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ENERGY RESEARCH

Deutschlands Kraftwerksstrategie: Einstieg in die Wasserstoffnutzung im Stromsektor

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Branchentag Wasserstoff

Wien, 24. April 2024

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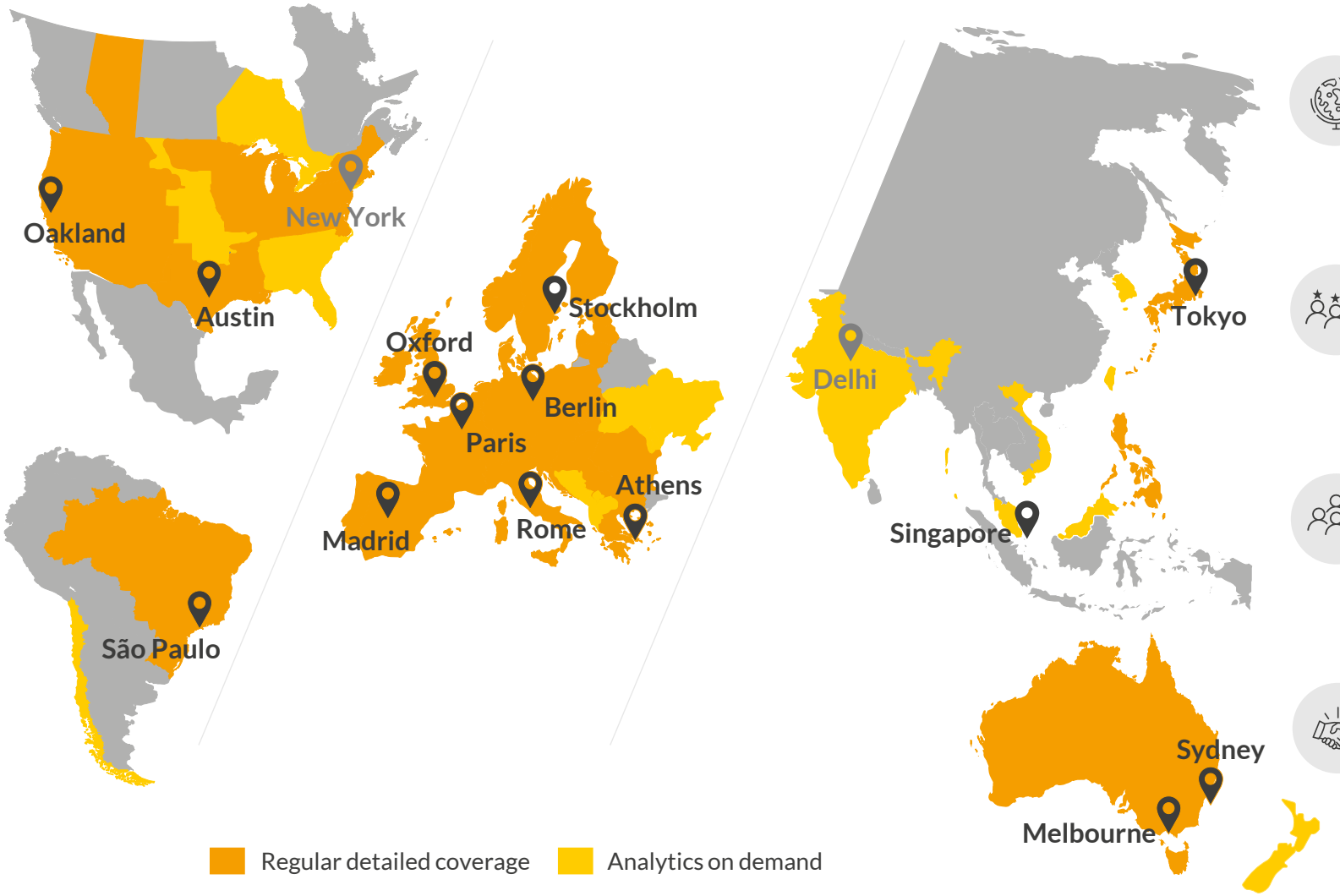

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Source: Aurora Energy Research

