

Regional Approach Sofia: Energy goes both ways

27 April 2023

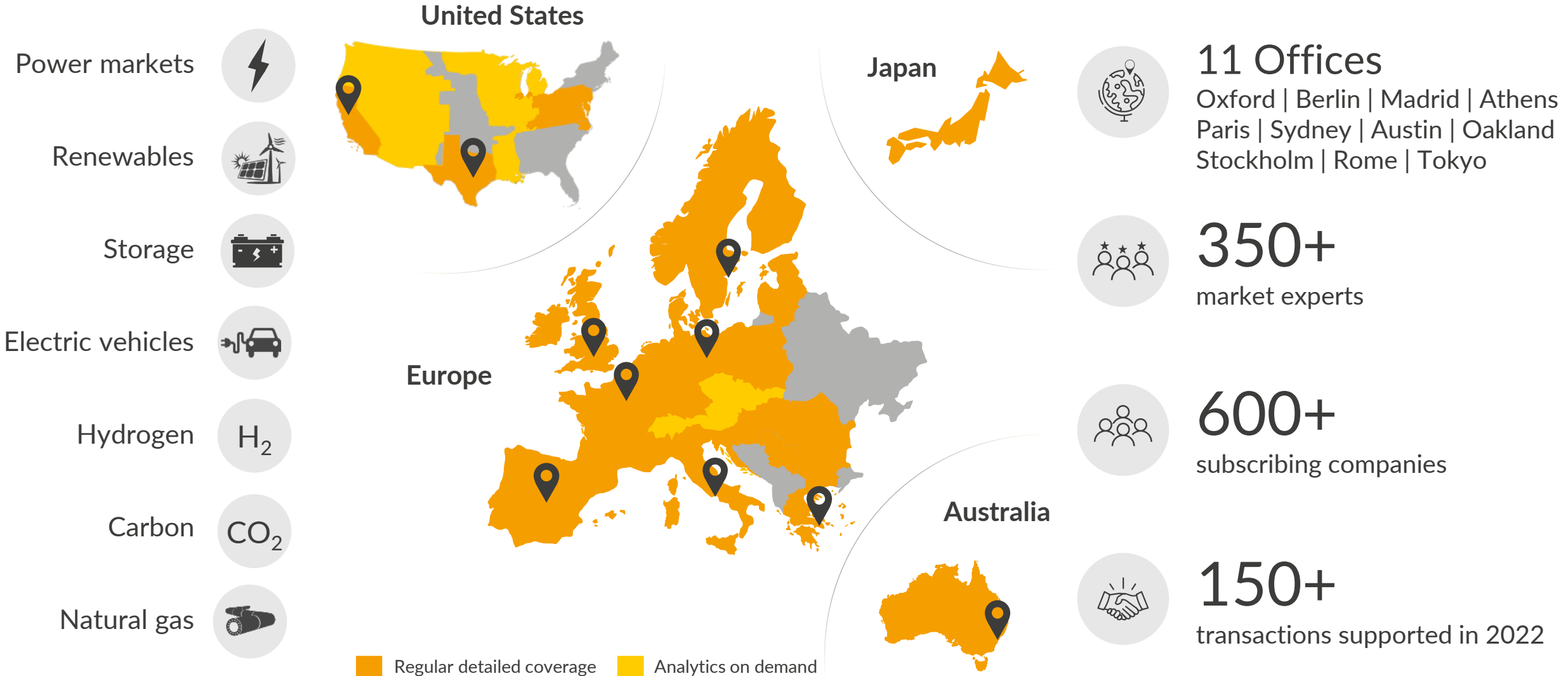
Sofia – Bulgaria

Energynomics

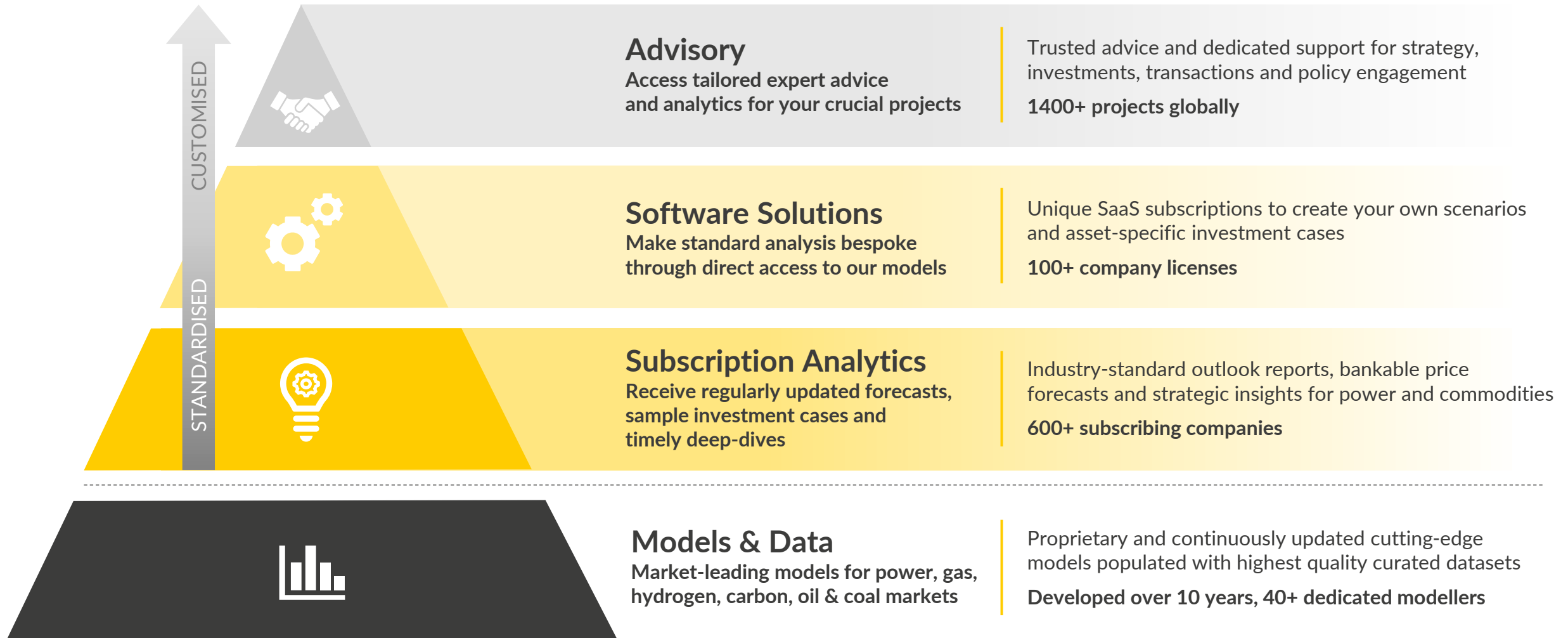


Aurora provides market leading forecasts & data-driven intelligence for the global energy transition

