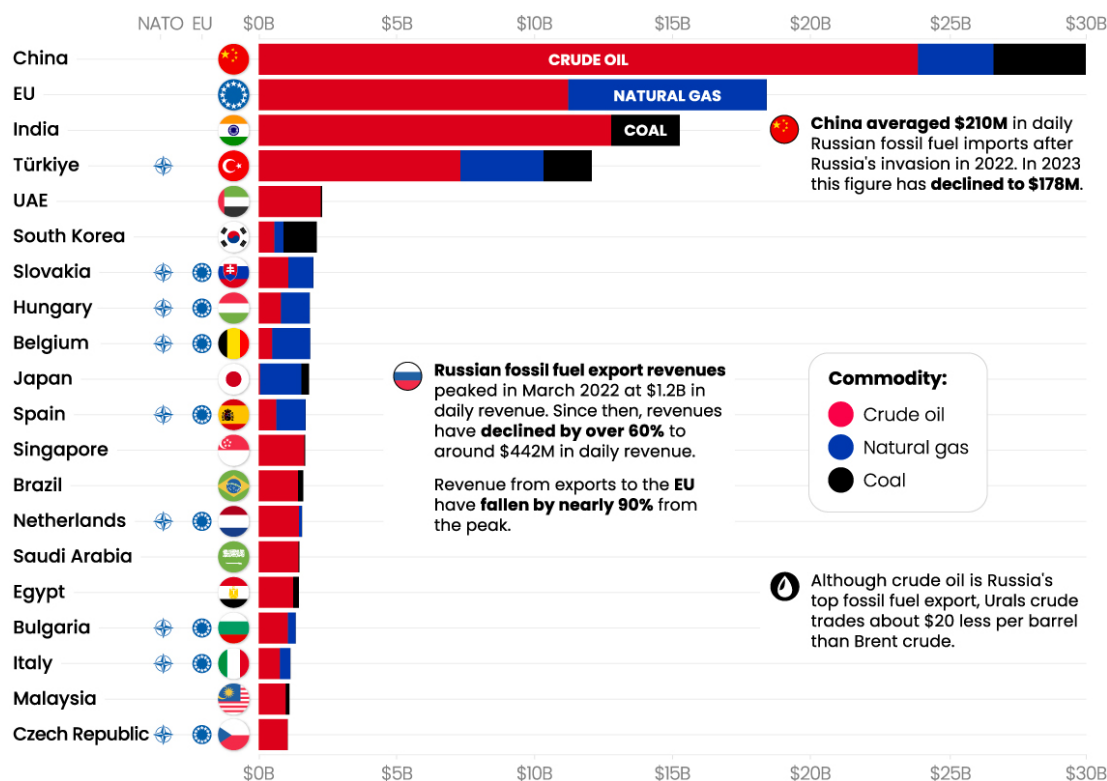


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Who's Still Buying Fossil Fuels From Russia in 2023?

FOSSIL FUEL IMPORTS IN 2023: JAN 1ST - JUNE 16TH 2023



Source: Centre for Research on Energy and Clean Air

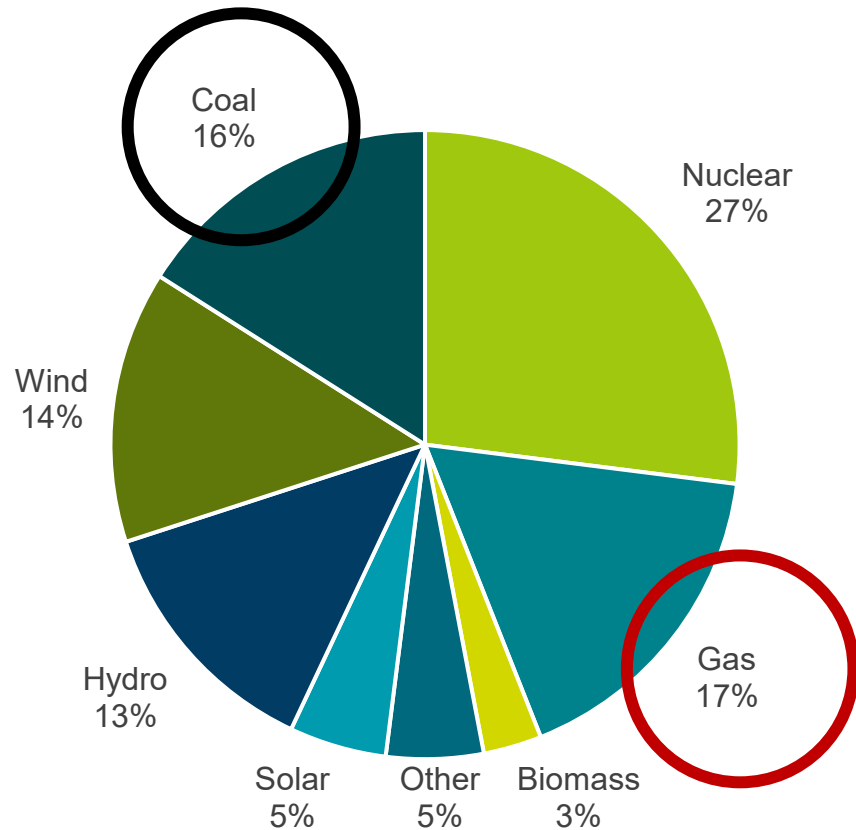
- Revenue from fossil fuels exported to the EU has declined more than 90% from their peak but still reaching 18 bill. USD in 1st half of 2023
- EU coal import ban from August 2022 on
- EU/G7 price cap of 60 USD per barrel for Russian crude oil; price support by OPEC+ nations
- German ban on Russian gas from end of 2024 / EU until 2027
- Russia is EU's third largest import country for LNG with ~ 19 bill m³ in 2022 (behind USA and Qatar)
- India has ramped up imports from Russia by 10x