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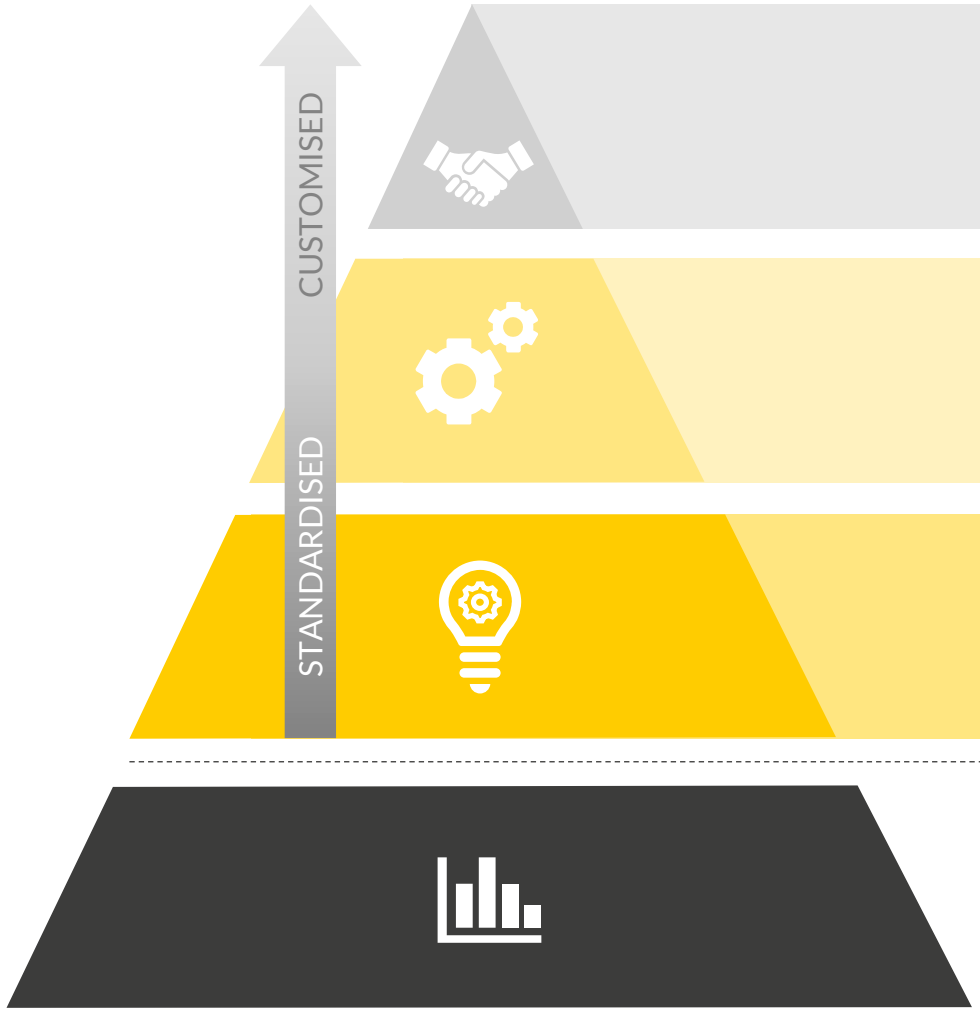

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>
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Source: Aurora Energy Research

With the impacts of the 2022 energy crisis fading, the energy policy debate is now focusing again on decarbonisation challenges