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



We cover 7 markets in the SE European market, having developed comprehensive Power and Renewables Market Forecast reports

South-Eastern Europe market coverage



Currently, we provide energy market services for Greece, Bulgaria, Romania, Hungary, Slovenia, Croatia and Serbia

- Comprehensive market analyses through our Power and Renewables Market Forecast subscriptions
- Bespoke advisory services (M&A, asset valuation, PPAs etc.)
- In depth look into the power market status quo, market liberalisation process and regional/EU integration

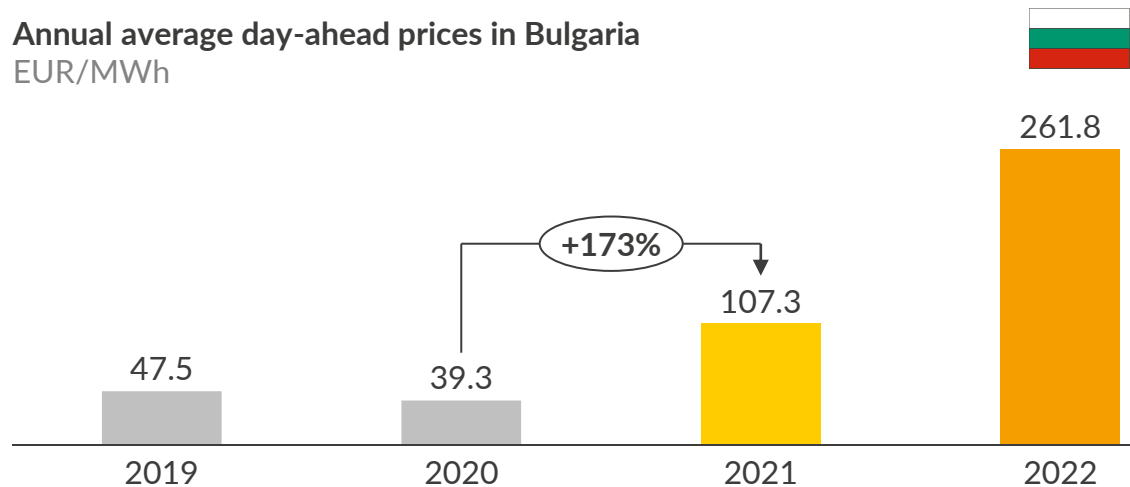


We offer comprehensive **Power and Renewables Market Forecast** reports which include:

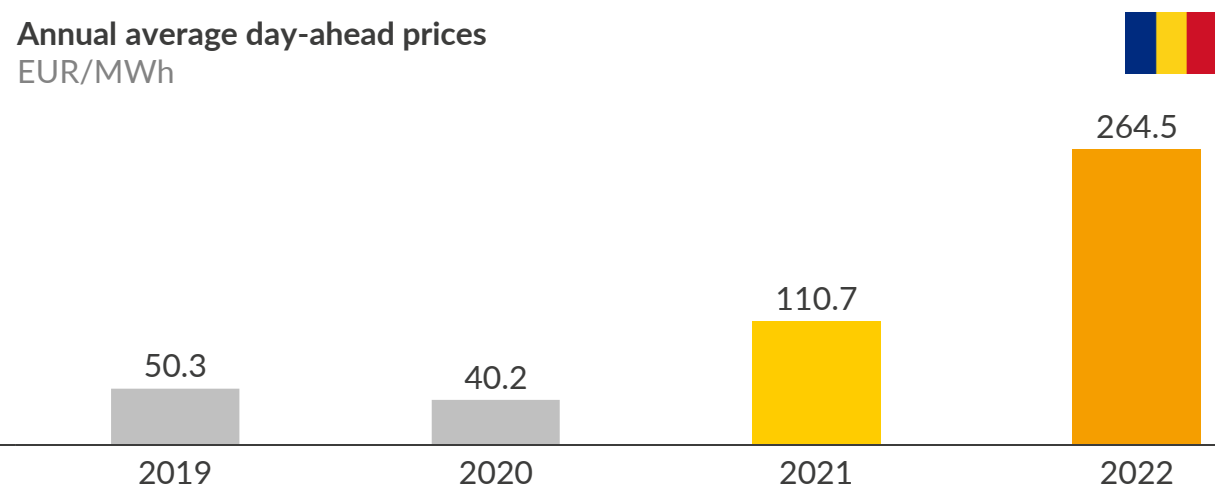
- **Forecasts of wholesale market prices along four scenarios** (Central, High, Low, Net Zero) until 2060 updated quarterly
- **All the latest trends and forecasts**, recent market and policy developments
- **Capacity development**, generation mix, interconnector capacity, capacity buildout, exports
- **Capture prices** (onshore, offshore solar), price distributions, spark spreads, peakload prices
- **Corporate PPA market analysis and valuation**, example of fair price valuation

2020 was dominated by the COVID-19 pandemic, but 2021 and 2022 saw a recovery in demand and a massive increase of baseload prices

