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ENERGY RESEARCH

The Czech Power Market: Key Trends and Challenges

New Market Service

Agenda

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I. About Aurora

II. Key trends in the Czech power market

III. Aurora's Power & Renewables Forecasts offering in Czechia

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

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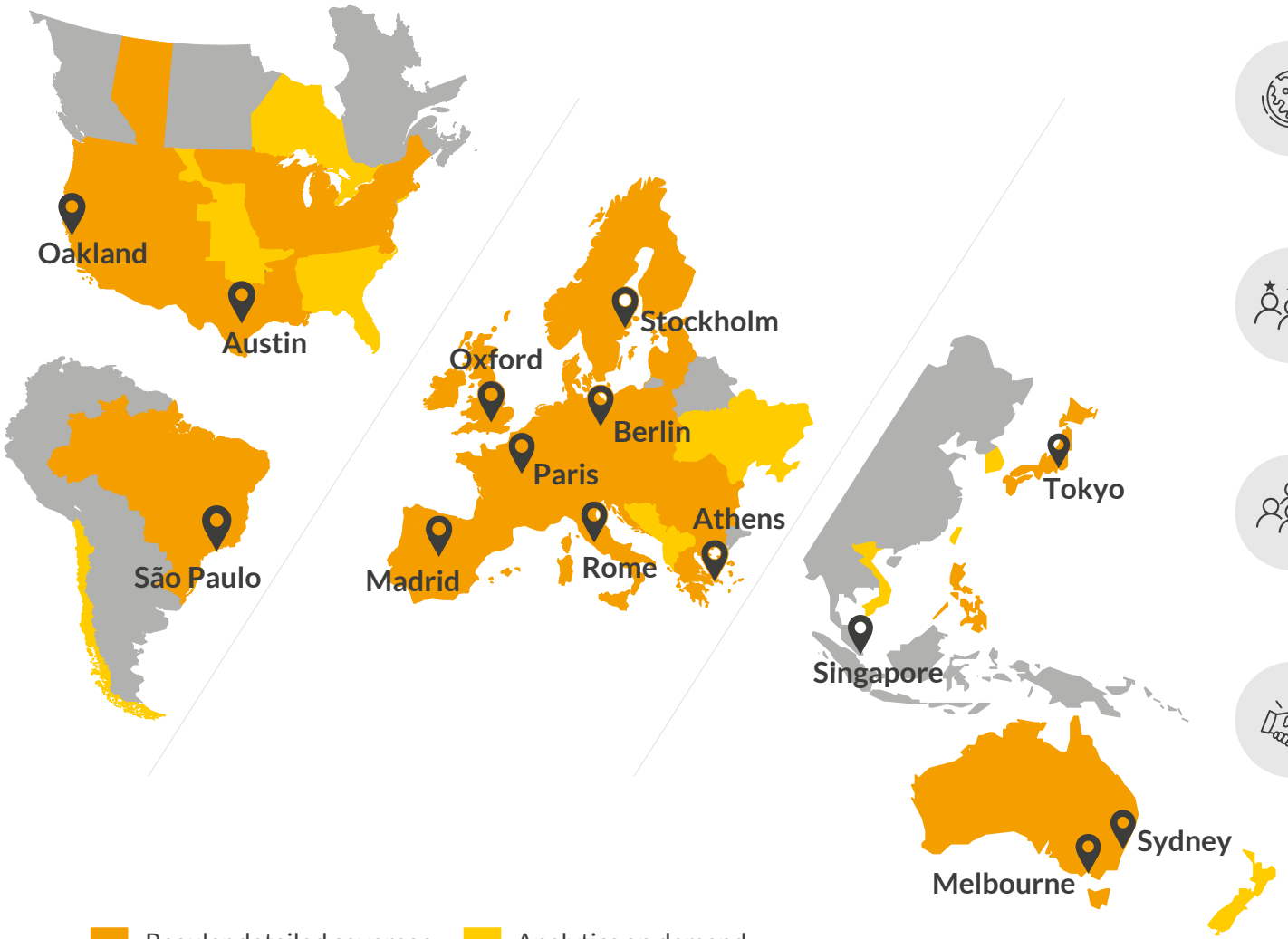
- Power markets
- Renewables & PPAs
- Storage
- Grid & Congestion
- Electric vehicles
- Hydrogen H_2
- Carbon CO_2
- Natural gas



14 Offices

600+
market experts

850+
subscribing companies

150+
transactions supported in 2023

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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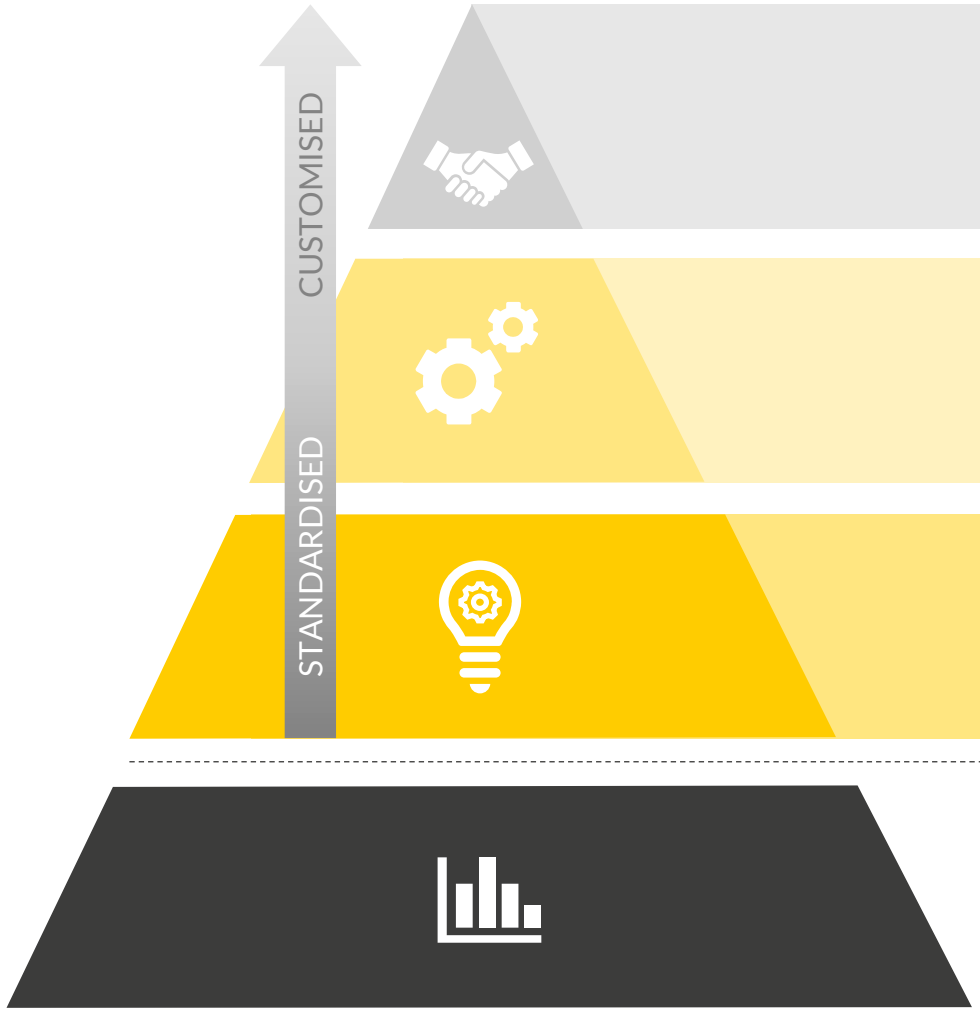