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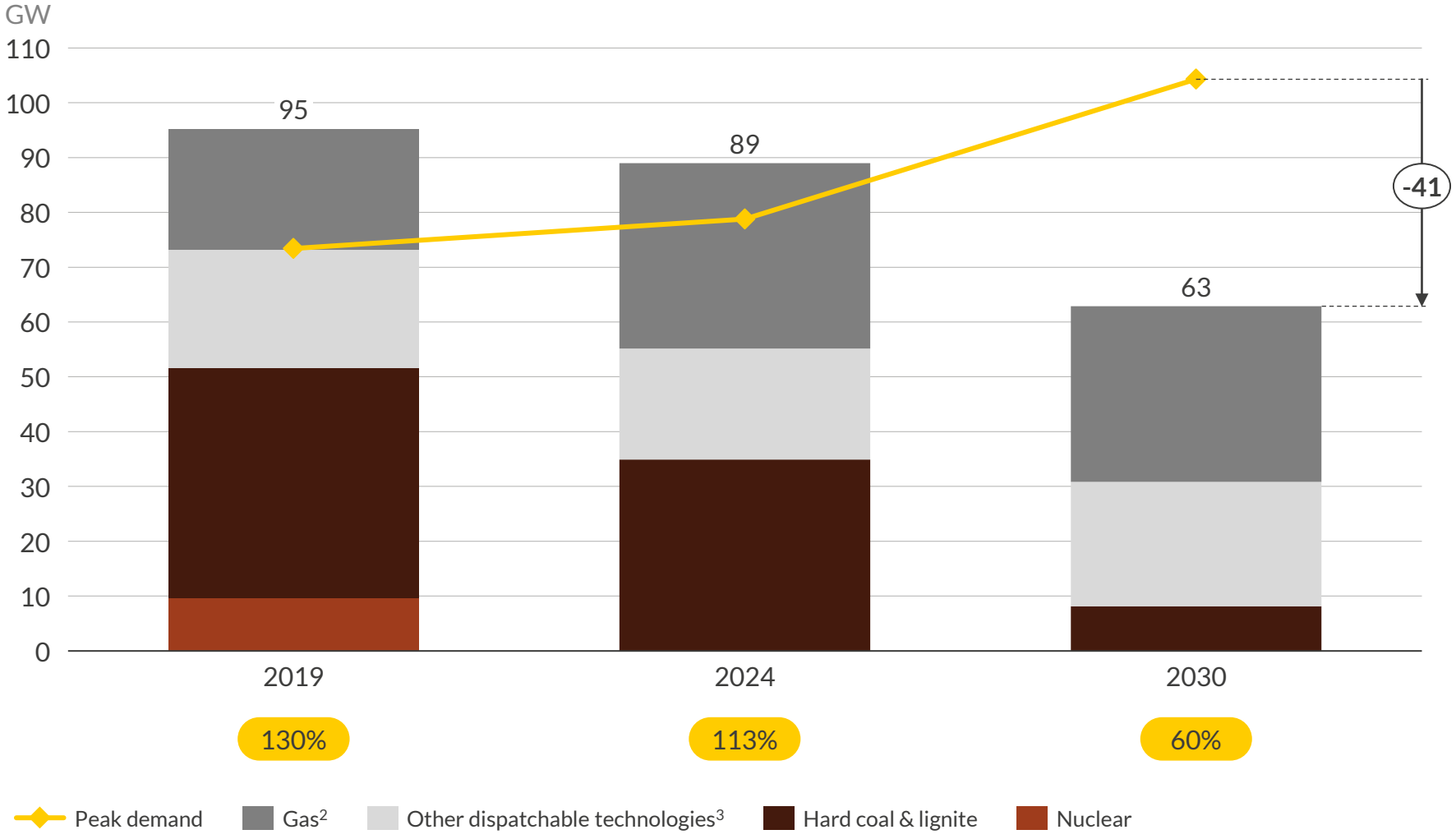
Monthly spot power and gas prices
€/MWh (nominal)

"The focus now is on initiating the conversion of our power plant fleet to hydrogen and thus setting the course for achieving climate neutrality for the entire electricity sector.

Sources: Aurora Energy Research, Federal Ministry for Economic Affairs and Climate Action

Coal plant closures and a growing power demand will create a gap between peak demand and dispatchable thermal capacity

Peak demand and dispatchable capacity without new gas-fired power plants[1]



- In the Central scenario, we project the closure of 27GW of hard coal and lignite plants by 2030 while increasing electrification of industry, transport, and heat will drive up peak demand by 26GW.
- Without an incentive for the buildout of new gas-fired power plants, this would result in a gap of 41GW between peak demand and dispatchable capacity by 2030.
- The *Bundesnetzagentur*[4] foresees a buildout of 17-21 GW gas-fired power plants by 2031 in its latest security of supply report[5].

1) Based on the Aurora Central scenario, but no further buildout of gas-fired power plants (except for CHPs) is assumed. 2) Includes CCGTs, OCGTs and other thermal peaker. 3) Includes hydro, biomass and other thermal. 4) Federal Network Agency. 5) *Bericht zu Stand und Entwicklung der Versorgungssicherheit im Bereich der Versorgung mit Elektrizität, Januar 2023.*

Sources: Aurora Energy Research, BNetzA

Germany's energy policy narrows down options for new-built dispatchable capacity to gas plants, and their low-carbon alternatives