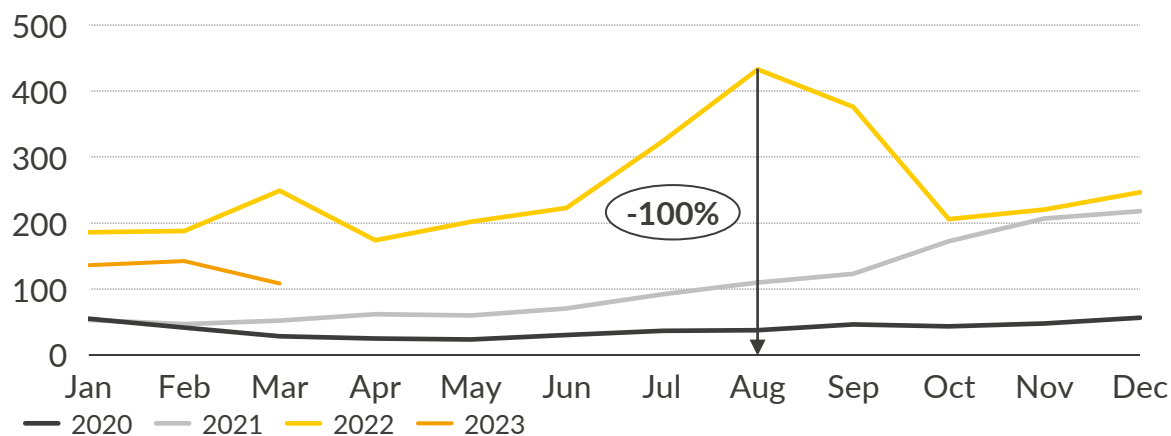
Annual average day-ahead prices in Bulgaria
EUR/MWh



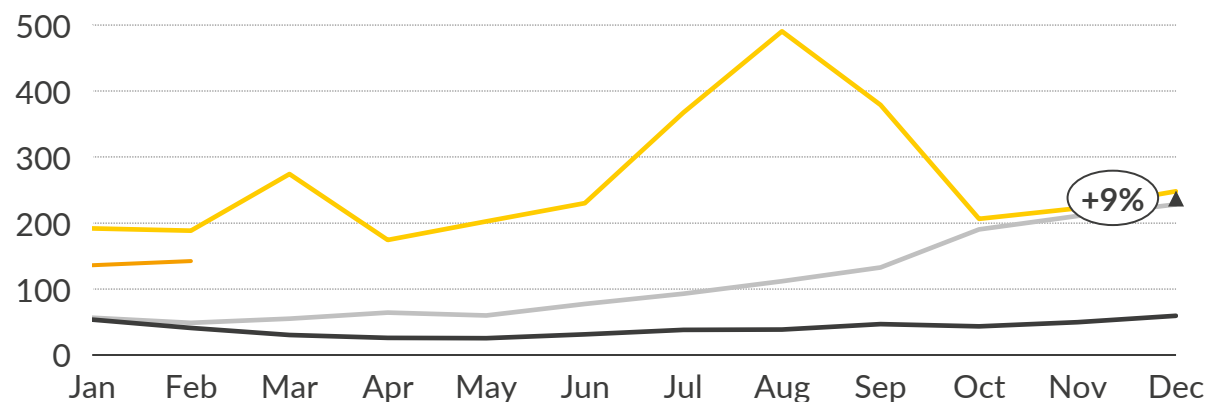
Annual average day-ahead prices
EUR/MWh



Monthly average day-ahead prices in Bulgaria
EUR/MWh



Monthly average day-ahead prices in Romania
EUR/MWh

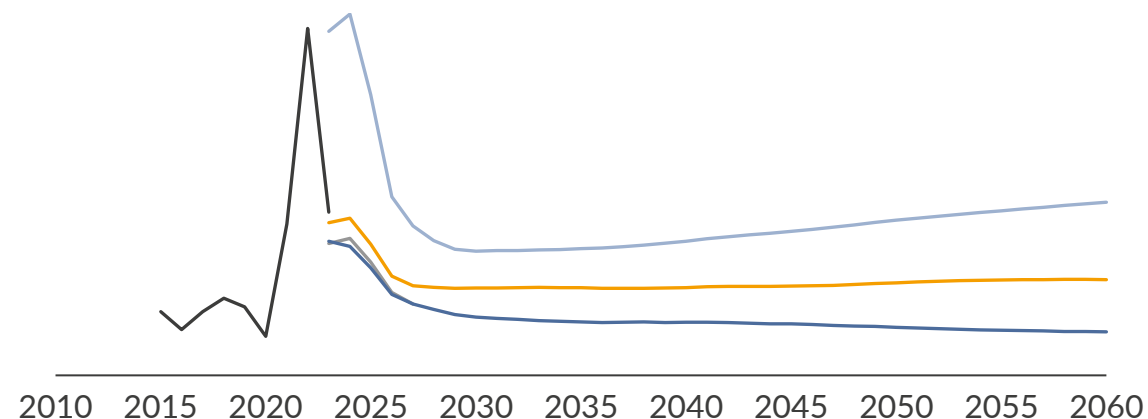


1) Data up to March 2023

Gas prices rise from the mid 2020s to 2030 due to supply tightness, whilst the EU ETS rises as a result of increasingly ambitious emissions targets

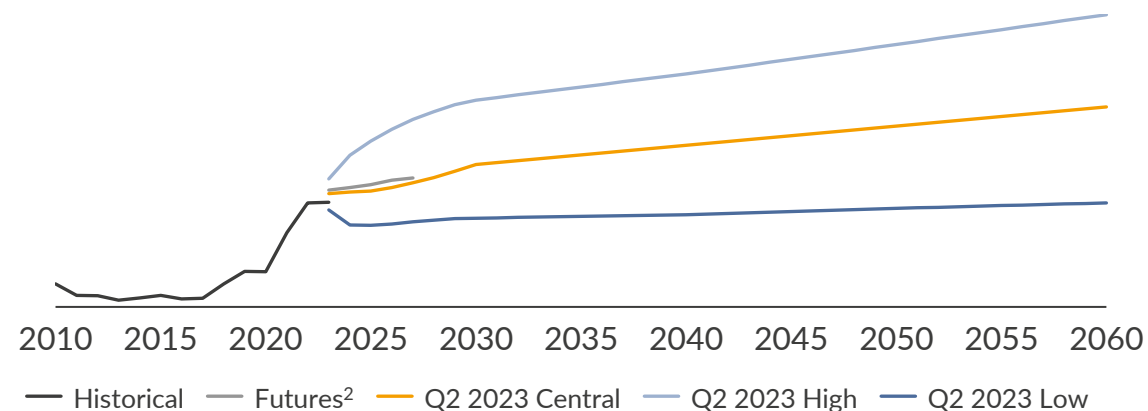
Gas prices

€/MWh (real 2022)¹



Carbon prices

€/tCO₂ (real 2022)¹



Key trends in commodity price forecast include:

- **Short term (2023 - 2027)**
 - The **gas price** in the period to 2027 averages below 50 €/MWh. Higher European gas storage levels and lower gas demand have pushed gas prices lower. By 2027, the market is expected to rebalance at over 30 €/MWh as LNG regasification capacity in Europe becomes abundant and a substantial expansion of global liquefaction infrastructure is expected
 - Short-term **carbon price** is driven by blending updated futures. April 2023 EUA price rises 11% above our January forecast driven by increased compliance buying and a delay in REPowerEU auction frontloading past April compliance deadline
- **Long term (2028 - 2060)**
 - The **gas price** in the period to 2060 averages in the mid 30s €/MWh, lower than the previous forecast due to the substantial upward revision of forecast Russian gas supply to South-Eastern Europe via TurkStream. Driven by growing Asian gas demand, gas prices start to increase again in the 2030s.
 - Without a binding year for zero ETS emissions, our Central **carbon price** forecast assumes ETS auctions end in the 2060s with a price of over 150 €/tCO₂, approaching the fuel switch cost to hydrogen

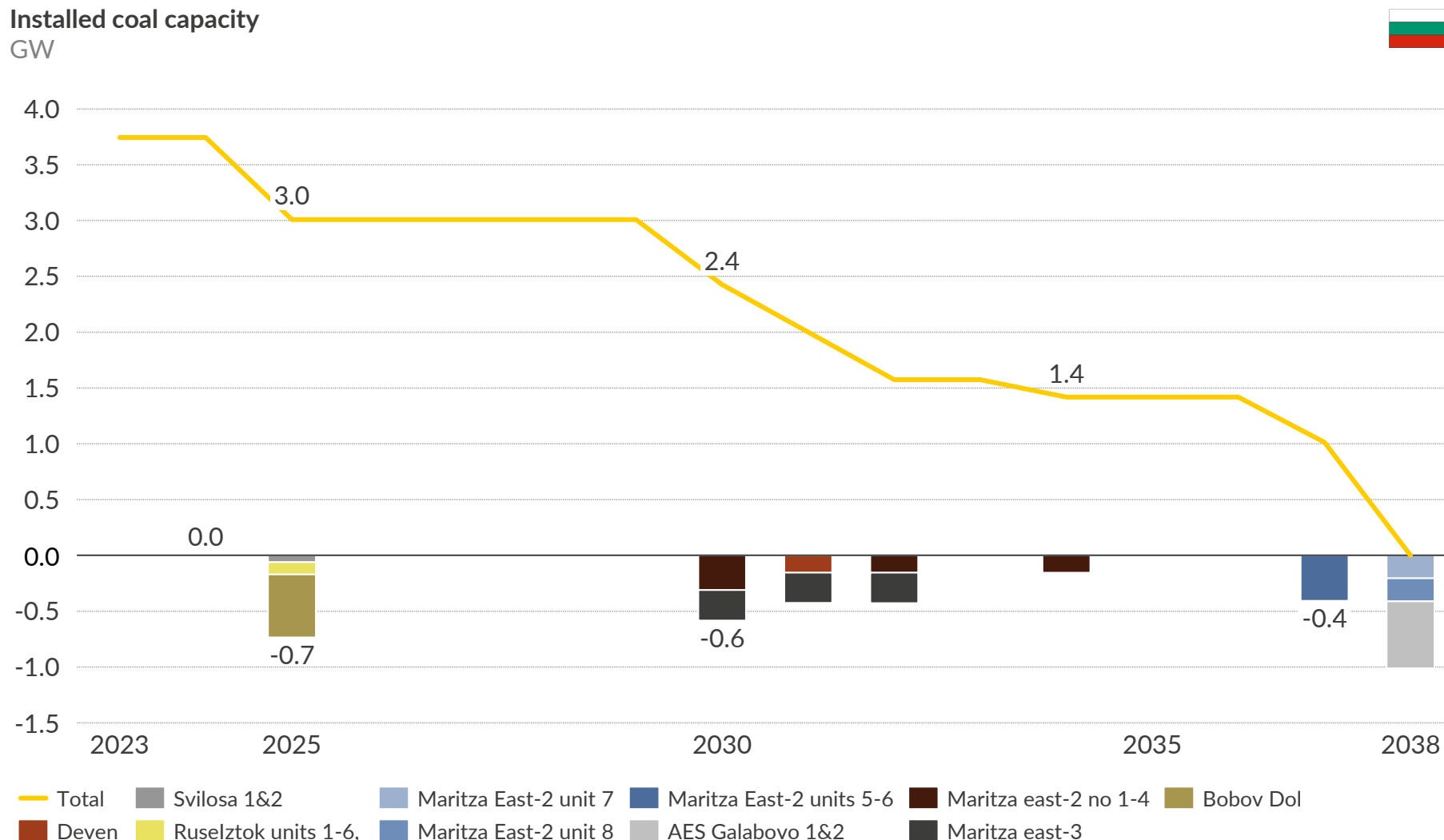
Role of commodity prices

Commodity prices are important drivers of wholesale prices and capacity buildout. In the short and mid-term, fossil fuel prices indicate the upper threshold for electricity prices, as price setting plants mainly run on gas.

1) For years 2023-2028, the prices shown take into account current futures prices for the years in question, with declining weights. 2) A rolling 14-day average as of 01/03/2023. For gas, TTF futures are shown.

