

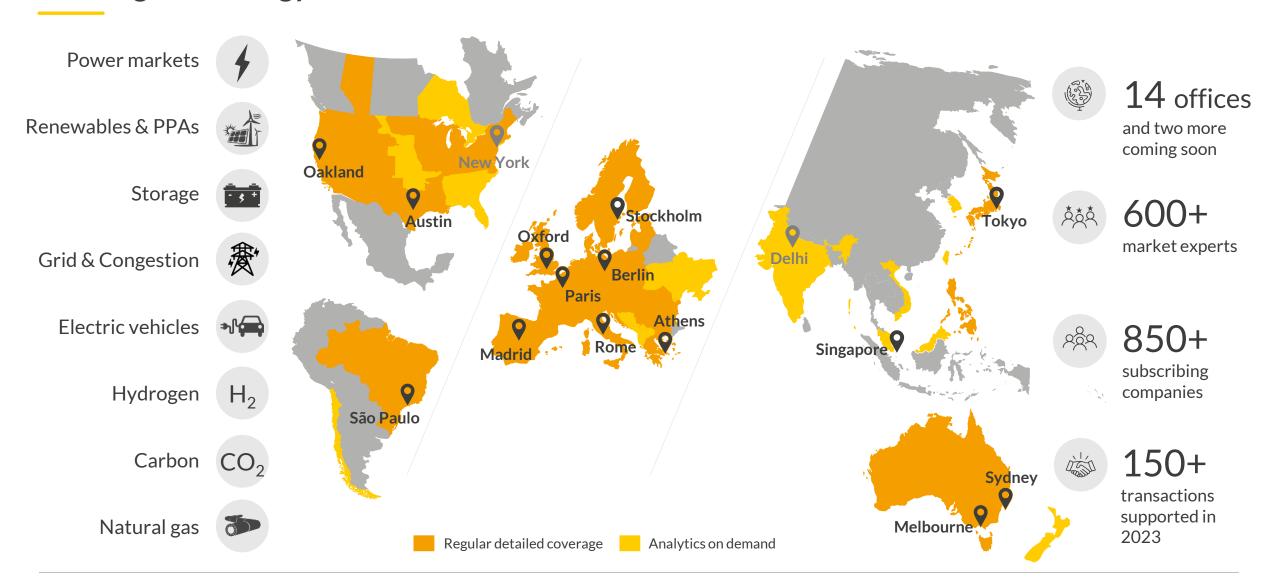
# The Czech Power and Renewables Market: Long-Term Outlook

**REDACTED VERSION** 



# Aurora provides market leading forecasts & data-driven intelligence for the global energy transition

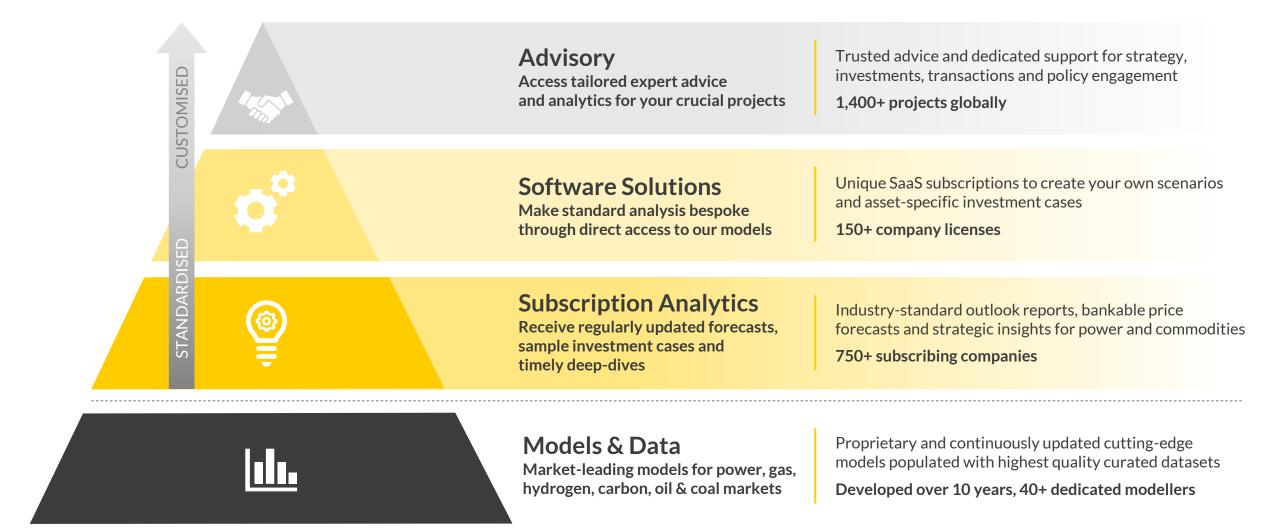




Source: Aurora Energy Research

# Our market leading models underpin a comprehensive range of seamlessly integrated services to best suit your needs





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# We work with a very broad range of clients ... their constant challenge keeps us up on our toes and ensures our independence

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"With its capabilities, intellect and with its credibility Aurora plays an essential role bringing the dialogue [in the global energy transition] to a different plane"

Ben van Beurden, CEO, Shell



"Aurora analysis and the provision of reliance was crucial for our debt funding. Their ability to explain market logics and revenue streams was vital for this successful financing."