Advisory

Access tailored expert advice and analytics for your crucial projects

Trusted advice and dedicated support for strategy, investments, transactions and policy engagement

1,400+ projects globally

Software Solutions

Make standard analysis bespoke through direct access to our models

Unique SaaS subscriptions to create your own scenarios and asset-specific investment cases

150+ company licenses

Subscription Analytics

Receive regularly updated forecasts, sample investment cases and timely deep-dives

Industry-standard outlook reports, bankable price forecasts and strategic insights for power and commodities

750+ subscribing companies

Models & Data

Market-leading models for power, gas, hydrogen, carbon, oil & coal markets

Proprietary and continuously updated cutting-edge models populated with highest quality curated datasets

Developed over 10 years, 40+ dedicated modellers

Source: Aurora Energy Research

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**

Power & utilities

fortum, FORSA ENERGY, edp, e·on, IBERDROLA, Tesla, Urenco, centrica, CALPINE, 50hertz, RWE, Ørsted, drax, enel, InterGen, uniper, EDF, UK Power Networks, ESB, Enea, Viridor, EnBW, axpo, sorgenia, Energa, Eneco, SSE, nationalgrid, ukpowerreserve, ENGIE, Terna, VATTENFALL, Statkraft, enviva

Energy consumers

BASF We create chemistry, Port of Rotterdam, GLENCORE, Heineken, BOC Member of The Linde Group, MITSUBISHI POWER, umicore, SIEMENS, EVONIK, Google, ITM POWER Energy Storage | Clean Fuel, INEOS, UPM, SALZGITTER AG, Unilever, SNCF, SIMEC, AlzChem, DB, wieland, orange

Financial sector & investors

GREENCOAT CAPITAL, Close Brothers Asset Finance, 北京控股有限公司, CIP, JLEN, equitix, Allianz Global Investors, SOCIETE GENERALE, CaixaBank, Commonwealth Bank, Foresight, BARCLAYS, LLOYDS BANK, NatWest, Partners Group, MUFG, InfraRed, CPP INVESTMENT BOARD, ENERGY INFRASTRUCTURE PARTNERS, Marubeni, OCTOPUS INVESTMENTS, ONTARIO TEACHERS' PENSION PLAN, Legal & General, RBC, 中国投资有限责任公司, bluefield Partners LLP, NTR, mirova, UniCredit, COMMERZBANK, Moody's, DALMORE CAPITAL, Downing, RIVER STONE, National Australia Bank, HSBC, MACQUARIE

Oil & gas

ORLEN, Vitol, GASAG, equinor, eustream, OGE, SW//M Stadtwerke München, bp, snam, centrica, nationalgrid, Thyssengas, Naturgy, fluxys, Shell

Project developers

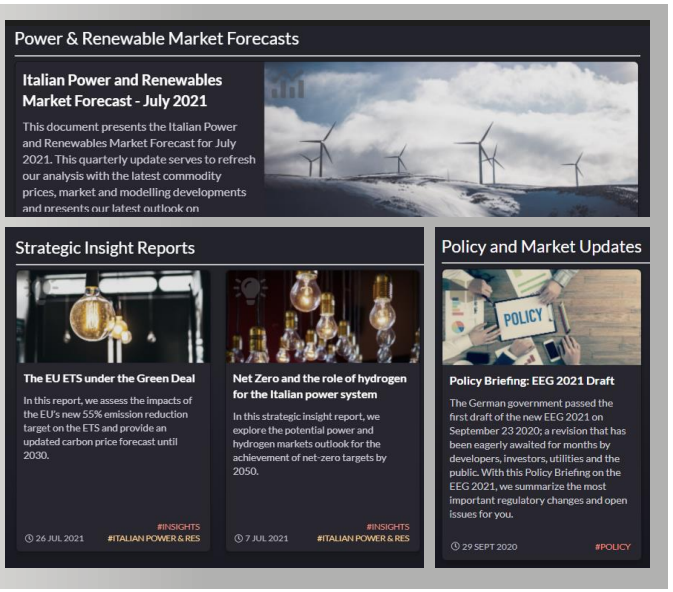
BELECTRIC, CanadianSolar, POLENERGIA, GreenFrog Power, solarcentury, brockwell energy, NEOEN, enlight, PACIFICO, tagenergy, BORALEX, British Solar Renewables, BayWa r.e., Good Energy, low carbon, BANKS Group, greentech, Invenergy, res power for good, bnrg, powercapital renewable energy, Anesco, HIVE ENERGY, TECHNIQUE SOLAIRE, EnergieKontor, lightsource bp, bp