Bulgaria's coal fleet is expected to more than halve by the early 2030s while a full coal exit is expected by 2038

Installed coal capacity
GW

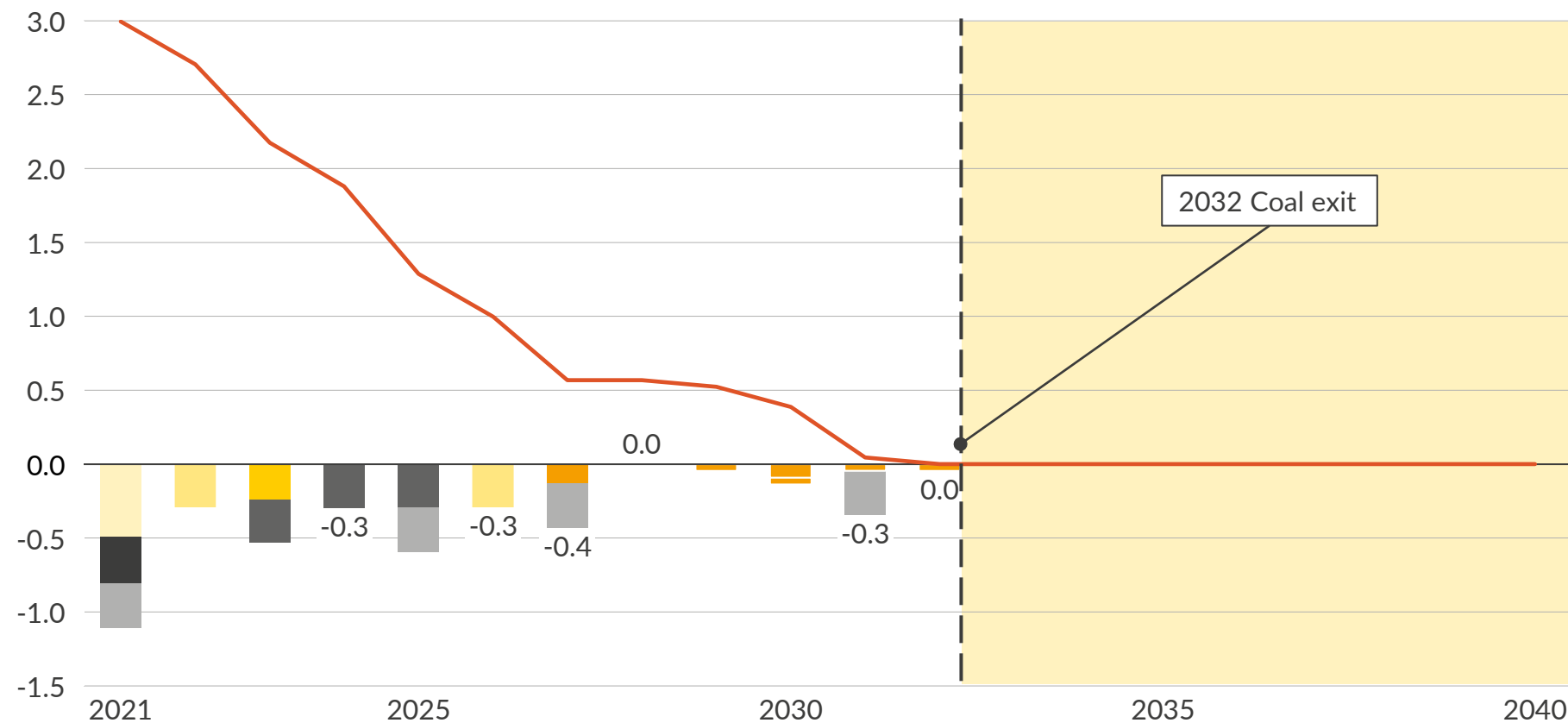


Comments

- Bulgaria's coal power stations have an average commissioning date of 1980
- This means that by 2038 almost all plants will have reached retirement age, even those with refurbishments
- The retirement rate is accelerating in the early 2030s and over 2GW of coal capacity is set to retire over the decade
- Bulgaria has not announced any coal exit legislation. However, lifetime, CO₂ prices, and unfavorable plant economics are expected to drive coal power stations out of the system

Romania's coal fleet is expected to be reduced by more than 50% by 2026 and eventually fully retire by 2032

Installed capacity
GW



— Total ■ Paroseni 4 ■ Isalnita 7-8 ■ Mintia-deva 5-6 ■ Turceni 3-7
 ■ Coc-agg¹ ■ Craiova-ii 1-2 ■ Mintia-deva 2-4 ■ Rovinari 3-6 ■ Arad

1) Aggregate of remaining coal CHP capacity.