Jeremy Taylor, Director, Green Frog Power







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# Our April 2024 forecast contains the following key updates and takeaways



# Key assumption updates and takeaways

Update of Czech fuel and carbon price projections in the short term (deltas relative to February 2024 2<sup>nd</sup> Mutli-Client Study Workshop)

**Demand forecast revision** 

Assumption updates

akeaways

Solar load factor revision

**RES+** subsidy revision

Prices fall in the short term influenced by commodities

Rapid lignite exit

Fast buildout of renewables

### **Description**

	Gas Price	Coal Price	Carbon Price
Short Term (2024-27)	- %	- %	- %
Long Term (2028-2060)	- %	+ %	- %

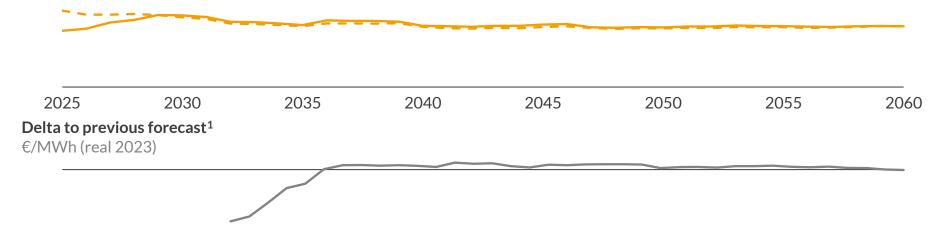
- We have taken a more bullish view on long-term energy intensity reductions, leading to TWh less base demand by 2060. This is partly compensated by TWh additional demand due to a larger role for heat pumps in district heating.
- We have developed specific load profiles for the Czech market based on Solaris, Aurora's tool for irradiation analysis.
   We assume a load factor for bifacial utility-scale solar installations.
- We have revised our assumption for the budget available under the RES+ scheme, based on the reduction in its share of the total Czech Modernisation Fund budget. We have also revised our assumptions about the subsidy intensity of investments under the scheme and the technologies which access funding.
- A mild winter and slowdown in European industrial output have led to dramatic drops to gas and carbon prices. This results in baseload prices falling €/MWh on average between 2024 and 2029, with prices for 2024 down €/MWh.
- Most lignite capacity retires by 2027 as EU ETS price levels make them economically unviable and no support scheme
  exists to facilitate their continue operation. Replacement dispatchable capacity comes mostly in the form of batteries,
  demand side response and gas CHPs.
- Subsidy support for utility-scale and rooftop solar causes installed capacity to reach attractive economics, restrictive permitting limits onshore wind capacity to GW in 2035.

Sources: Aurora Energy Research

# Baseload price peaks at €/MWh in 2029, then gradually decreases, stabilising around €/MWh between 2040 and 2060

Baseload wholesale electricity price

€/MWh (real 2023)



- Compared to our previous forecast, the baseload price is short-term futures-driven decrease in commodity prices. €/MWh lower on average from 2024–2029, mostly due to the
- From 2030 onwards, the current forecast lies €/MWh on average above our previous forecast as slower onshore wind buildout, based on onshore wind pipeline and permitting limitations in the Czech market.

— Historical baseload — Baseload — Previous baseload — Delta

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#### Outlook for baseload prices

2024-2035

■ Baseload price rises to a relative peak of €/MWh in 2029, as retiring lignite capacity tightens the system. Prices then rebalance around €/MWh in the early 2030s.as CCGT and RES buildout combats rising commodity prices.

2036-2050

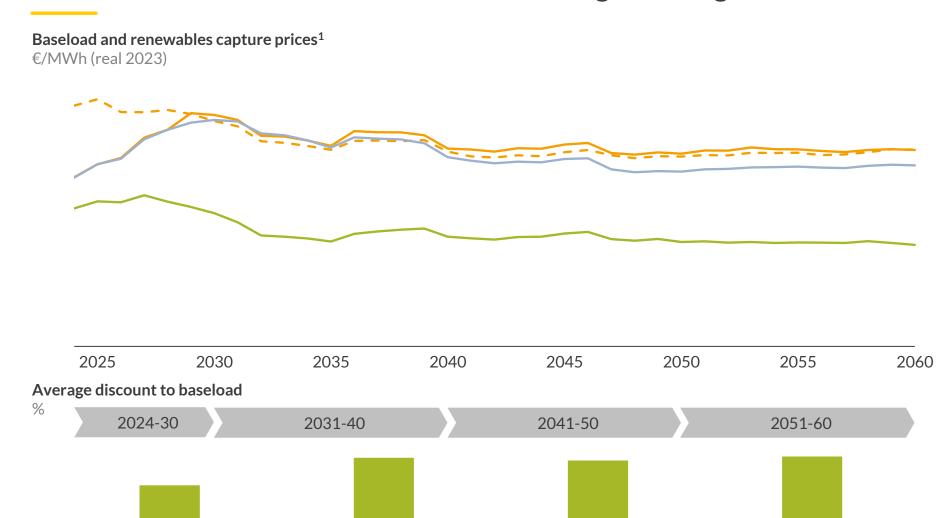
- After 2035, the switching of gasfired capacities to hydrogen in Germany causes a jump in Czech baseload price.
- Nuclear capacity expansions at Dukovany and Slovak Bohunice in the 2040s drive Czech baseload price to fall and stabilise.

2051-2060

 Until 2060, baseload price averages €/MWh as slowing demand growth is matched by unsubsidised solar PV buildout.

<sup>1)</sup> Refers to Aurora's preliminary market outlook for Czechia, presented during the 2nd workshop of the Czech and Slovak Multi-Client Study in Prague on 14 February 2024.

# Solar profile costs rise dramatically over the next decade, driven by subsidised solar buildout in Czechia and neighbouring markets



#### **Onshore Wind**

- Onshore wind capture prices are largely aligned with baseload prices, benefitting from high power prices in winter when most onshore wind generation occurs.
- Across the forecast, onshore wind buildout is restricted by Czech permitting procedures and geotechnical potential<sup>3</sup>, causing capture prices to be elevated.