In the EU26 roughly 2/3 of electricity production are „low-carbon“
thereof ~ 40 % from renewables

electricity

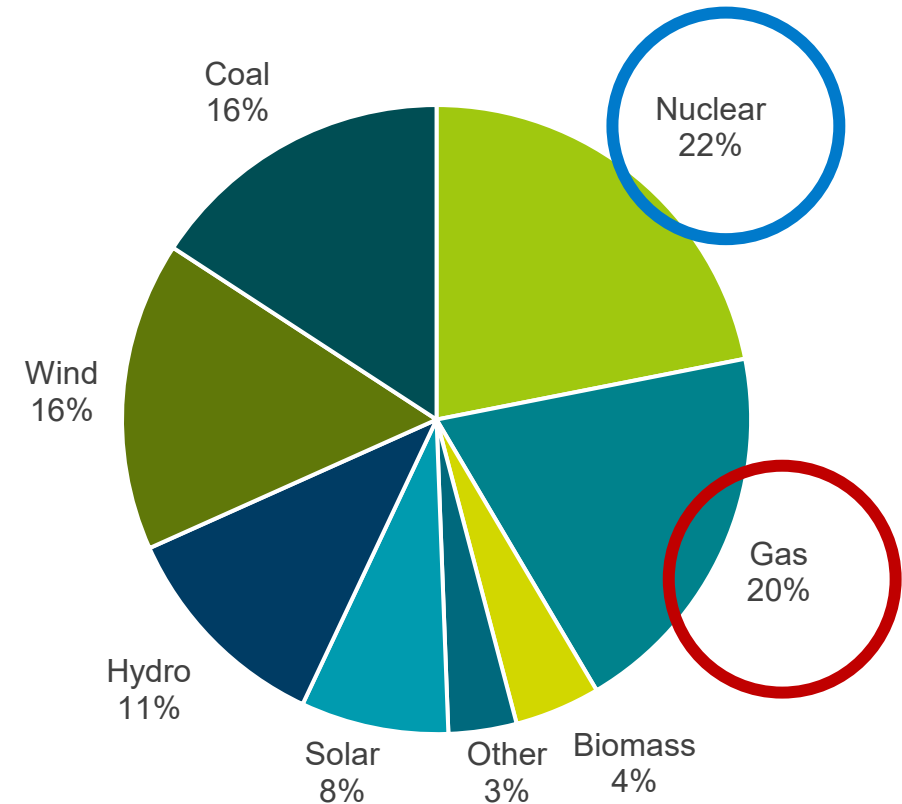
2021

2.620 TWh



2022

2.461 TWh



Source: Eurostat data 2023

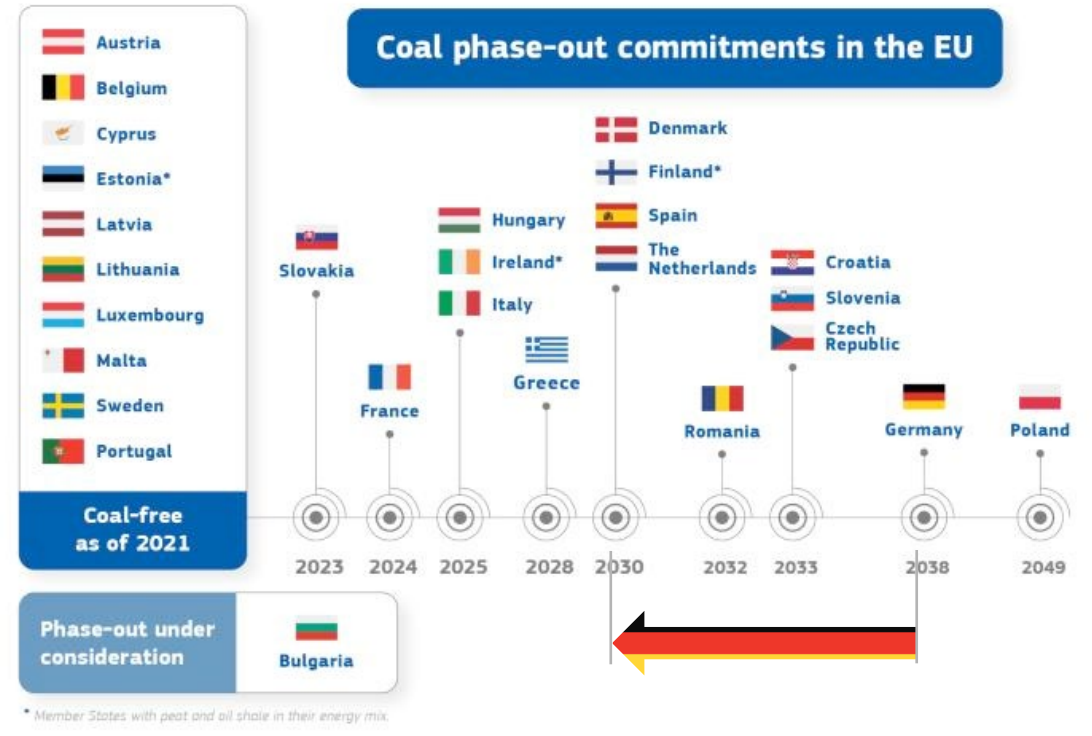
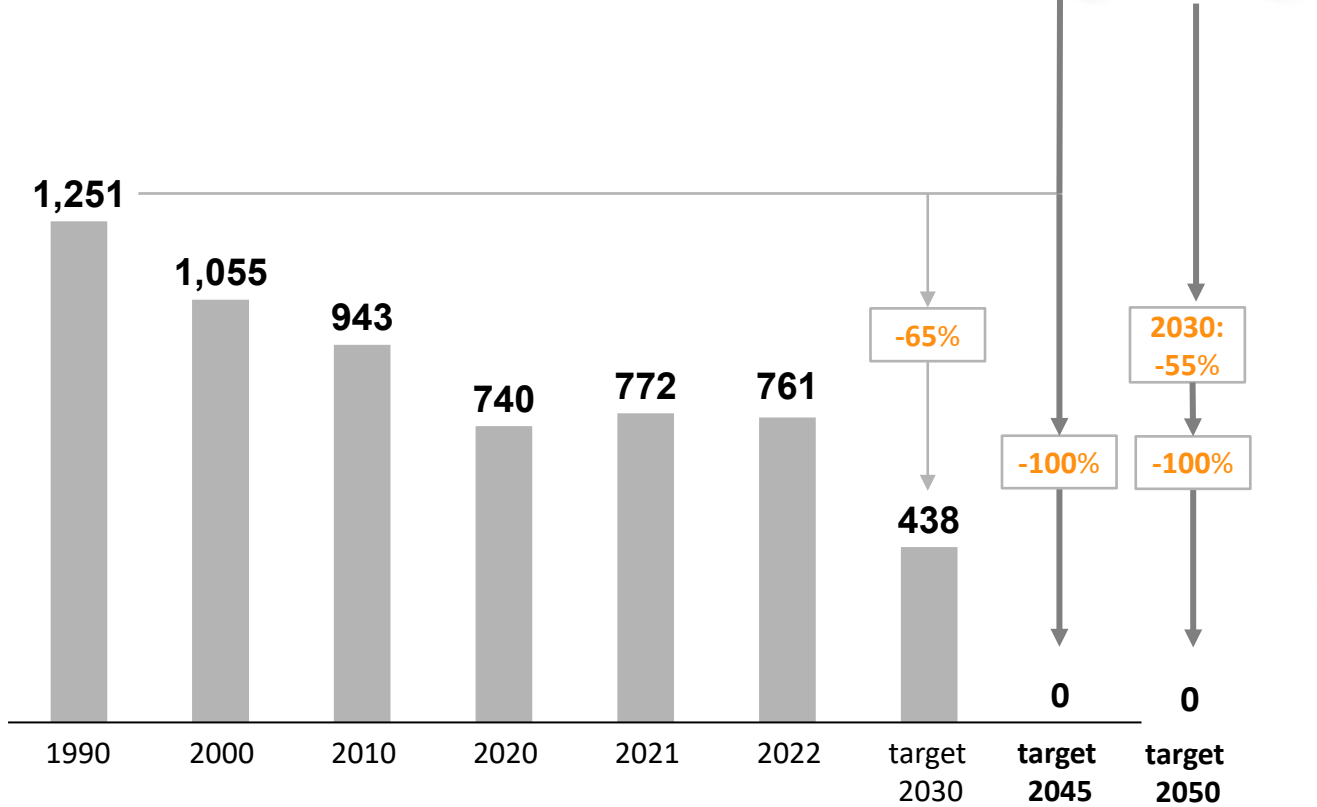
2 Energy policy framework in Europe and Germany



Challenging climate targets in Europe – Germany even more ambitious – coal phase-out seems unavoidable

 **Targets**
 in Mil. t CO₂aq.

- Nuclear and coal phase-out laws
- Climate Protection Law
- Fit for 55
- RePowerEU
- Clean Energy Packages