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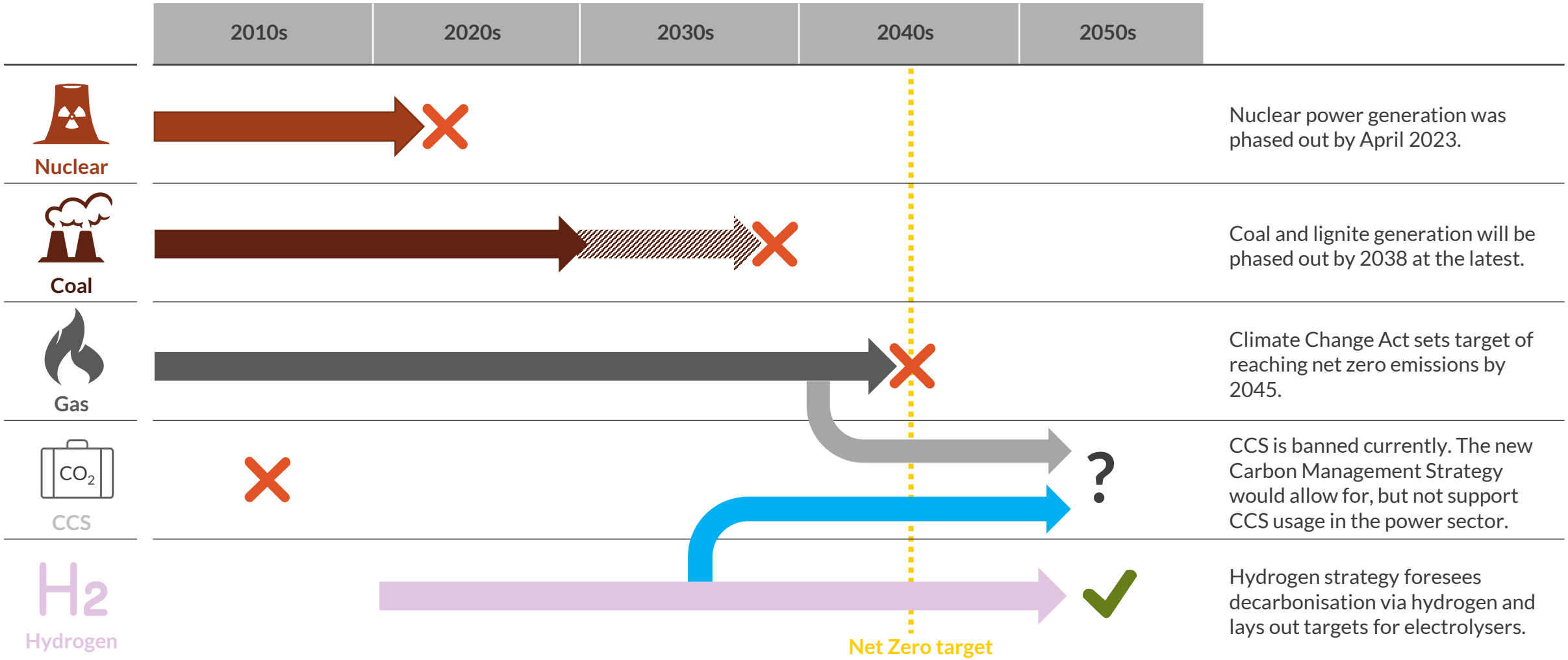
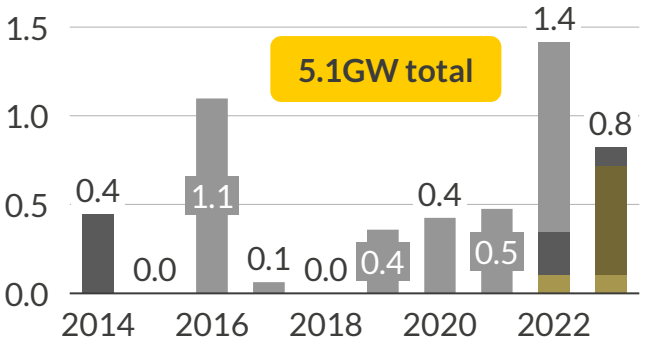


Source: Aurora Energy Research

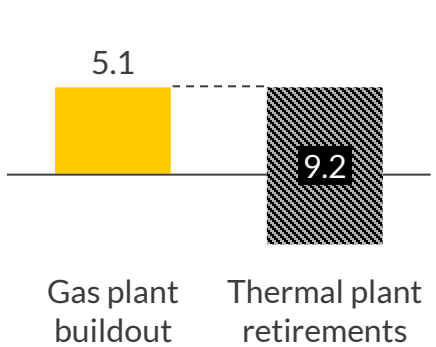
Due to uncertainty about the existing market design, utilities and investors are hesitant to build new gas-fired power plants

In the past decade, the buildout of gas-fired power plants has lagged behind the decommissioning of thermal[1] power plants.

Historical gas-fired power plant new-builds[2]