#### Solar

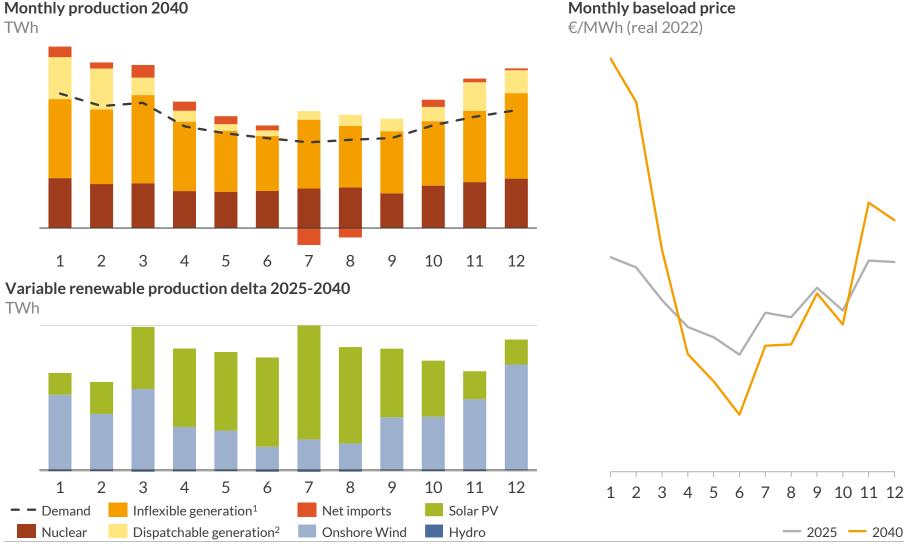
- Solar capture prices peak in 2027 at €/MWh, decrease to €/MWh in 2035, driven by subsidised solar buildout, then increase to 2040 as exhausted subsidies stall buildout.
- After 2040, solar capture prices stabilise around €/MWh as merchant investments replace retiring capacity. Capture price variation in the 2040s highlights the impact of new commissioned nuclear capacity at Dukovany.

Baseload - Previous baseload<sup>2</sup> - Onshore wind - Solar

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<sup>1)</sup> Uncurtailed generation-weighted capture prices. 2) Refers to Aurora's preliminary market outlook for Czechia, presented during the 2nd workshop of the Czech and Slovak Multi-Client Study in Prague on 14 February 2024. 3) A maximum geotechnical onshore wind potential of 11GW, based on the results of the Academy of Sciences study and enhanced by anticipated technological development after 2040 and the public view of wind energy.

# Nuclear, high solar generation and lower seasonal demand drive an increasingly large discount between summer and winter prices



- Inflexible generation in Czechia remains strong across the seasons, with renewable generation peaking in the summer months when solar PV potential is at a maximum, and forced CHP operation peaking in the winter months when heat demand is highest.
- Baseload prices in June 2040 are just % of the 2025 value, with renewables and nuclear together exceeding the total monthly demand.
- Dispatchable generation and imports ensure that high demand is met in winter, when solar PV generation is minimal.
- Onshore wind offers an additional contribution to production in cooler months, but its weather-dependent nature means that dispatchable capacity is necessary to meet demand.

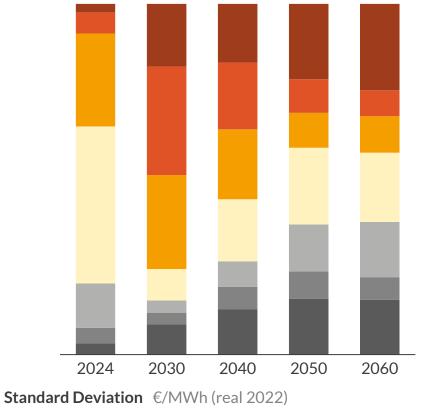
1) Inflexible generation includes renewables and forced CHP generation. 2) Dispatchable generation includes generation from lignite, hard coal, gas CCGT, oil/gas peaker, hydrogen CCGT, hydrogen peaker, biomass, battery storage, DSR and pumped storage.

Sources: Aurora Energy Research

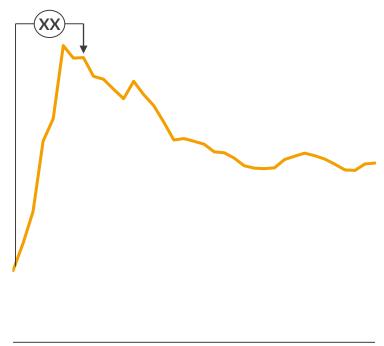
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# Price volatility rises strongly by 2030 as lignite is retired and solar built, before falling once additional flexibility enters the market

# Frequency distribution of the electricity price (real 2023)



Average daily 1h spread in Day-Ahead market €/MWh (real 2023)



2024 2030 2035 2040 2045 2050 2055 2060

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- The retirement of lignite capacities results in capacity tightness by 2030. Alongside recovering commodity prices, this leads to increased occurrence of high price hours.
- Concurrently, the fast buildout of solar causes % of hours to be prices below €/MWh by 2040.
- Together, these factors lead to 1-hours spreads above
   €/MWh from 2027 onwards, creating an attractive case for battery investments.
- In the long term, the slowdown in solar investment and the uptake of new dispatchable capacities (inc. batteries), flexible demand and nuclear reduce keep below €/MWh.

VY VY VY VY VY

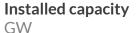
<20€ 20-40€ 40-60€ 60-80€ 80-100€ 100-120€ >120€

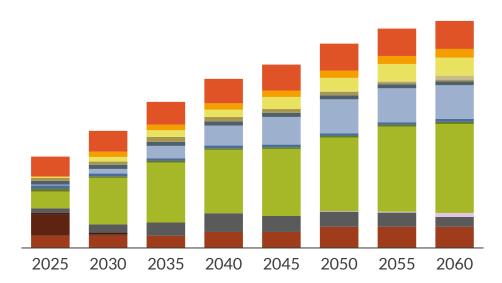
Source: Aurora Energy Research

# attractive subsidies, allowing renewables to cover \(\bigcup\_{\circ}\)% of generation

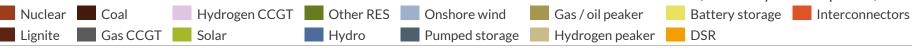
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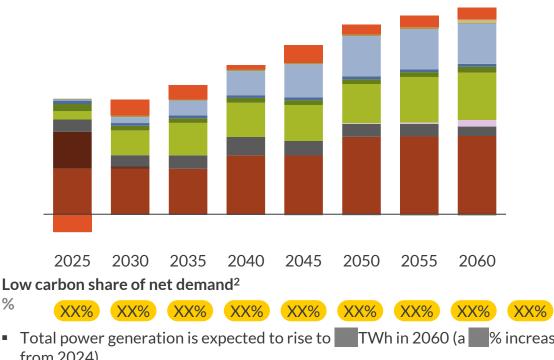




- Installed capacity increases by
   GW until 2060, mainly driven by renewables, whose total capacity reaches GW. Fast short-term solar buildout is driven by available investment subsidies.
- Lignite capacity falls from GW in 2024 to GW in 2030, as units become uneconomic. New investments come mostly in the form of gas CHPs, peaking units and batteries, with dispatchable capacity<sup>1</sup> reaching GW by 2060.
- Nuclear capacity rises to
   GW with new units at Dukovany and Temelín.