Policy & regulation

Bundesnetzagentur, Bundesministerium für Wirtschaft und Klimaschutz, Ministerie van Economische Zaken en Klimaat, seai, Climate Change Committee, DRC Development Research Center of the State Council of the People's Republic of China, Roinn Cumarsáide, Gnóthaithe ar son na hAeráide & Comhshaoil Department of Communications, Climate Action & Environment, European Climate Foundation, European Commission, HM Treasury, Energy Regulatory Office, JETRO Japan External Trade Organization, National Audit Office, Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, NATIONAL INFRASTRUCTURE COMMISSION, AEMO, LOW CARBON CONTRACTS COMPANY, Electricity Settlements Company, Department for Business, Energy & Industrial Strategy

Source: Aurora Energy Research

All your services in one place—login to EOS the user friendly, purpose built, interactive database



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Source: Aurora Energy Research

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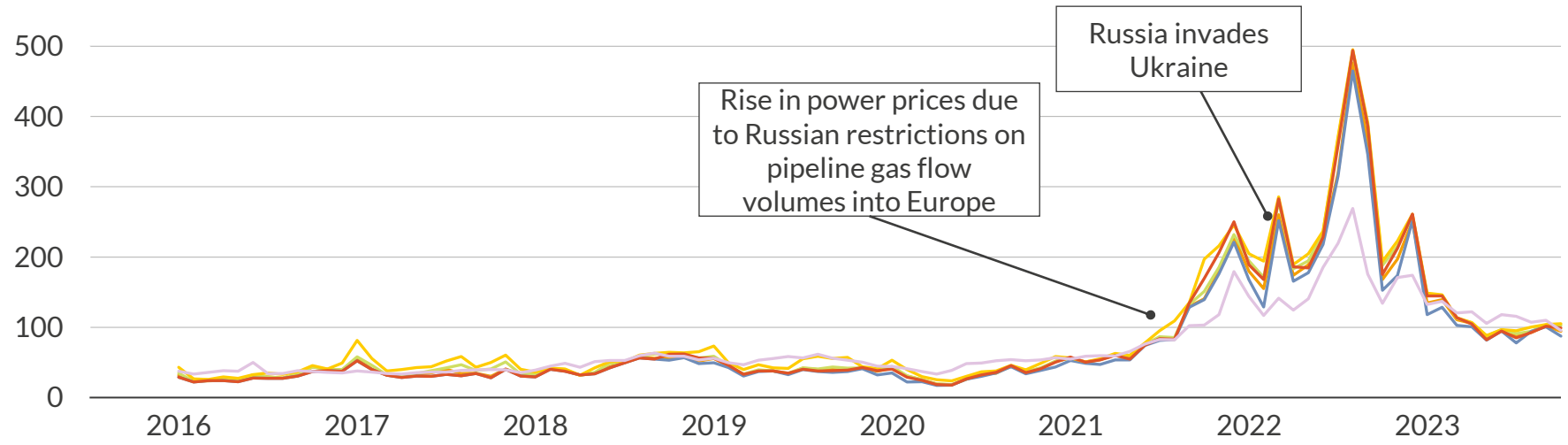
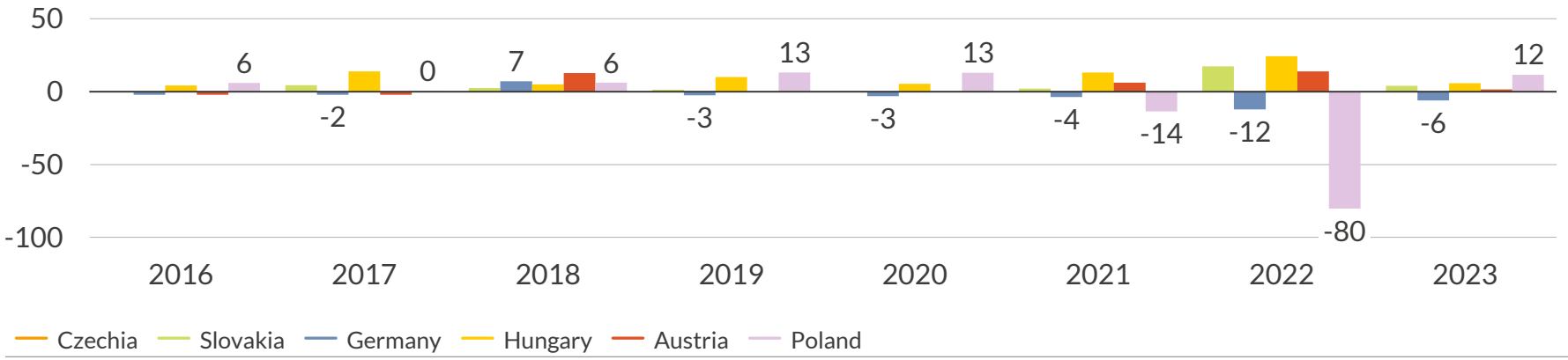
Czech power prices have historically tracked neighbouring markets, benefitting from cheap baseload generation and German imports

Historical baseload electricity prices[1]
€/MWh (nominal)



Average annual delta in baseload electricity prices between neighbouring countries and Czechia
€/MWh (nominal)



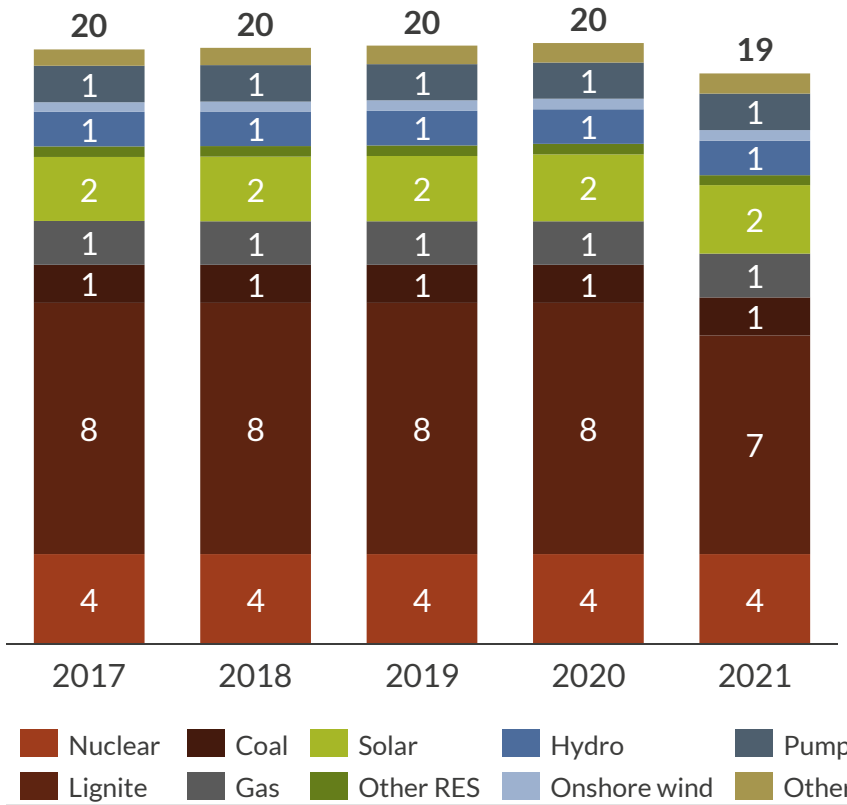
1) Monthly average.