Decarbonization in Germany: Future Blue print for 2045

Renewable energy

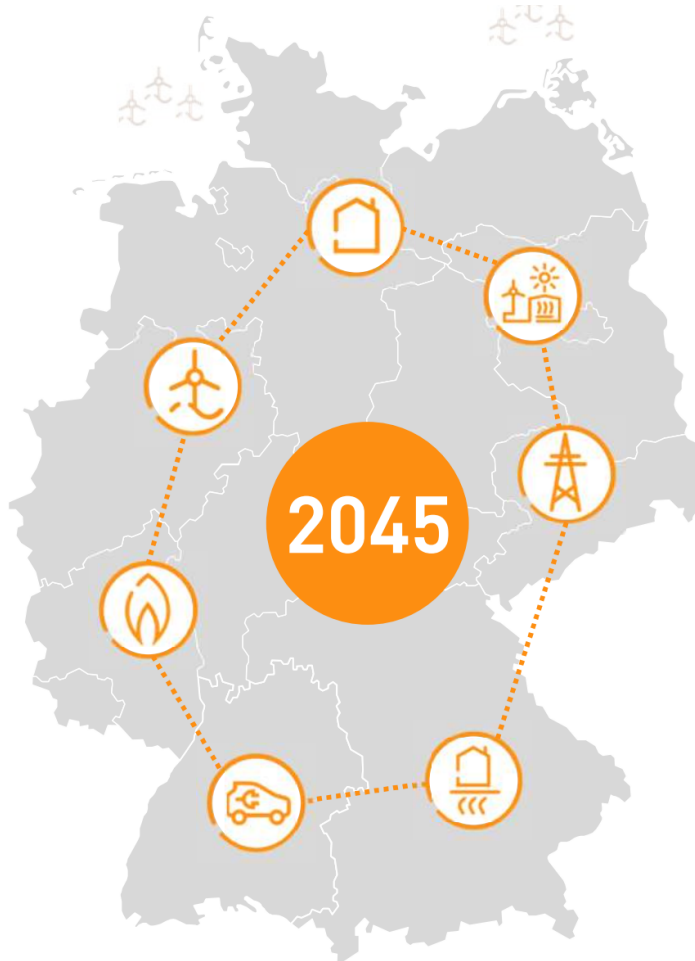
- ... provides climate-neutral power generation
- Installed RE capacity: approx. 600 GW (today approx. 145 GW), of which 210 GW wind, 380 GW solar plus 8 GW hydro and 5 GW biomass

Security of supply

- ... ensured by gas-fired power plants running on hydrogen, battery storage and hydropower (pumped storage): 65 GW gas turbines and CCGT (2021: approx. 30 GW); 15 GW battery storage

Transport and mobility

- Electric power standard for passenger cars, approx. 40 m electric vehicles, mainly passenger cars and delivery vans
- Heavy/long-distance transport powered by H₂, biogenic fuels or battery electric



Electricity consumption

- ...increases to approx. 820 TWh due to high level of electrification in all sectors (currently approx. 500 TWh)
- Energy efficiency reduces conventional consumption to ~400 TWh
- New consumption from 2025 (~200 TWh by 2045) due to sector coupling

Grids (electricity)

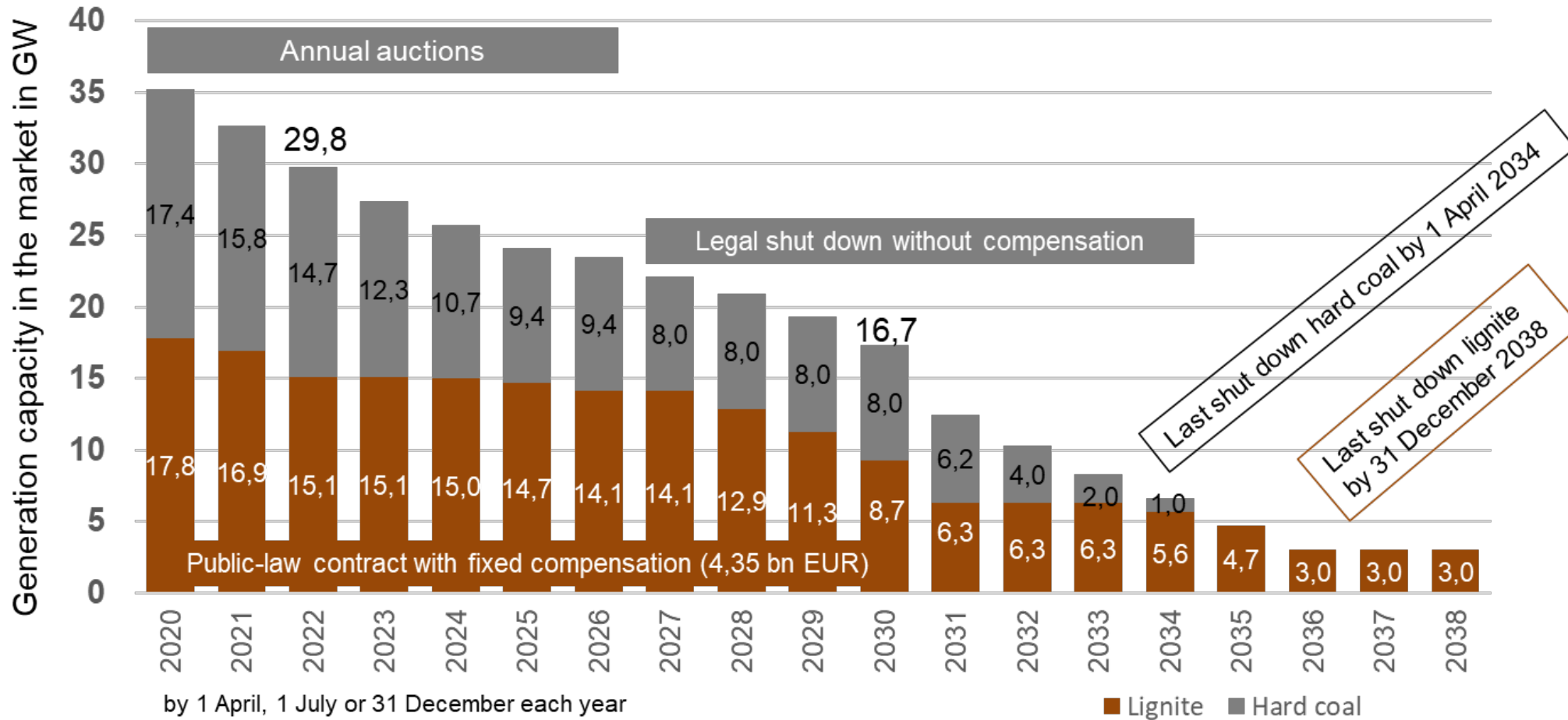
- Massive expansion by 2045
- €110 bn in investment needed in the transmission grid (€75 bn by 2030)
- €75 bn in investment in distribution grids (€30 bn by 2030).
€75 bn to connect offshore wind farms