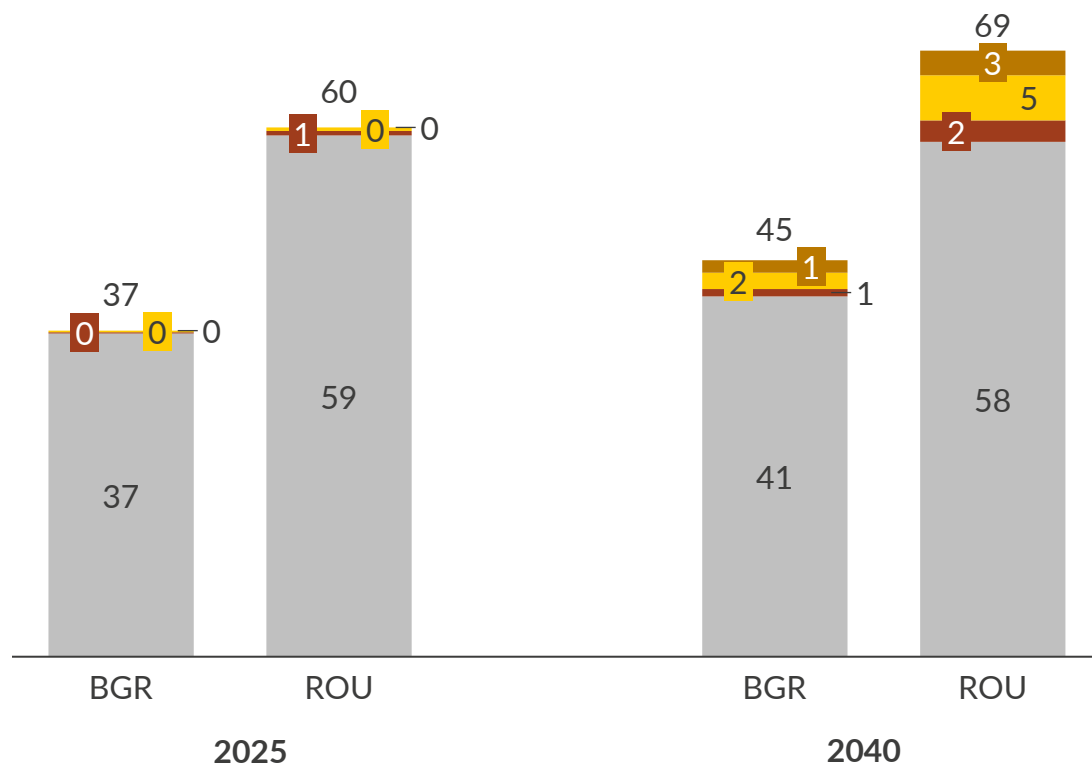
Comments

- Based on the lifetime and already announced retirement plans, Romania's coal capacity is expected to halve by 2026
- Coal is expected to be out of the Romanian power system by 2032 in line with the coal exit goal of the government
- By mid 2020s, a large retirement wave, as part of CE Oltenia's restructuring plan, is expected to lead to a significant loss of baseload capacity that could be replaced by gas, RES and potentially nuclear if the CfD scheme supports it

We also expect a larger system size due to electrification of heat, transport but also green hydrogen production