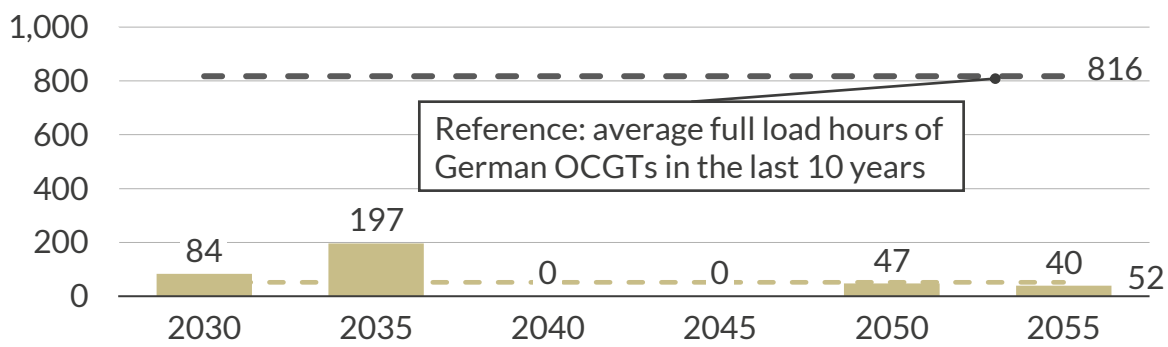
Capacity balance (2014-2023)



- Over the last 10 years, more than 9GW of large[2] thermal power plants left the German power system.
- Over the same time span, 5.1GW of large gas-fired power plants were commissioned, creating a net reduction of 4.1GW in thermal capacity.
- 72% of the newly built gas-fired power plants are subsidised CHP[3] plants which receive a feed-in premium, meaning that the purely market-driven buildout of gas-fired power amounts to only 1.4GW.

Market actors do not believe in recurring and longer high price periods that are needed for a gas-fired power plant to be viable in the energy-only market.

Full load hours of an OCGT plant with fuel conversion to H_2, Aurora Central[4]



- Due to the increase in renewable generation, full load hours of gas-fired power plants will fall significantly even before the switch to hydrogen[5].
- This means that new gas power plants can only be profitable in the energy-only market if system scarcity leads to high peak prices.
- However, political actions and signals have undermined confidence in peak prices and the persistence of the energy-only market altogether:
  - In response to the energy crisis in 2022, the government intervened in the market and skimmed off surplus revenues[6].
  - The traffic light coalition has mentioned a capacity mechanism already in its coalition agreement in 2021.

CCGT CHP[3] | CCGT | OCGT | Recips CHP[3] | Full load hours | Average full load hours 2030-2060

1) Including nuclear, coal, lignite and gas-fired power plants. 2) Power plants with capacity >50MW considered. 3) Combined Heat and Power. 4) Switch from natural gas to hydrogen use in 2038. 5) The trend shown for OCGTs can be observed for CCGTs as well, although the number of full load hours is higher. 6) *Überschusserlösabschöpfung*

Sources: Aurora Energy Research, BNetzA

Germany's *Kraftwerksstrategie* is set to deploy 10GW of H_2-ready power plants as a bridge to a potential capacity mechanism in 2028

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Up to **10GW of new H_2-ready gas plants** form the core of the power plant strategy

Announcement of a **capacity mechanism**

New H_2-ready natural gas power plants

- 4 auction rounds of 2.5GW each for CAPEX subsidies
- Full conversion to hydrogen[1] required between 2035 and 2040[2]
- OPEX subsidy to cover the fuel price difference to natural gas[3]
- Funding needs of 15–20bn €, to be financed out of the KTF[4]

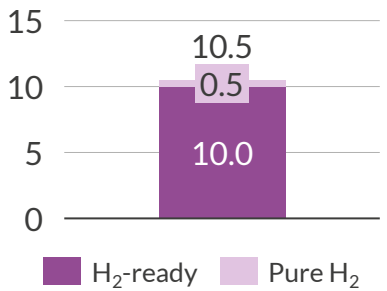
H_2 power plants

- 500MW of pure H_2 plants for research and exploratory purposes

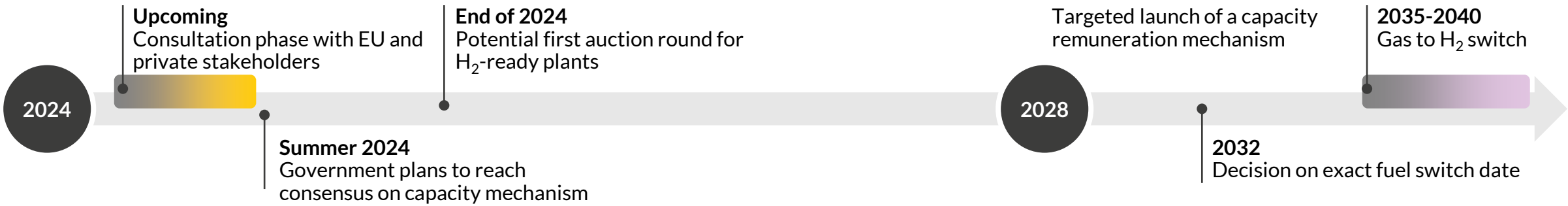
Auction for long duration energy storage (LDES) technologies