Sources: Aurora Energy Research, ENTSO-E.

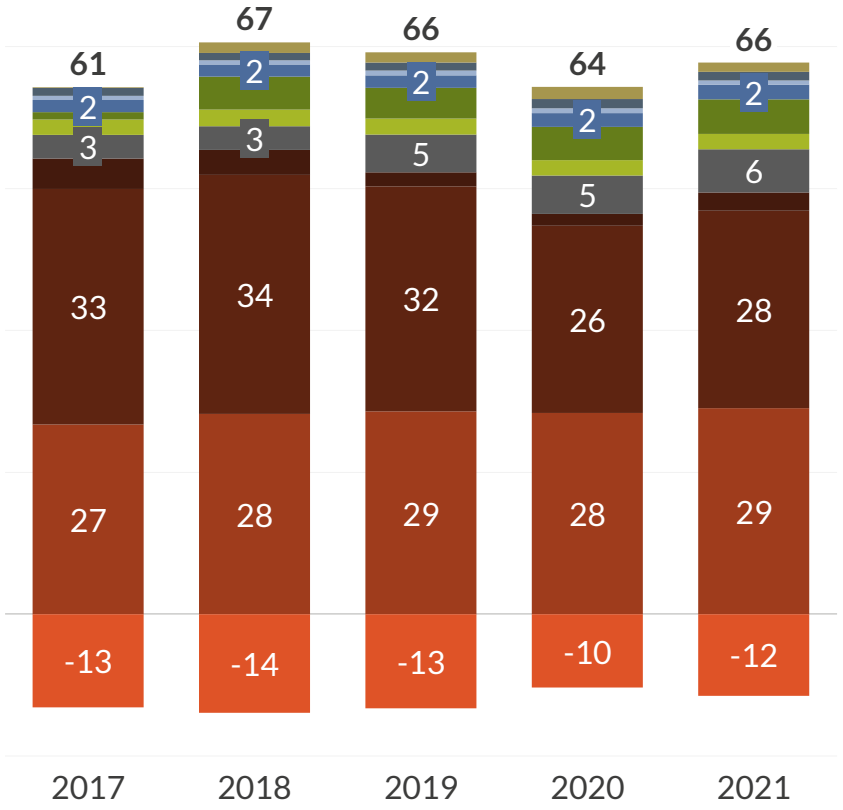
- The large share of lignite, nuclear and hydro in generation mixes has historically meant low exposure to commodity prices. Power prices stayed low and stable in Czechia and Slovakia together with low ETS prices.
- Nonetheless, high levels of interconnection meant both markets were left exposed to record gas prices following Russia's invasion of Ukraine.
- Czech and Slovak prices have closely tracked those of their neighbours. Slovakia has traded at a premium to Czechia, largely due to greater exposure to the more expensive Hungarian market.
- Polish prices diverge more strongly, caused by weaker interconnection and reliance on domestically-produced coal.

Nuclear and lignite are central to the Czech power mix, accounting for 85% of demand in 2021, with a minimal role for renewables

Historical installed capacity in CZE
GW



Historical electricity production and net imports in CZE[1]
TWh



Nuclear
Coal
Solar
Hydro
Pumped storage
Net imports
Lignite
Gas
Other RES
Onshore wind
Other thermal[2]

1) Does not include generation from behind-the-meter assets, net of generating unit self-consumption. 2) Other thermal includes oil and uncategorised thermal plants.

Sources: Aurora Energy Research, ENTSO-E, E-Control.

- Nuclear constitutes a key part of the Czech power system, with 4 GW of capacity historically covering approximately 40% of demand.
- Lignite remains the largest generation source in the Czech market, accounting for 36% of production in 2021. This represents a 6 TWh fall compared to 2018 because of unit closures and rising ETS prices.
- Onshore wind and solar play a marginal role in both systems, with 0.3 GW of wind and 2 GW of solar accounting for just 4% of generation in 2021.
- Czechia has historically been a large net exporter thanks to cheap generation from nuclear and lignite under low ETS prices.

The Czech market is transformed over the next decade as lignite retires and subsidies incentivise renewable capacity to reach 27 GW by 2035