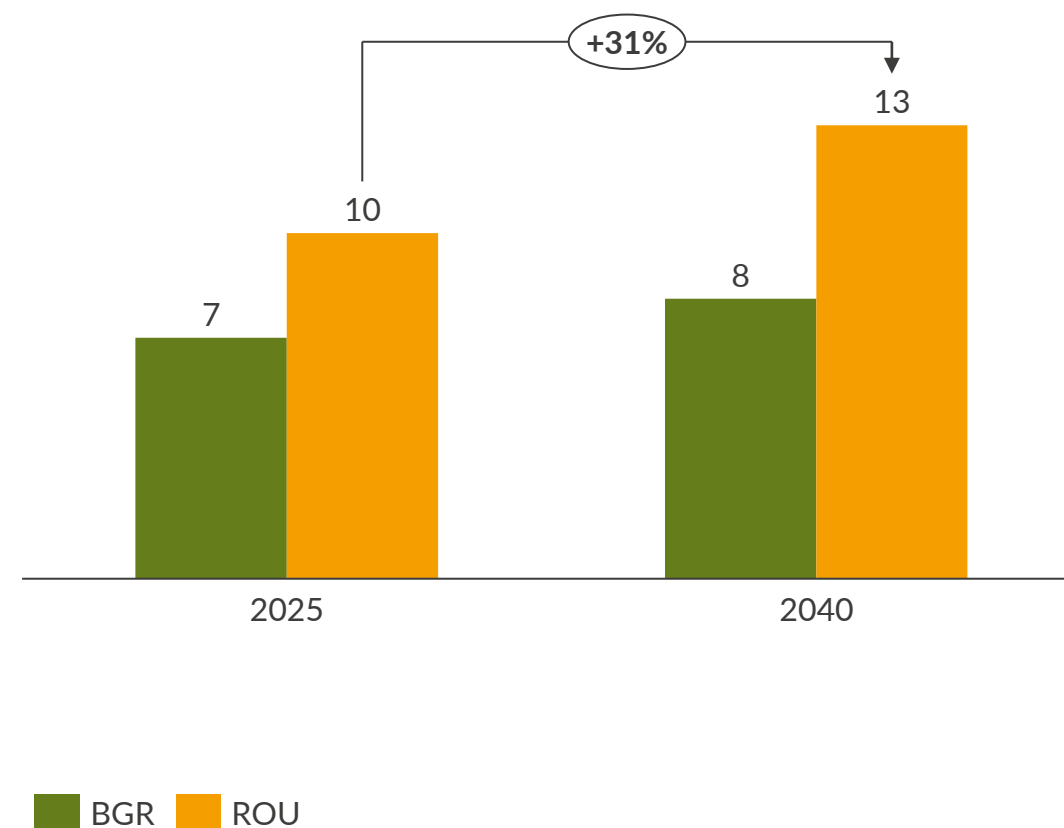
Annual demand demand in 2025 and 2040

TWh



Annual peak demand in 2025 and 2040

GW



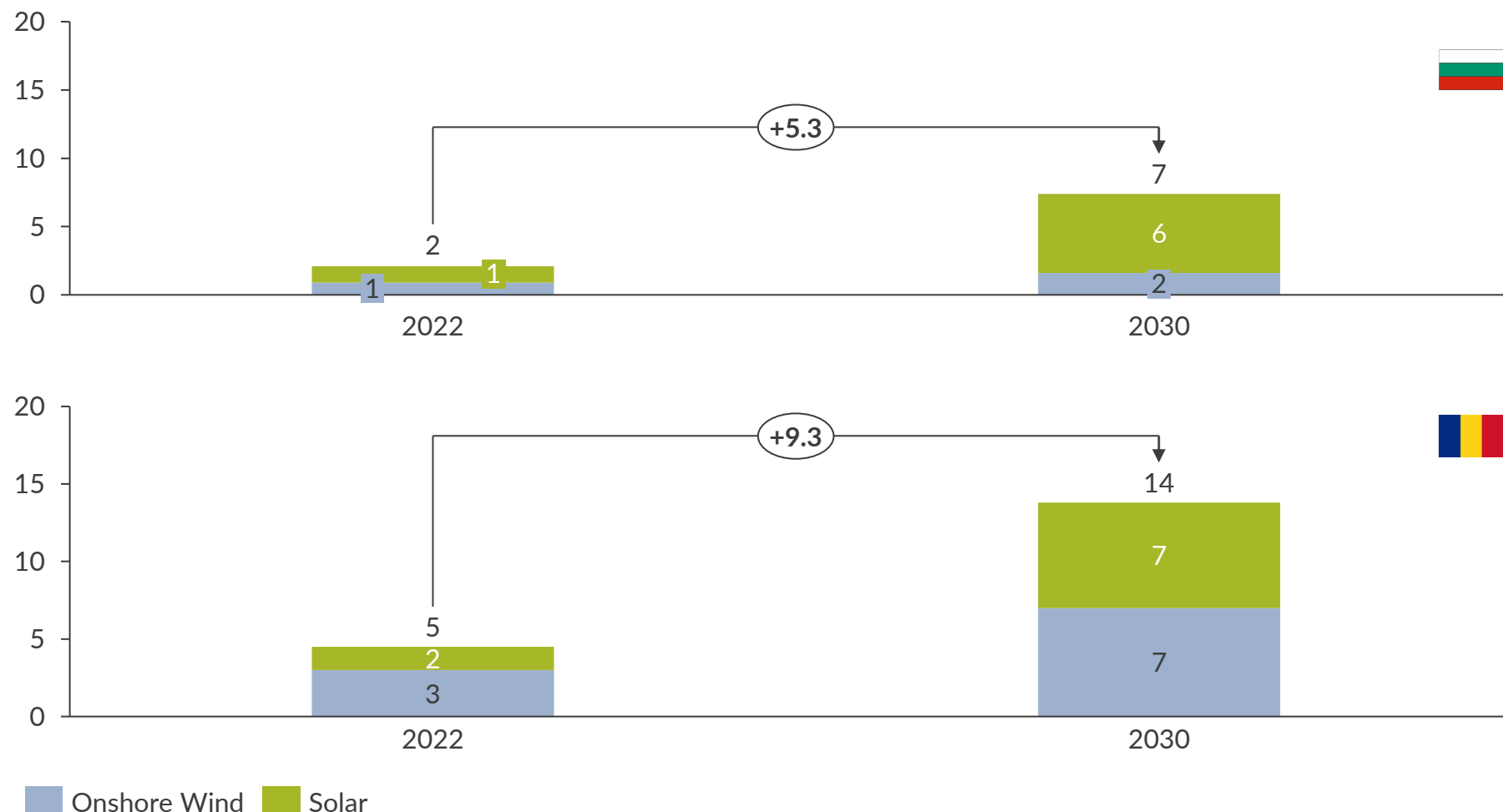
■ Base ■ Heat ■ EV ■ H²

■ BGR ■ ROU

1) Data up to Sep 2022.

The coal exit plans and increasing commodity prices lead to a large, renewables growth which will increase the system's intermittency

Installed capacity
GW



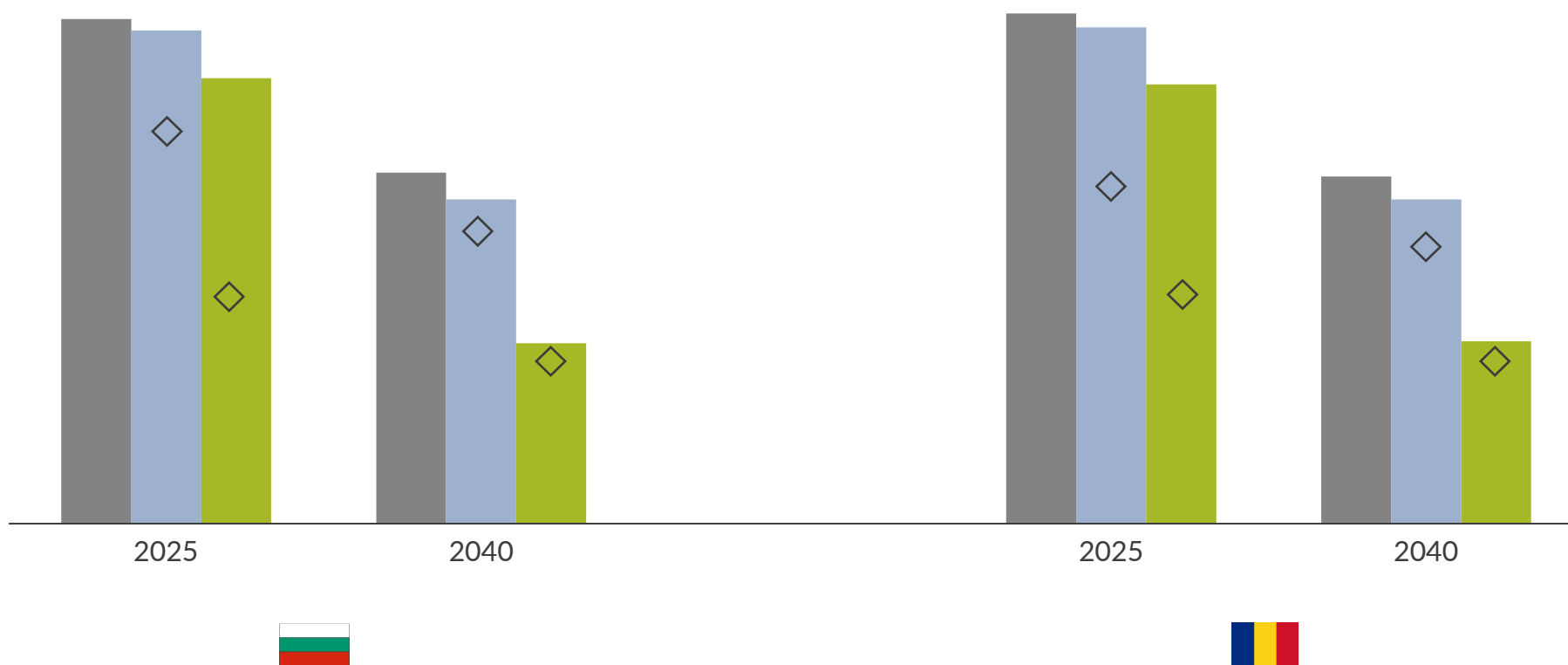
Comments

- Over 14 GW of new renewables capacity could be installed in Bulgaria and Romania over the next 8 years, placing South Eastern Europe as a hot market for investors
- The majority of new capacity is expected to come from solar PV as merchant economics appear more attractive than those of onshore wind
- These levels of RES penetration lead to high instances of excess generation but also of more tight periods as dispatchable capacity decreases – batteries are crucial for supporting this transition

Capture prices for wind and solar appear attractive for large amounts of merchant deployment