- Technology-neutral tender for LDES technologies, details still under consideration

New capacity announced



- The government has committed to developing concepts for a **market-based capacity mechanism** to be **launched by 2028.**
- Focus for this mechanism is on **technology neutrality**, i.e., allowing different generation technologies, storage, and demand-side response options to participate.
- The new gas-fired power plants incentivised via the **power plant strategy** are meant to be **"fully integrated" into the capacity mechanism.**



Introduction of both power plant strategy and capacity mechanism hinge upon **approval under EU state aid law.**

1) Not restricted to electrolytic (green) hydrogen, blue hydrogen can also be used as a fuel. 2) Exact conversion date to be defined in 2032. 3) Available until 2040 for max. 800 full load hours per year. 4) *Klima- und Transformationsfonds* (Climate and Transformation Fund).

Source: Aurora Energy Research

The *Kraftwerksstrategie* promotes the offtake of hydrogen for power generation, but relies on advancements in supply and infrastructure

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	H_2 generation and supply	H_2 infrastructure and storage	H_2 offtake and power generation
Challenges	▪ Before a liquid market forms, long-term offtake agreements are crucial for securing financing in H_2 production projects. ▪ Subsidising the production of H_2 can bring prices down, but offtake might still not be secure.	▪ Confidence in infrastructure buildout is crucial for the ramp-up of the hydrogen market. ▪ High investment costs meet (initially) low utilisation of infrastructure, which makes financing difficult.	▪ Plant operators are dependent on future H_2 production and transport infrastructure and face price insecurity. ▪ Due to high H_2 prices and retrofitting costs, the use of H_2 in the power sector requires support.
Existing policies	▪ EU target to produce 10mn tonnes and import 10mn tonnes by 2030 ▪ 800mn € auction volume for local H_2 production	▪ The European Hydrogen Backbone initiative foresees the development of a ~40,000 km hydrogen pipeline network by 2040.	▪ Currently, over 85% of offtake projects account for the industry and mobility sector and only 7% for the power sector in Europe[2].
	▪ 10GW electrolyser target by 2030 ▪ 900mn € auction volume for imported H_2 and H_2 derivates	▪ 9,700 km core hydrogen grid *(Kernnetz)* target by 2037.	▪ Recent announcement of a €4bn CCfD[2] bidding round to support decarbonisation of energy-intensive industries.
	▪ France: 6.5GW electrolyser target by 2030 ▪ UK: 10GW of hydrogen production by 2030 ▪ Spain: 11GW electrolyser target by 2030	▪ Netherlands: plan to finalise the national H_2 grid by 2030	▪ Netherlands: plans for a subsidy programme for the decarbonisation of gas-fired power plants
KWS[1]	▪ KWS relies on the downstream links of the value chain but with H_2 uptake only starting between 2035 and 2040, only sends a weak demand signal to H_2 producers and infrastructure developers		▪ Promotes the offtake of hydrogen for power generation by subsidising fuel costs.