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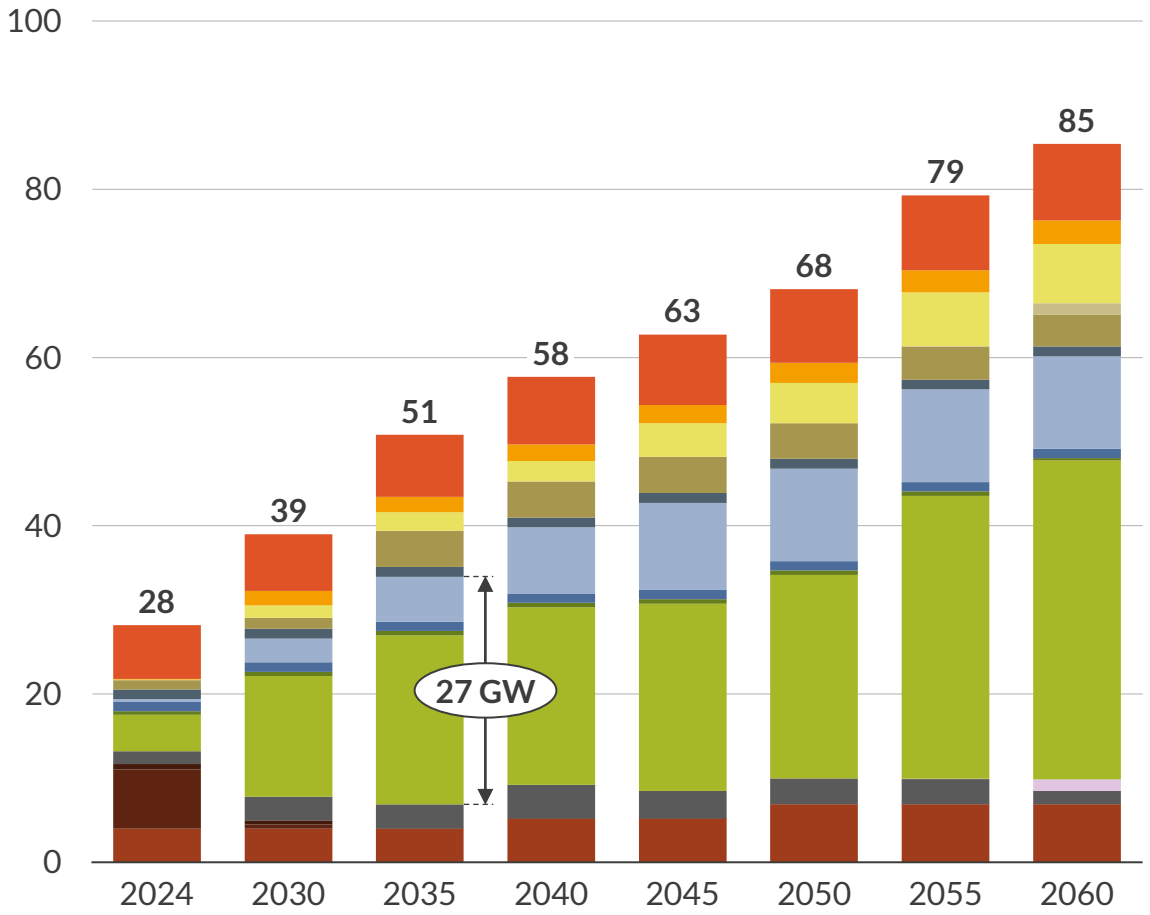
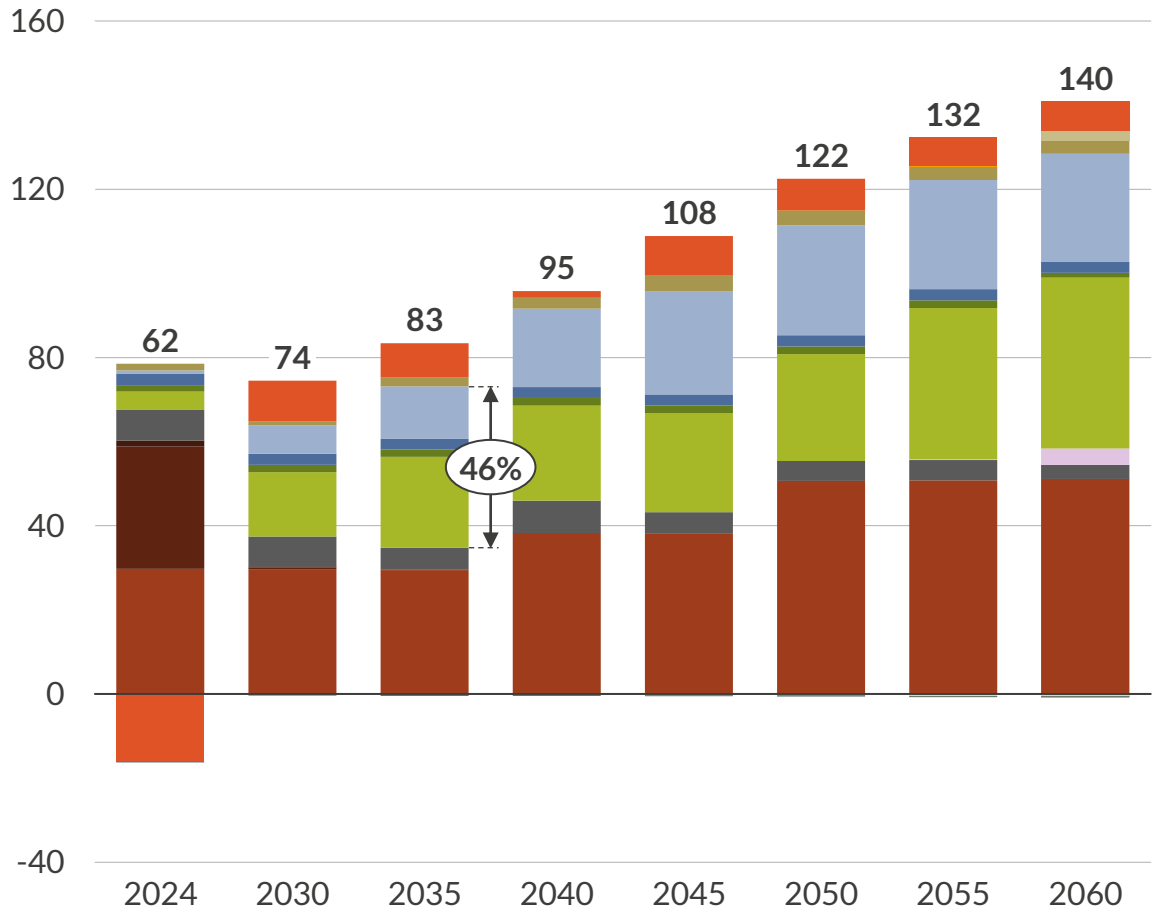
Installed Capacity

GW



Electricity Production and Net Imports

TWh



Nuclear | Coal | Hydrogen CCGT | Biomass/ other RES | Onshore wind | Gas / oil peaker | Battery storage | Interconnectors

Lignite | Gas CCGT | Solar PV | Hydro | Pumped storage | Hydrogen peaker | DSR

Sources: Aurora Energy Research

Czech non-CHP coal units become uneconomic and are retired by 2027, long before the 2033 phaseout plan