Heat supply

- ... predominantly electric or with green gases
- Heat demand to fall by 1/3
- H₂ with ≤20% market share

Courtesy of EnBW AG

Decarbonization in Germany: Coal phase-out

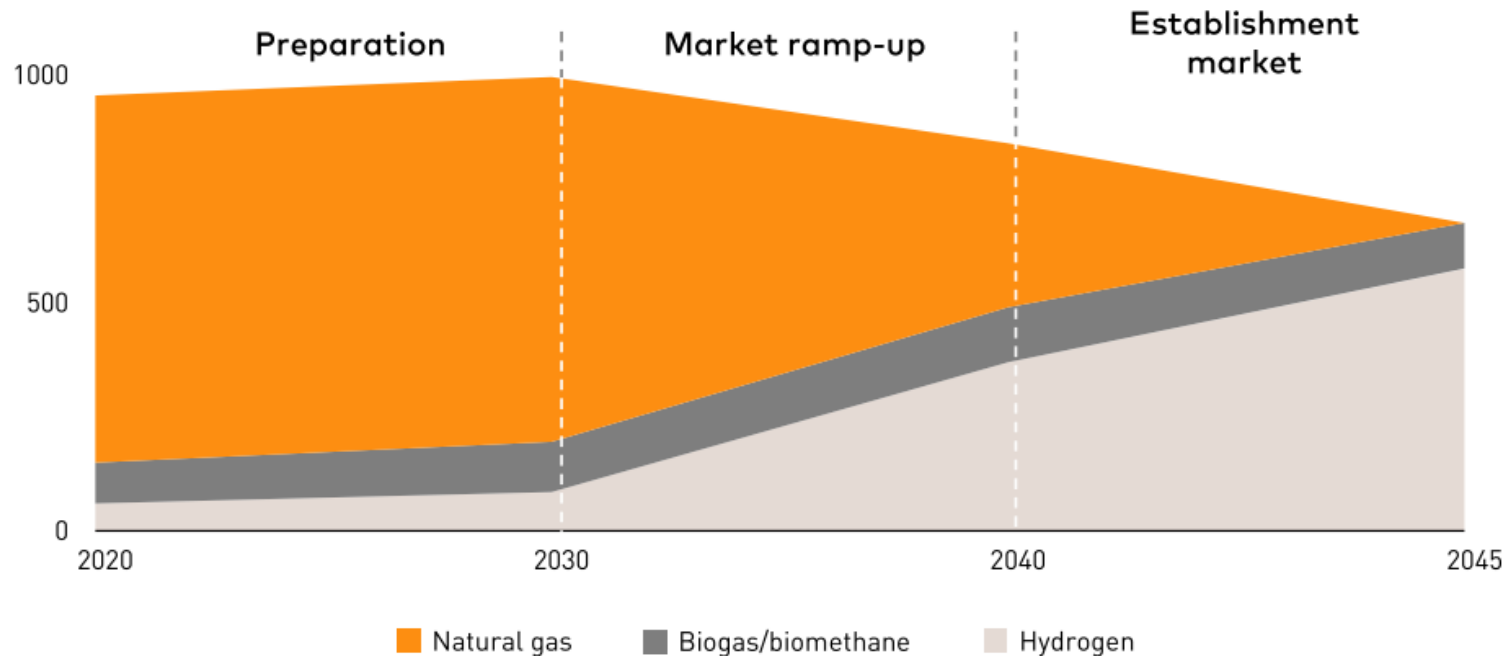


RWE's lignite phase out moved to 31.12.2030 – further political acceleration expected

Decarbonization in Germany: Natural gas gradually being replaced by carbon-neutral gases