**Electricity production and net imports** TWh



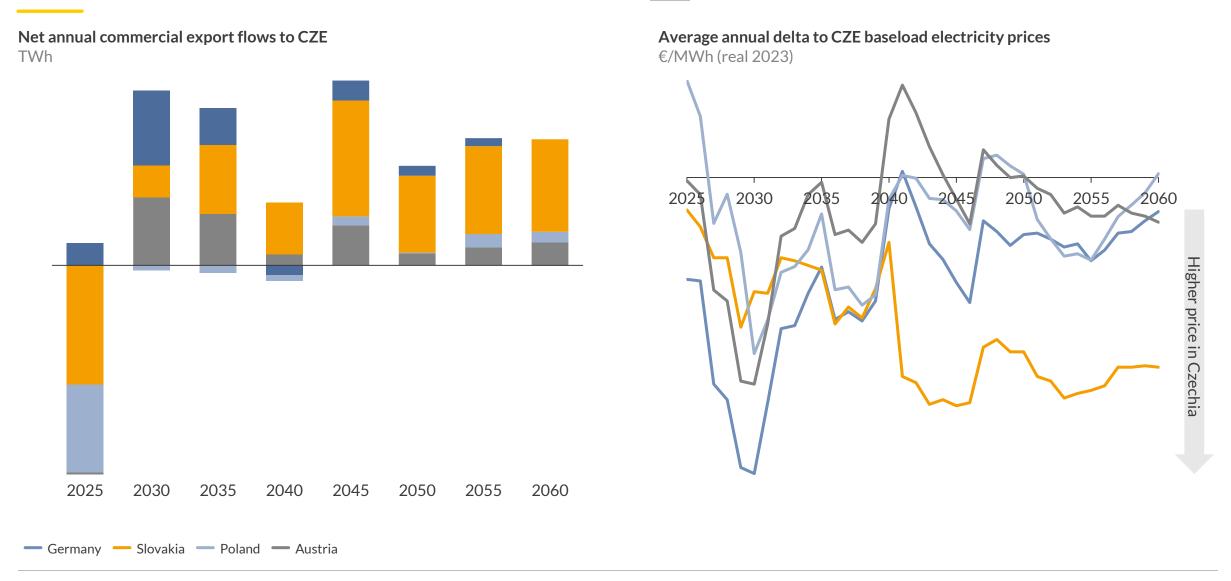
- Total power generation is expected to rise to
   TWh in 2060 (a % increase from 2024).
- Renewable generation increases by
   TWh in the period to 2060, rising from a % share of power demand in 2024 to a % share in 2060.
- Czechia, currently a net exporter, becomes a net importer in the late 2020s.

1) Dispatchable capacity includes lignite, hard coal, gas CCGT, oil/gas peaker, hydrogen CCGT, hydrogen peaker, biomass, battery storage, DSR and pumped storage capacity, 2) Low carbon generation includes nuclear and renewables,

Sources: Aurora Energy Research

# Lignite closure and insufficient new investments push Czech prices above neighbouring markets by 2030, leading to TWh of imports





Sources: Aurora Energy Research, ENTSO-E.

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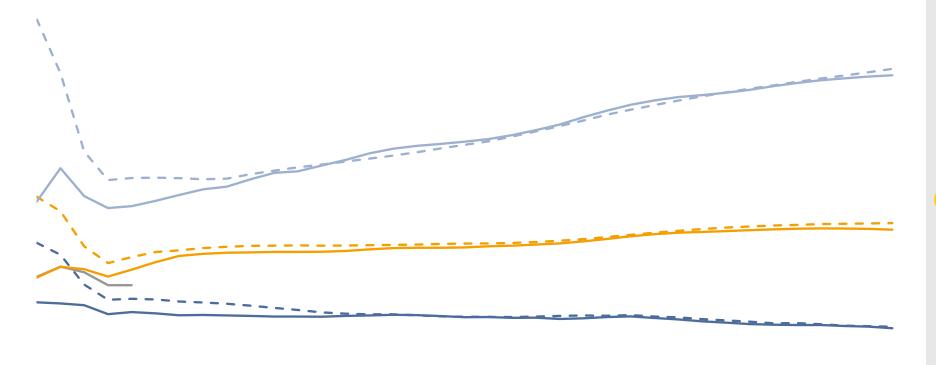
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# Gas prices in Europe stabilise by 2027, as more LNG is available in the global markets, then climb driven by ramping demand in Asia

### Natural gas prices

€/MWh (real 2023)1





<sup>1)</sup> For years 2024-2028, the prices shown take into account current futures prices for the years in question, with declining weights. In 2024, forecast prices include historical prices up to Feb-24. 2) Futures on trading days between 26/02/2024 and 08/03/2024. For gas, THE historical and futures prices are shown.

Sources: Aurora Energy Research, EEX, CME

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#### 2024-2027

- The gas price averages €/MWh in 2024-2027, lower than the previous forecast due to mild weather, robust supply, and high stocks.
- After 2025, prices fall as additional LNG import capacity in Europe comes online and global export capacity expands.

#### 2028-2060

- The gas price averages
   €/MWh in 2028-2060,
   lower than the previous
   forecast.
- Prices rise by 2030 amid consistent global demand growth with limited new LNG capacity additions post-2027.
   After 2030, rising gas demand in Asia increases the cost of marginal supply, partially mitigated by renewables and electrification deployment in Europe.