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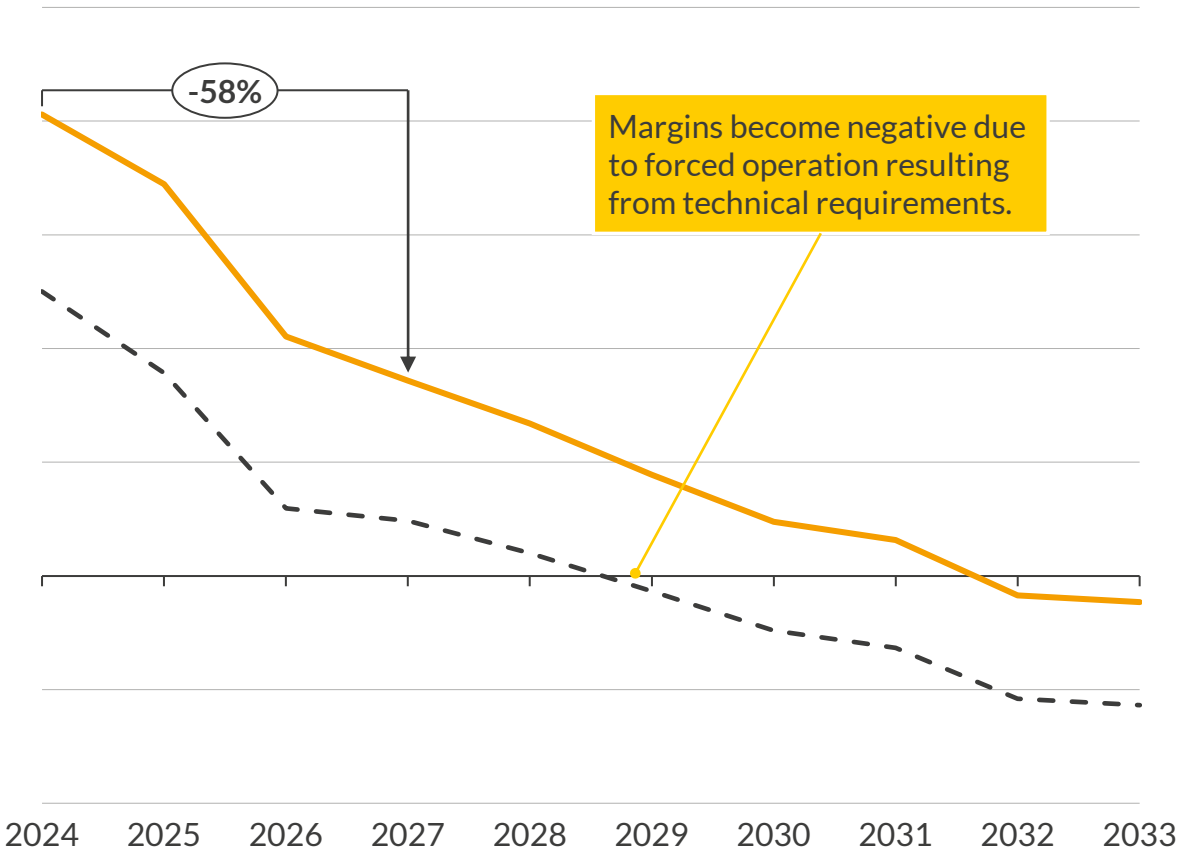
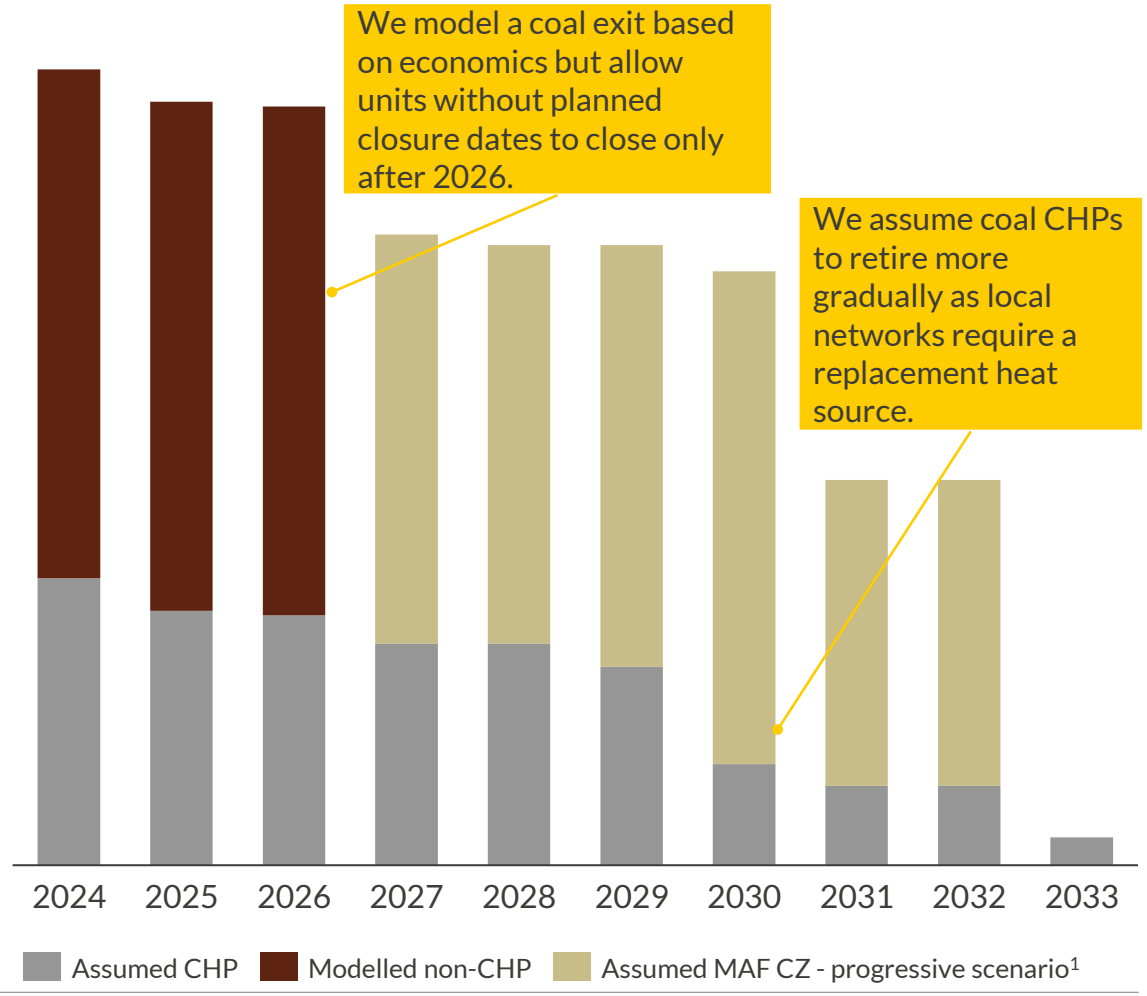
Czech lignite wholesale gross margin