Expected gas demand in Germany (incl. feedstock use)¹

in TWh



Explanatory notes

- EU climate neutrality requires fossil fuels to be replaced in all sectors by 2050¹
- Time to 2030 should be used for setting up the market and improving the technologies
- Three aspects are particularly important:
 - Rapid establishment of a universal hydrogen infrastructure
 - Creation of an appropriate market regulatory framework (such as certification of origin for green hydrogen)
 - Creation of incentives promoting demand for climate-neutral hydrogen

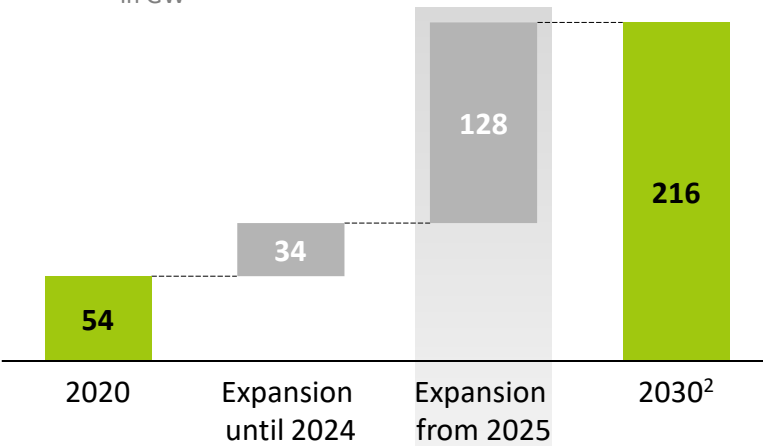
Courtesy of EnBW AG

What does it mean in reality – RES targets in Germany until 2030



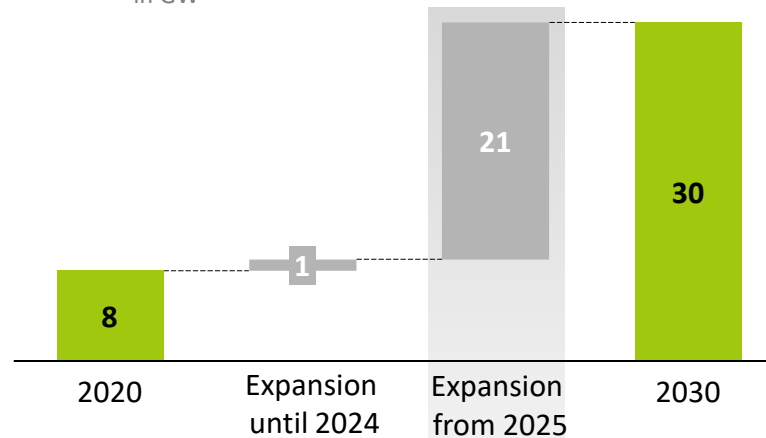
Solar PV – Installed capacity/expansion¹

in GW



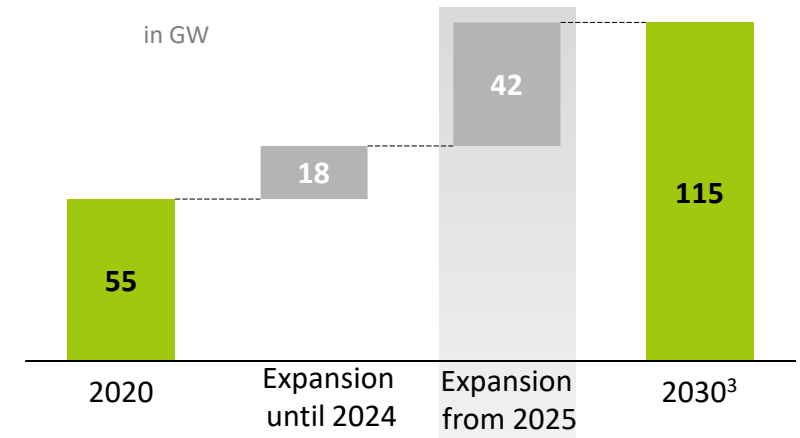
Wind Offshore – Installed capacity/expansion¹