# European gas futures for 2024 delivery fell % since our January report, however our expectation of 2030 delivery is down just %

European (TTF) gas price<sup>1</sup>

Europe's industrial gas

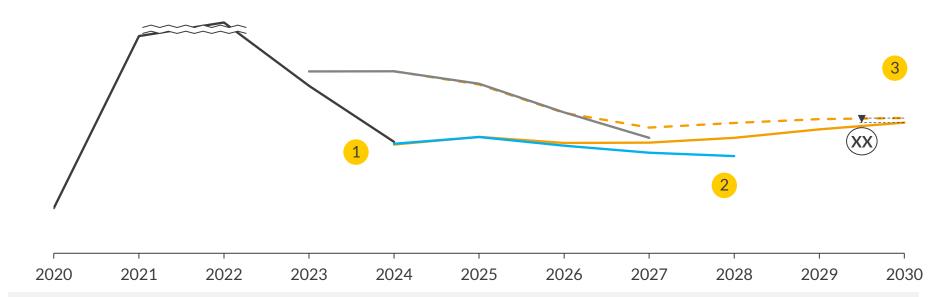
recovery from a year

earlier.

demand over winter was

particularly low, resisting

€/MWh (real 2023)



Why did 2024 futures drop by since our January report?

Q4 2023

Northeast Asian LNG imports remained unusually weak, freeing up supply and lower shipping costs.

Persistent mild weather limited residential gas demand and kept storage withdrawals low.

O1 2024

Underground gas inventories ended winter at high levels, cutting import demand and depressing prices.

— Historical — Apr 24 Central<sup>1</sup> — Jan 24 Central<sup>1</sup> — Apr 24 Futures<sup>2</sup> — Jan 24 Futures<sup>3</sup>

1) For years 2024-2028, the prices shown take into account current futures prices for the years in question, with declining weights. 2) Futures on trading days between 26/02/2024 and 08/03/2024. 3) Futures on trading days between 17/11/2023 and 30/11/2023. 4) Futures on trading days between 21/08/2023 and 01/09/2023.

Sources: Aurora Energy Research, EEX, Carbon Pulse, Bloomberg, Petroleum Economist, Financial Times, Business Green, European Commission

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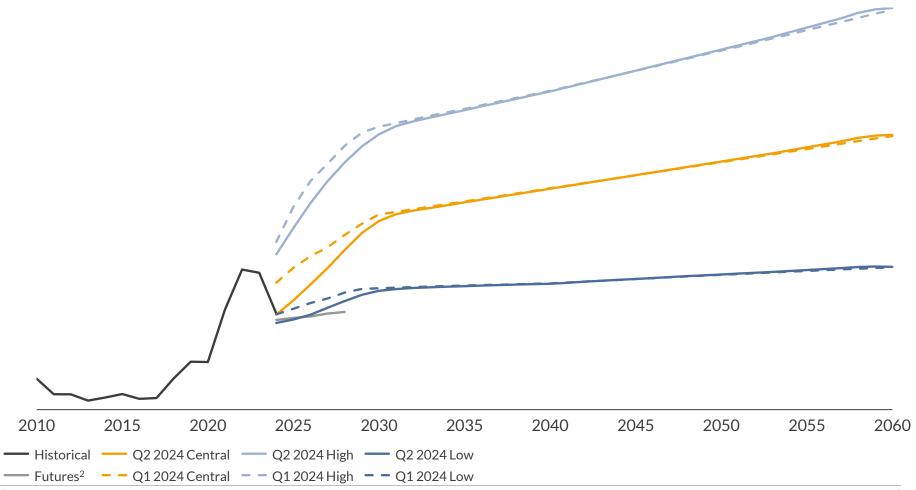
- 1 2024: Driven by the drop in futures, we revised our 2024 gas price forecast % lower.
  - The drop in futures is driven by short-term factors, as well as lower European demand.
- 2 Late 2020s: In the late 2020s, we forecast prices to rise steadily in real terms, diverging from where futures were trading in early Mar-24.
- 3 By 2030: By 2030, our forecast is € /MWh, up from € /MWh in 2024.
  - This means our 2030 forecast is nearly unchanged from our Jan 2024 forecast.
  - The rise in gas prices in the 2020s and beyond is caused by bullish factors outside of Europe. Importers increasingly need to compete with growing appetite for LNG from other regions, particularly in Asia.

# 2030 EU carbon price declines by 6 compared to our January forecast anticipating slower recovery of some industry sectors

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### **Carbon prices**

€/tCO<sub>2</sub> (real 2023)<sup>1</sup>



<sup>1)</sup> For years 2024-2028, the prices shown take into account current futures prices for the years in question, with declining weights. In 2024, forecast prices include historical prices up to Feb-24. 2) Futures on trading days between 26/02/2024 and 08/03/2024.

Sources: Aurora Energy Research, EEX, CME

### 2024-2027

- Carbon prices average €/tCO<sub>2</sub>, % down from our previous forecast, due to weaker economic activity from the EU's manufacturing sector.
- The drop in prices is driven by lower futures prices, higher cost of capital, and slower economic recovery for some sectors.

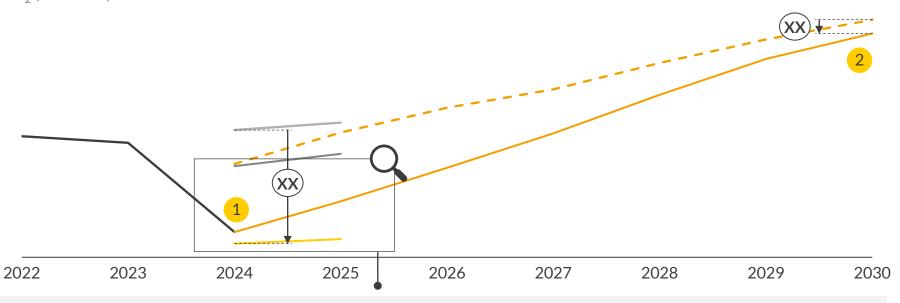
#### 2028-2060

- Carbon prices average
   €/tCO<sub>2</sub>, unchanged from the previous forecast, and rise to
   €/tCO<sub>2</sub> by 2060.
- In the medium term (2028-2035), prices are driven by policy ambition and hedging demand which is balanced by a weakening economy.
- Our Central forecast assumes the carbon price approaches a subsidised fuel switch cost to green hydrogen for power production by 2060.