€/kW (real 2022)



Czech installed hard coal and lignite capacity

GW

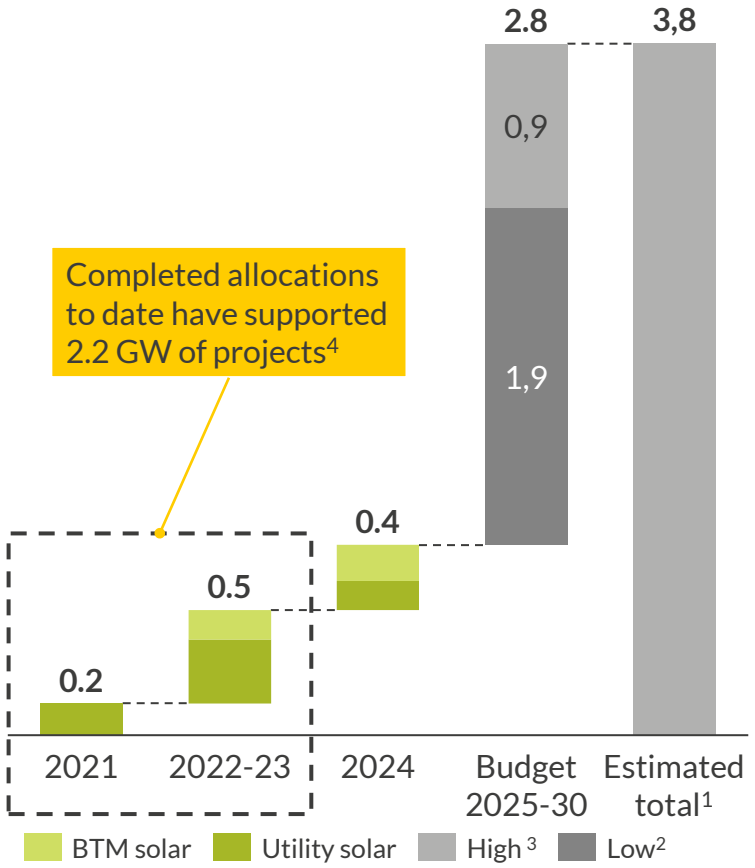


1) Resource Adequacy Assessment of the Power Grid of the Czech Republic until 2040, CEPS MAF CZ, 2022. 2) Wholesale Gross Margin calculated based on an assumed thermal efficiency of 42.5% HHV. 3) Wholesale Gross Margin calculated based on an assumed thermal efficiency of 37% HHV.

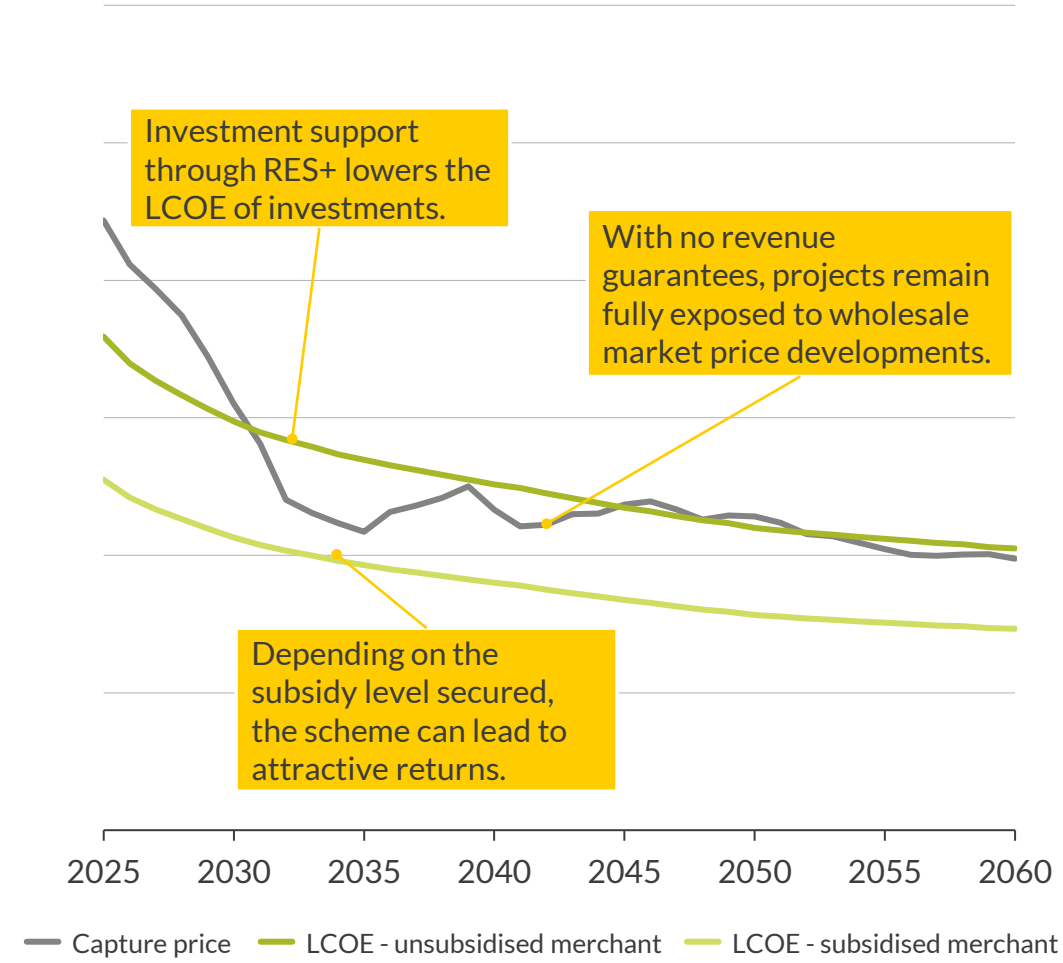
Sources: Aurora Energy Research, CEPS MAF CZ