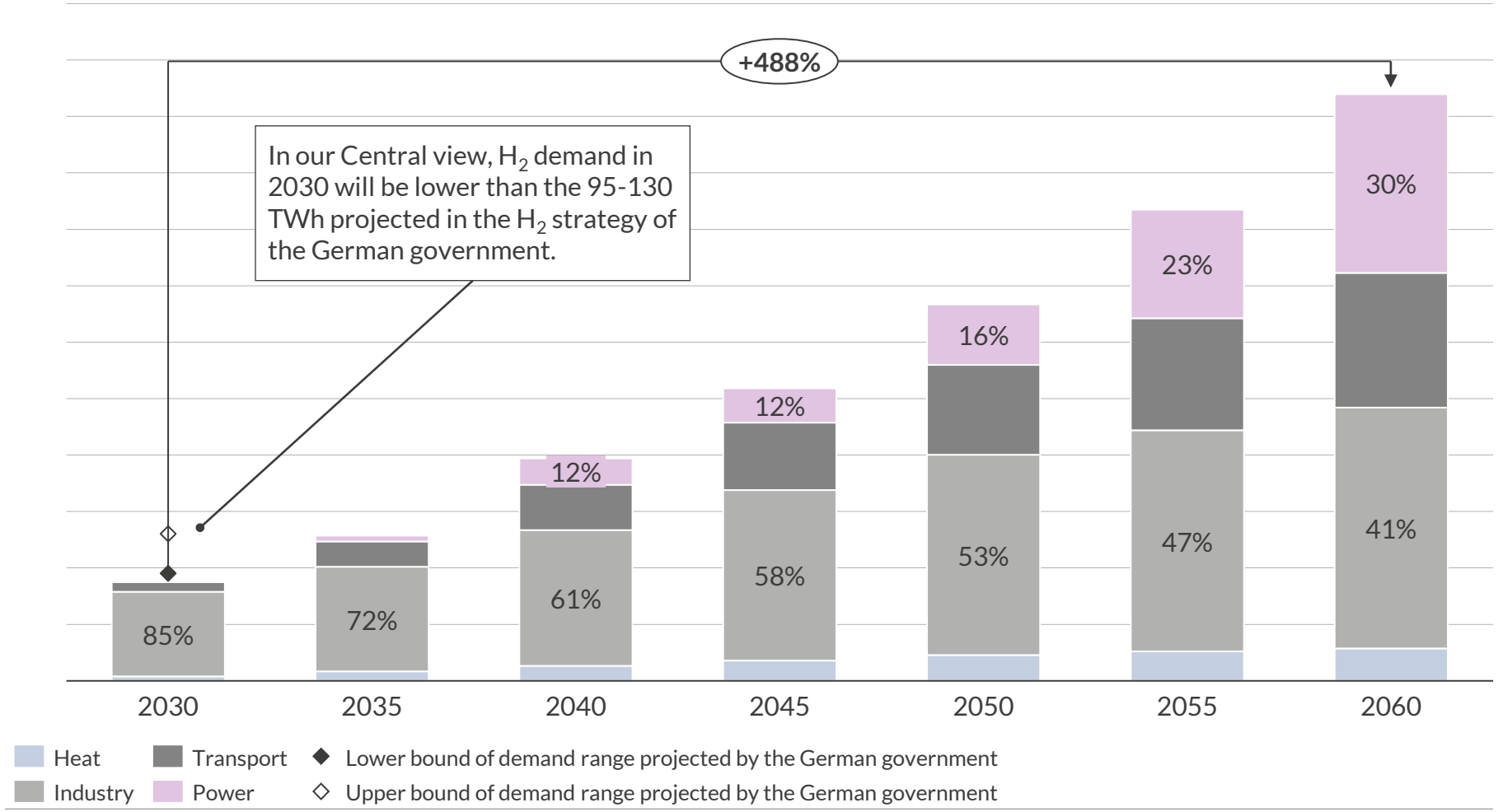
Role of the KWS for the hydrogen economy

1) Power Plant Strategy (*Kraftwerksstrategie*). 2) Carbon Contract for Difference.

Source: Aurora Energy Research

Industry will continue to be the most important H_2 consumer, power and transport sectors will be relevant offtakers from the mid-2030s

Hydrogen demand by sector in Germany
TWh, final energy consumption



1) Direct Reduced Iron. 2) Road transport will primarily use direct hydrogen while maritime and aviation may opt for ammonia and synthetic fuels.

Source: Aurora Energy Research

- Germany's hydrogen demand will more than double between 2030 and 2040 with industry and transport sectors leading the charge.
- Hydrogen is expected to play a key role in new industrial applications and processes, like industrial process heat and a feedstock in steel production[1].
- Transport hydrogen demand focuses on heavy-duty vehicles, aviation, and maritime.[2]
- The role of hydrogen in the power sector is anticipated to begin in the 2030s, with a sudden demand increase once H_2-ready gas power plants switch to H_2.

The German hydrogen core grid is planned to span across all regions, but completion in the South will not take place until after 2030