# Carbon futures dropped by 6 % for 2024 while we only expect 6 % lower prices by 2030 compared to our January forecast

### Carbon price

€/tCO<sub>2</sub> (real 2023)



### Why did futures drop by % since October?

Q2 2023

)23

Apr 24 Central

Announcement that frontloaded EUAs will be auctioned 2023-2025 to fund RePowerEU

Historical

Q4 2023

German industrial output drops, particularly for high emitting sectors

- Jan 24 Central

Q4 2023

ECB rates remain high at % despite lower inflation expectations

Futures Mar 24

Gas prices continue to drop, keeping emissions from the power sector low

Q12024

Extension of compliance deadline eases short-term demand

Q12024

— Futures Dec 23 — Futures Oct 23

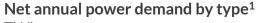
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### Deep-dive on next slide

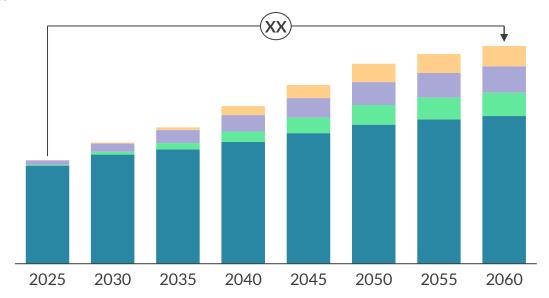
- 1 2024: Driven by the drop in futures, we revised our short-term forecast of carbon prices downwards by \(\bigcup\_{\pi}^{\pi}\)
- 2 Until 2030: We expect prices to approach our January 2024 Central forecast by 2030
  - We continue to expect lower emissions from the power sector, but anticipate a recovery of industry demand and a steep decline in supply
  - The carbon price in 2030 is
     % below our January
     forecast as we predict lower
     industrial output than
     previously anticipated in the
     long-term in the sectors glass,
     lime and paper

# Czech annual power demand reaches TWh in 2060, decreasing by TWh compared to our previous forecast due to lower industrial energy intensity





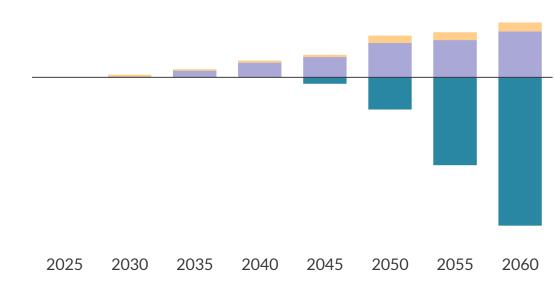
TWh



- Between 2025 and 2060, we expect total power demand in Czechia to increase by XX TWh ( %).
- Industrial electrification is a key driver, with total base demand increasing by XX TWh ( %) across the forecast and XX% of total demand in 2060 still comprised of base demand.
- Electrification of transport sees demand from electric vehicles reaching TWh by 2060, making up % of total demand, while demand from heat pumps reaches TWh by 2060.



Delta in net annual power demand compared to previous forecast<sup>2</sup> TWh



- Total annual demand remains largely aligned with our previous forecast in the short- to medium-term, increasing on average by less than TWh until 2050, before the total delta reaches to TWh in 2060.
- Electric heat demand increases by
   TWh in 2060 due to an assumed greater role played by large-scale heat pumps in district heating, within our model.
- Base demand decreases by TWh in 2060 compared with our previous forecast, caused by assumed reductions in long-term energy intensity in the industrial, commercial, and domestic sectors.

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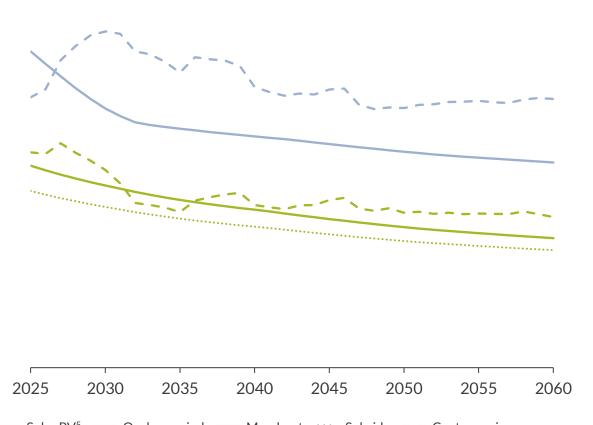
# Capture prices remain above the merchant LCOE for onshore wind, whereas solar relies on subsidies to enable buildout until the 2040s



The levelised cost of electricity (LCOE) shows the relative economic competitiveness of utility scale renewable technologies with different market entry years. As well as projected cost changes, the load factor and the cost of capital, based on the route to market type, strongly influence the forecasted LCOE curve.

### Renewable LCOE trajectories<sup>1</sup>

€/MWh (real 2023)