in GW



Wind Onshore – Installed capacity/expansion¹

in GW



Required expansion each working day (from 2025)¹

90 MW PV

... approx. ½ capacity of Germany's biggest PV park/day

+

15 MW Offshore

... approx. a 900 MW wind farm every 2 month

+

30 MW Onshore

... approx. 7 turbines/day

3 Perspectives for dispatchable generation

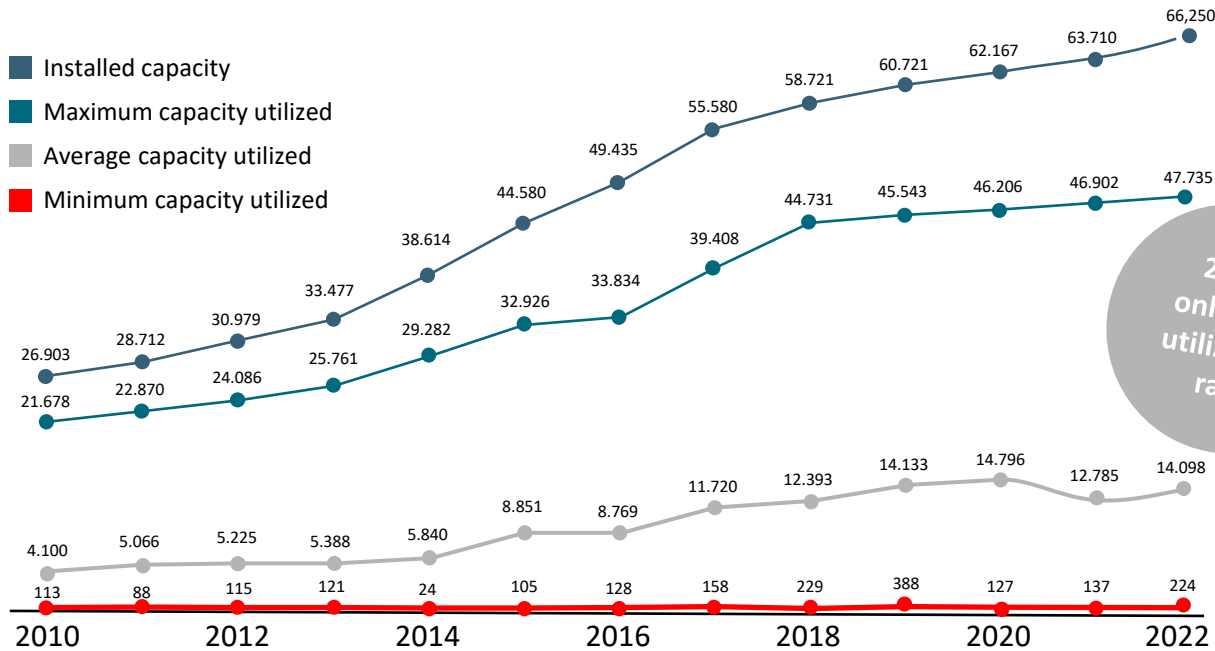


Perspective 1: dispatchable generation and flexibility options

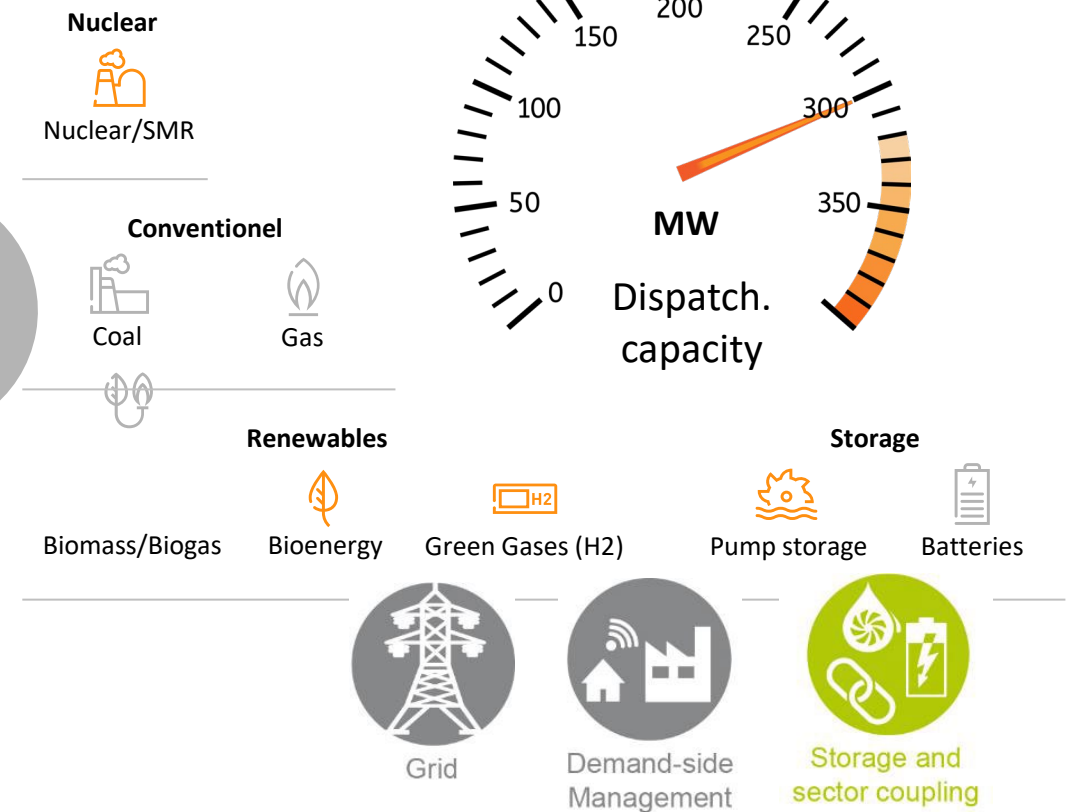
Demand grows with increasing RES in the system