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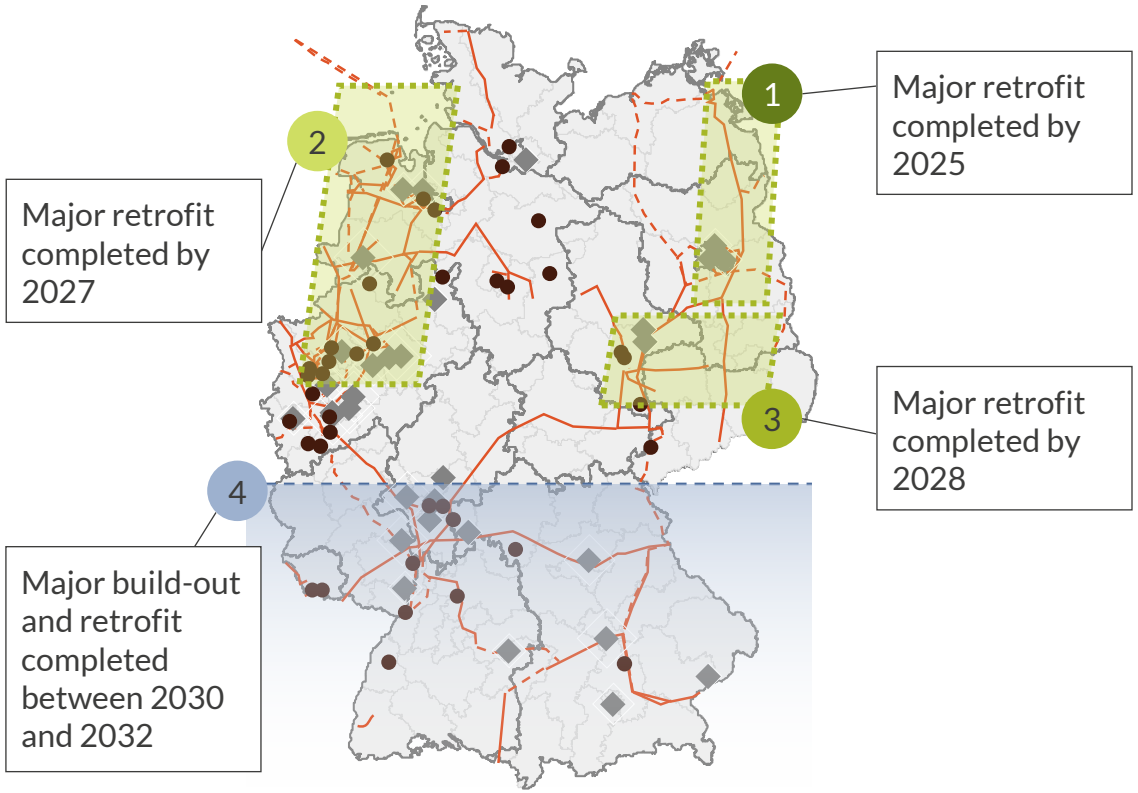
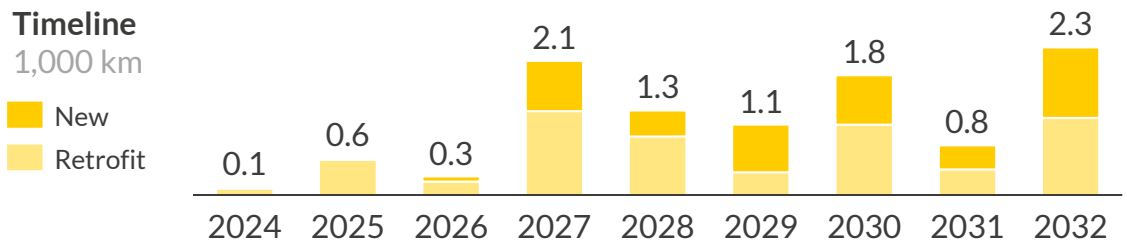
Hydrogen core grid plan



Overview of the planned development of the hydrogen core grid

	Retrofit	New	Total
Total length km	5,630 (58%)	4,091 (42%)	9,721

Timeline
1,000 km



Relevance for the power plants to be built under the KWS

- The planned **completion of the pipeline network by 2032 would be early enough** to ensure the H_2 supply to power plants between 2035 and 2040.
- **In case of delays**, the **supply of hydrogen to power plants in the South could be at risk**, as the Southern grid sections are to be completed last.
- Many of the existing gas and coal-fired power plants are located close to the planned pipeline network, making their **locations well suited for the construction of the new H_2-ready power plants**.

⚠ On **Friday 5 April**, the governing coalition announced an **agreement on the financing mechanism of the hydrogen core network**, according to which the **targeted finalisation of the grid is backdated to 2037**. This would **increase the supply risk** in case of delays in the planned buildout timeline.

Sources: Aurora Energy Research, BNetzA, FNB

Key takeaways

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1 Due to the coal exit and rising power demand, ~20GW of new dispatchable capacity is required by the early 2030s in the German power market. Most capacity will be provided by (H_2-ready) gas plants. However, lacking price signals and policy interventions have led to investor attentism.

2 For the first time, the Power Plant Strategy (KWS) will provide support for the usage of H_2 in the German power sector. Aiming at incentivising up to 10GW of new H_2-ready gas plants, the KWS foresees both investment and fuel subsidies for power plants converting to H_2 until 2040.

3 The KWS sends an important signal for the ramp-up of the H_2 economy, addressing the demand side. Besides ambitious implementation, its effectiveness will strongly depend on the interplay with other policies along the H_2 value chain, incl. subsidies for industry offtake and the H_2 core grid.

- ***We are currently conducting a study on the KWS. Reach out to nicolas.leicht@auroraer.com for more details.***

Source: Aurora Energy Research

Details and disclaimer

Deutschlands Kraftwerksstrategie: Einstieg in die Wasserstoffnutzung im Stromsektor

Branchentag Wasserstoff
Wien, 24. April 2024

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