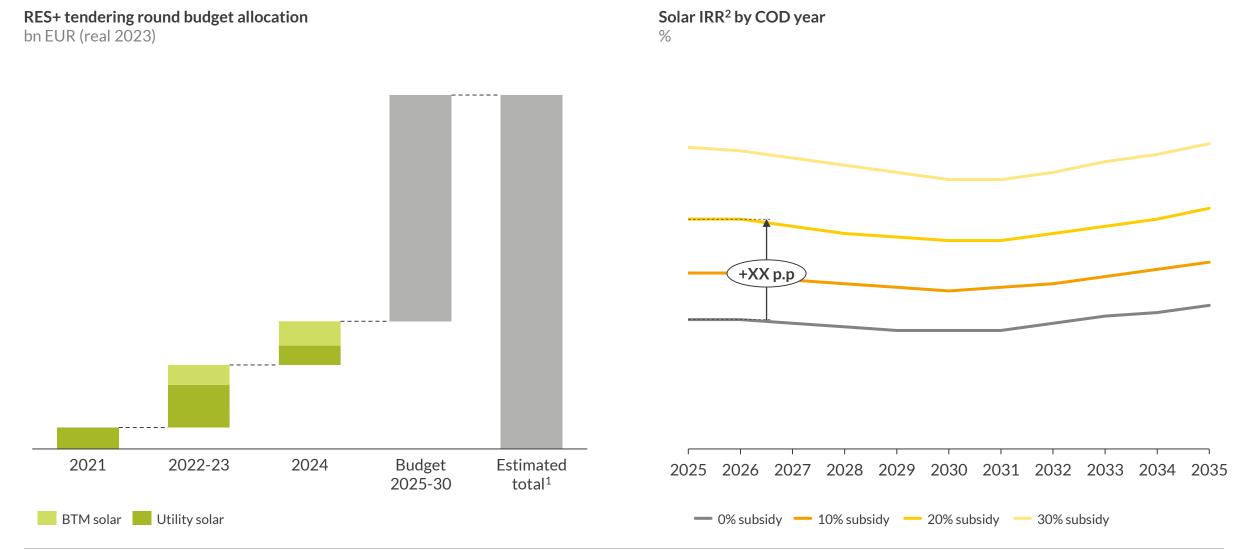


Technology	Parameter	Assumption
Onshore wind	Size	100 MW utility scale
	Lifetime	27 years
1	Load factor <sup>2</sup>	%
	WACC (merchant/PPA) <sup>3</sup>	%/%
Solar PV (fixed bifacial)	Size	50 MW utility scale
	Lifetime	30 years
	Load factor <sup>2</sup>	%
	WACC (merchant/PPA) <sup>3</sup>	%/%
	Assumed subsidy intensity <sup>4</sup>	%

Solar PV<sup>5</sup> Onshore wind Merchant · · · · Subsidy — Capture price

# 2 bn EUR of RES+ subsidy remains available to solar and co-located storage; a % subsidy intensity enables IRRs around %





<sup>1)</sup> Subsidy amount is dependent on the Modernisation Fund and therefore EU ETS price development. 2) Project IRR, real, pre-tax.

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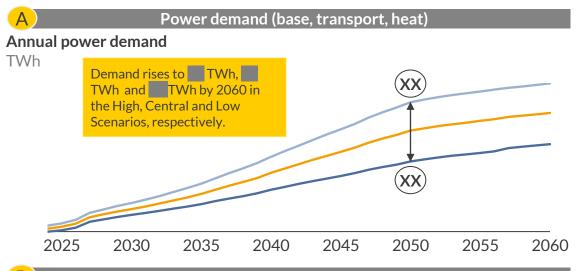


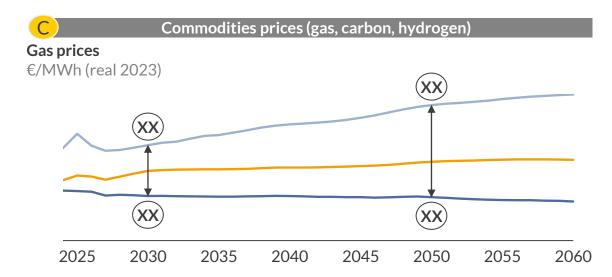
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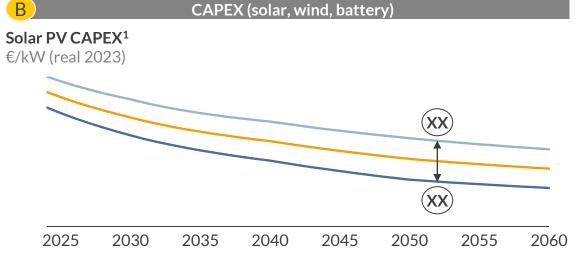
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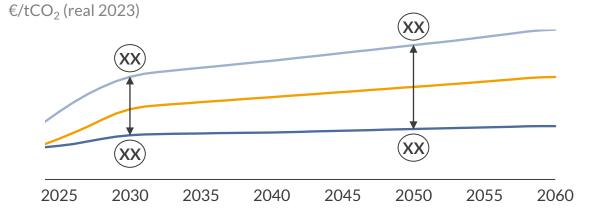
# Our High/Low Scenarios are constructed using plausible deviations in power demand, CAPEX and commodity prices











Central — High — Low

Sources: Aurora Energy Research 23

**EU-ETS** carbon prices

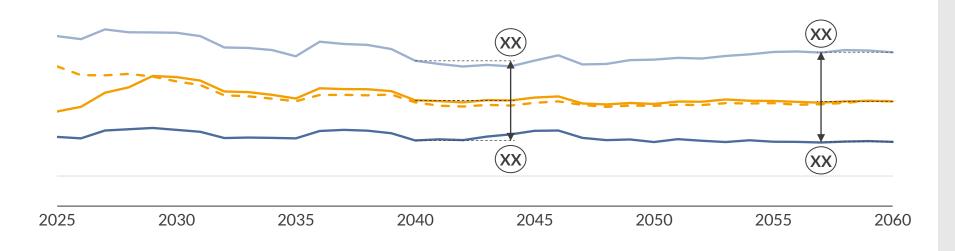
<sup>1)</sup> Merchant bifacial solar PV CAPEX (unsubsidised) is shown,

— Historical baseload — Central — Low — High

# Until 2060, power prices in the High case are \( \bigs\) % higher on average relative to Central, and \( \bigs\) % below Central in the Low case

### Baseload wholesale electricity price

€/MWh (real 2023)



<sup>1)</sup> Refers to Aurora's preliminary market outlook for Czechia, presented during the 2nd workshop of the Czech and Slovak Multi-Client Study in Prague on 14 February 2024.

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#### High

- The baseload price trajectory increases sharply between 2024 and 2025 and remains elevated at an average of €/MWh until 2031. Until 2060, the High baseload price averages at 8 above the Central Scenario.
- Higher demand increases the tightness of the system, and elevated commodities prices further drive up baseload price in the High Scenario.

#### Low

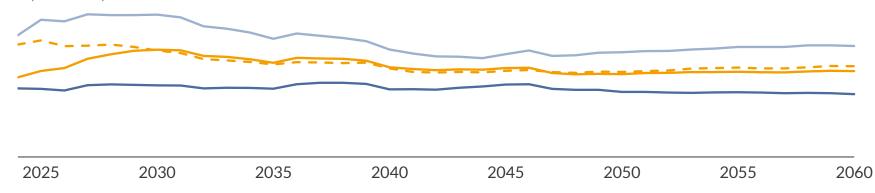
- The Low Scenario baseload price trajectory is depressed at an average of €/MWh: %
   below the Central Scenario.
- The sustained low pricetrajectory in this scenario is driven by low commodities prices, decreased renewables
   CAPEX and weak power demand.