Wind generation in Germany from 2010 until 2022

in MW



Options for dispatchable power generation and flexibility

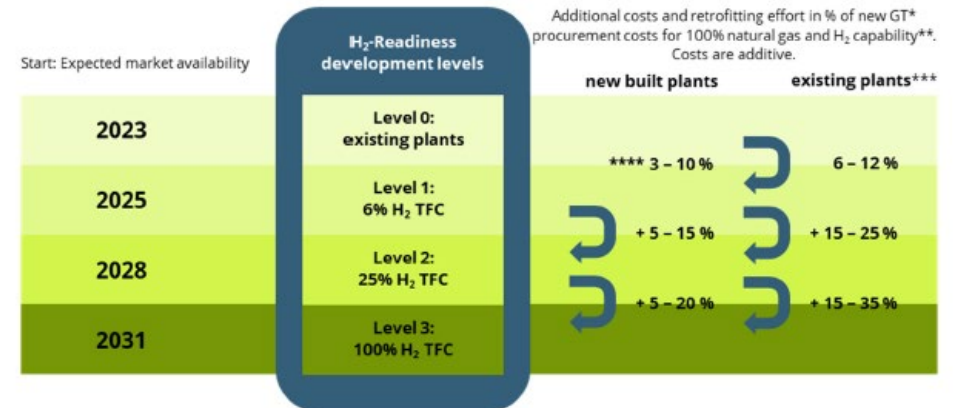
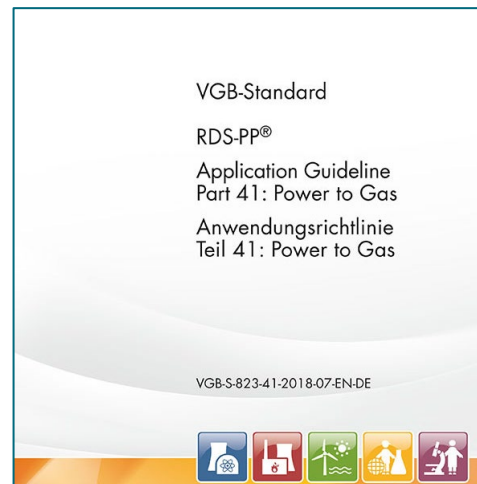


Perspective 2: Hydrogen H₂-Readiness is key for sustainable fuel-switch in the future

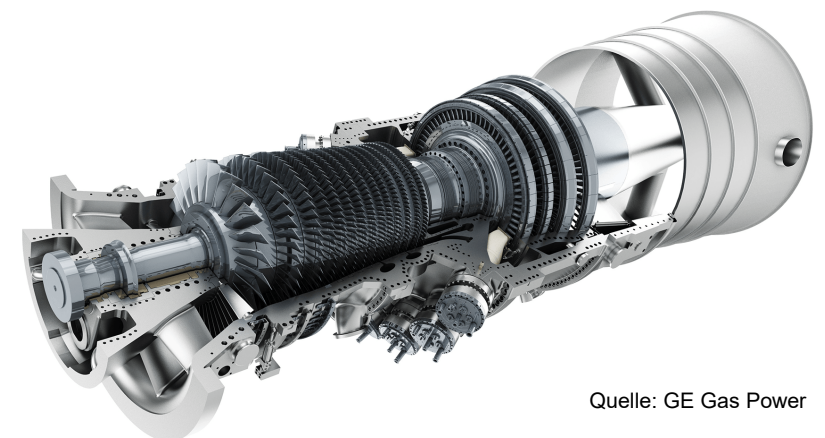
- H₂-ready means that a plant can be operated with 100 % H₂ in its lifetime.
- Use of H₂ is possible in gas turbines, engines, industry furnaces and fuel cells. At present, no economic viability is presentable.
- Burning H₂ leads to higher NO_x-emissions compared to natural gas.
- Emission limits and material standards need to be adopted in regulation on European and national levels.



vgbe position paper
H₂-ready
September 2022



* The scope of retrofitting refers to the retrofitting of all components necessary for operation, but the cost reference is the gas turbine as core component
 ** A pre-planned modular design of the ancillary systems can significantly reduce retrofitting costs for new plants (H₂ capability)
 *** In many cases, retrofitting existing systems can make much more economic sense, even if measures to extend the service life, etc. still have to be carried out on the GTP
 **** Additional costs for H₂ capability



Quelle: GE Gas Power

Perspective 3: Repurposing of Coal Plant sides

Multiple benefits in technological, commercial and social dimensions

Well developed infrastructure

External – access to:



Grid



Transport: harbour, roads and railway



Gas network



Water



District heating

Miscellanea



Highly qualified personnel



Availability of space



Existing permits



Saving decommissioning cost

Well developed infrastructure

Internal



Digitalized site



Cooling systems



Water treatment



Heating systems



Steam systems

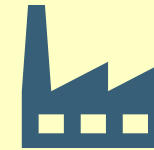
Consumption near-by



Households and offices



Business and agriculture



Industry

- (1) European energy politics aims at an energy system mainly based on VRE requiring a high level of system flexibility.
- (2) In the short- and medium term absence of large-scale, long-term storage options dispatchable generation is essential for security of supply.
- (3) Dispatchable generation will remain the largest flexibility option in the system, gradually switching from fossil fuels to carbon-neutral hydrogen and other green gases, using repurposed fossil assets.

Thank you
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