The fast buildout of Czech renewables is driven by around 3 bn € of investment support available through the RES+ scheme

RES+ tendering round budget allocation
bn EUR (real 2022)



Levelised cost of energy vs capture prices for solar in Czechia
€ /MWh (real 2022)



- The Czech RES+ scheme is an investment subsidy based on Modernisation Fund revenues from the sale of ETS certificates.
- Currently 20% of Czech Modernisation Fund revenues are allocated to RES+, providing some 3 bn € of support budget, depending on future ETS prices.
- Support is provided through technology-specific tenders, with competiitve tenders for utility-scale projects. All support to-date has been allocated to solar and co-located batteries.
- Support is provided in the form of a one-off investment support.
- The support features no revenue guarantees, meaning projects retain full exposure to wholesale market development.

1) RES+ has a budget allocation of 20% of the Czech Modernisation Fund for the period 2021-2030. The Modernisation Fund value is dependent on the future price of EU ETS certificates. 2) Based on an average EU ETS price for 2021-30 of 75 €/tCO_2 (real 2022). 3) Based on an average EU ETS price for 2021-30 of 100 €/tCO_2 (real 2022).
Sources: Aurora Energy Research, Czech Ministry for the Environment

Aurora's unique, proprietary, in-house modelling capabilities allow to assess challenges for the CZE and SVK power market in a holistic manner

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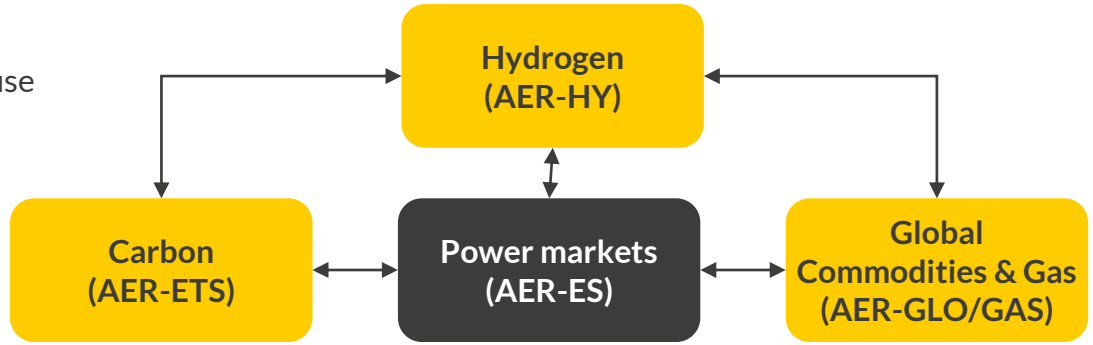
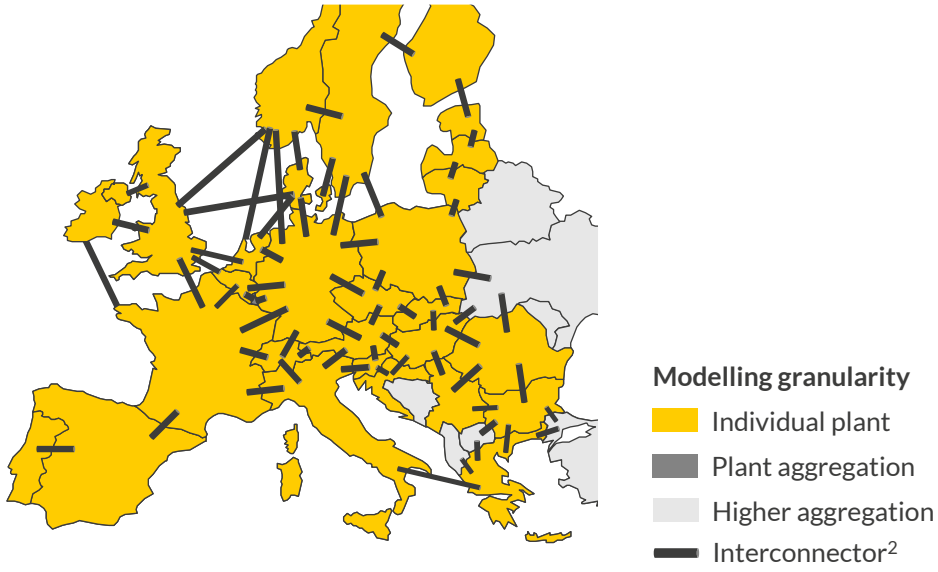
Integration of Aurora's four inhouse models

Endogenous interconnector flows based on price differentials

Interdependence of prices and capacities in different regions

High granularity right down to individual plant level





Advantages of Aurora approach

- Aurora have invested heavily in developing our dispatch models since 2013 and believe they are the most sophisticated available
- Our models have been rigorously tested and refined in a wide range of client contexts
- Flexible and nimble because we own the code
- Zero dependence on black-box third-party software (e.g. PLEXOS)
- Ability to model complex policy changes quickly
- Taking into consideration Europe wide developments through cross-border market modelling

1) Gas, coal, oil and carbon prices fundamentally modelled in-house with fully Integrated commodities and gas market model, 2) Sizes and lengths of interconnectors are for visual representation only, Illustrative and are not to scale

Source: Aurora Energy Research

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Czech Power & Renewables Forecasts:

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

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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

- **Bi-annual workshops** to discuss specific issues on the Czech market
- **Ongoing support** from our bank of analysts, including native speakers and on-the-ground experts

Our service can take your business to the next level. Discuss its benefits with **Joanna Marszalkowska, Commercial Associate**

✉ **joanna.marszalkowska@auroraer.com**


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