Sources: Aurora Energy Research

# Capture prices in High fall in the long term due to higher RES buildout, whereas Low prices are more stable across the forecast

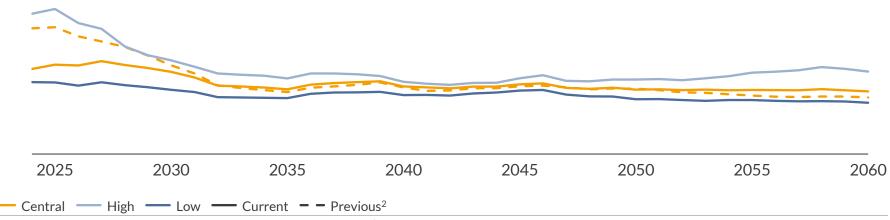
### Onshore Wind Capture Prices<sup>1</sup>

€/MWh (real 2023)



### Solar Capture Prices<sup>1</sup>

€/MWh (real 2023)



<sup>1)</sup> Fleet average, uncurtailed generation-weighted capture price across all regions. 2) Refers to Aurora's preliminary market outlook for Czechia, presented during the 2nd workshop of the Czech and Slovak Multi-Client Study in Prague on 14 February 2024.

Sources: Aurora Energy Research

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#### **Capture Price Outlook**

#### **Onshore Wind**

- Onshore wind sees limited cannibalisation and is strongly influenced by commodity and baseload price behaviour.
- The change in onshore wind capacity across scenarios drives the divergence of capture prices across the forecast, averaging +/ % in High and Low, compared with Central, after 2030.

#### Solar

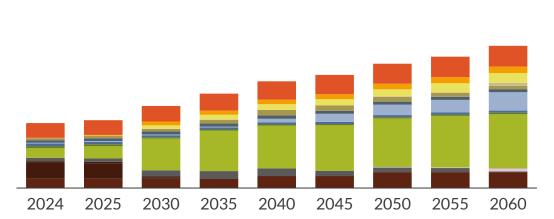
- Baseload and commodity prices greatly influence solar PV capture prices in the short term, where cannibalisation is limited.
- High and Low solar capture prices converge with the Central Scenario in the mid-term, driven by subsidised solar buildout.
- Post-2050, exhaustion of onshore wind buildout in High heightens baseload and solar capture price.

# Total capacities increase to **GW** and **GW** by 2060 in the Low and High Scenarios, respectively

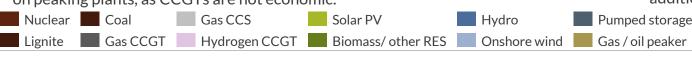
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1 Low Scenario

Installed capacity

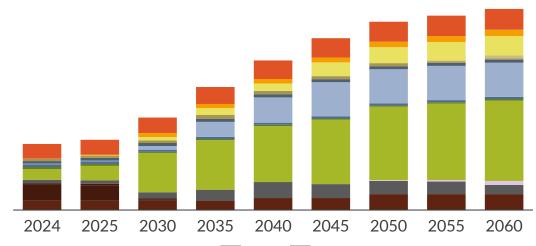


- Solar PV buildout is mostly restricted to subsidised capacities benefitting from the RES+ scheme, and as retiring subsidised capacity is replaced at the end of the forecast, further solar buildout is limited.
- Onshore wind buildout occurs across the whole forecast, but the capacity in 2060 fails to utilise even \( \begin{aligned}
   \text{ of the maximum geotechnical potential.} \end{aligned}
   \]
- Reduced demand in Low means that the addition of thermal capacity focuses on peaking plants, as CCGTs are not economic.

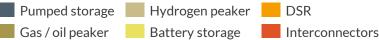




Installed capacity



- Renewable capacity increases by GW, a % increase, between 2024 and 2060, with subsidised solar buildout in in the first half of the forecast met with merchant solar and onshore wind buildout throughout.
- We assume that regulatory adjustments allow permitting of further onshore wind buildout compared to Central, with capacity reaching GW in 2060.
- Increased demand in High drives thermal capacity procurement, with an additional GW of gas CCGT capacity in 2040 compared with Central.



Sources: Aurora Energy Research

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- IV. Key market uncertainties: Our High/Low Scenarios
- V. Key takeaways

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# **Key takeaways**



- Baseload prices have slumped with commodity markets, but will rise to a level of ●/MWh by 2030. Afterwards investments into renewables, gas and later nuclear stabilise prices around ●/MWh.
- Lignite capacity falls to GW, while solar capacity reaches GW by 2030. This leads to a scarce and volatile system, with % of prices exceeding €/MWh and 1-hour daily spreads reaching €/MWh.
- Retiring lignite capacity is replaced by GW each of batteries and DSR, as well as GW of gas entering by 2035. Generation is replaced largely by TWh of additional solar and onshore wind and a switch from TWh net exports to TWh net imports by 2035.
- Fast buildout leads solar capture prices to fall to **MWh** by 2035, leaving projects reliant on Capex subsidies from the RES+ scheme. A 20% subsidy intensity can secure a **MRR for a project entering in 2028.**
- Baseload prices are around **% lower** under our Low Scenario, leading to solar capture prices stabilising between **and €/MWh** after 2030 and onshore wind capture prices remaining between **and e/MWh** throughout the forecast.

Source: Aurora Energy Research.

# **Czech Power & Renewables Forecasts:**



Dive into key market analysis and forecasts for the Czech power and renewables markets

Power & Renewables Forecasts

### Forecast Reports & Data



#### Biannual forecast reports with biannual data updates

- Forecast of wholesale prices to 2060
- Data under three Scenarios: Central, Low, and High
- Policy outlook detailing policy developments and their impacts
- Capacity development, generation mix and exports
- Capture prices of key technologies (onshore wind, solar)
- Power price distributions
- EU-ETS carbon price forecasts
- All forecast data easily downloadable in Excel format and available as interactive dashboards on our EOS platform

### **Strategic Insights**



**Analyst Support** 

- Yearly workshop to discuss specific issues on the Czech market
- Ongoing support from our bank of analysts, including native speakers and on-the-ground experts



# Details and disclaimer

#### **Publication**

The Czech Power and Renewables Market: Long-Term Outlook

Date 18<sup>th</sup> April 2024

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