Baseload and uncurtailed capture prices¹

EUR/MWh



Comments

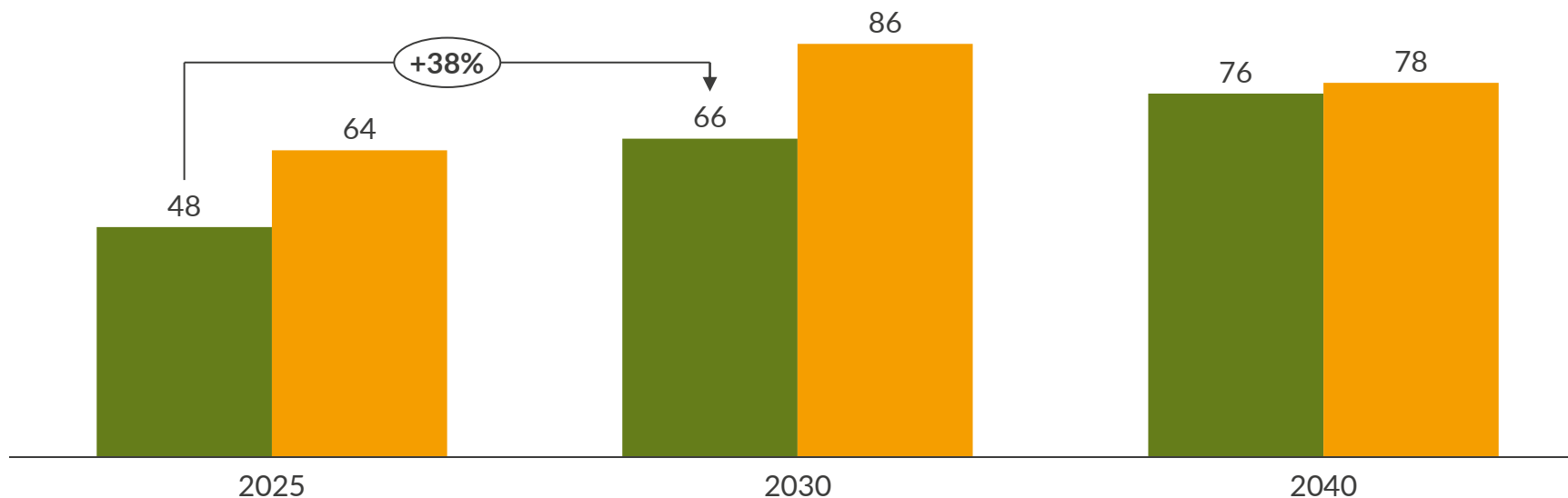
- The largest difference between capture prices and the LCOE for both wind and solar appears in 2025 due to high baseload prices which have not recovered fully from the gas price rally
- While the difference between capture price and LCOE reduces over time, there is a healthy margin all the way to 2040
- Onshore wind prices are expected to see much reduced cannibalisation compared to solar both due to its more diverse profile but also due to the lower deployment

■ Baseload ■ Capture price Wind ■ Capture price Solar ◇ LCOE - 10% discount rate

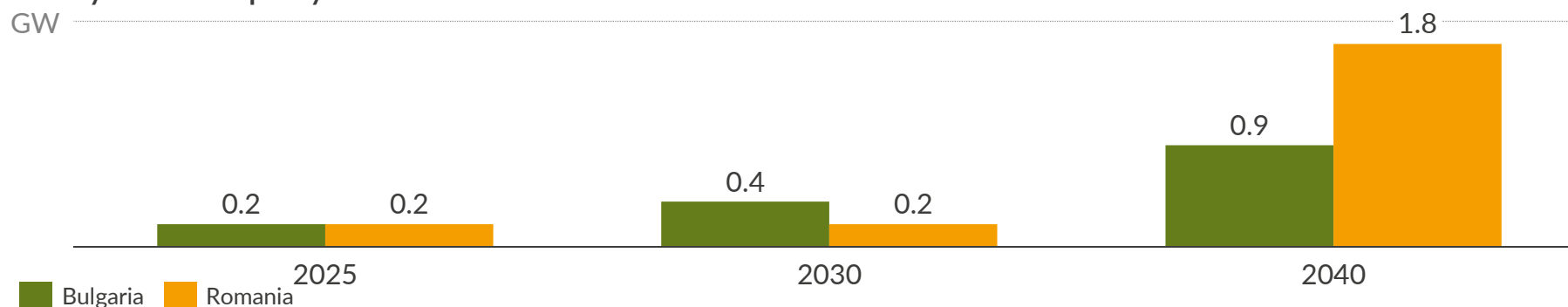
1) Average capture price for each MWh produced of theoretical generation.

Intraday price volatility increases with penetration of intermittent renewables and higher commodity prices

Average daily price spread¹
€/MWh



Battery installed capacity
GW



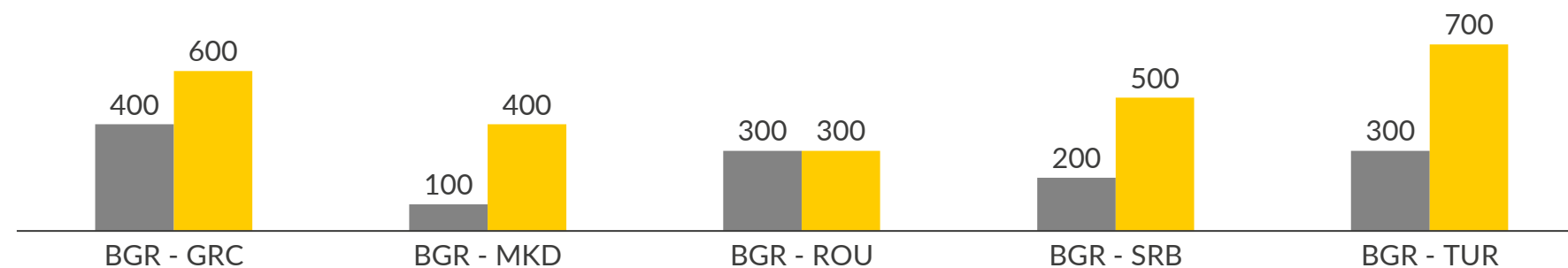
1) Average spread between the lowest and highest price during a day.

- Increased volatility is the result of a growing share of renewables:
 - High solar generation during daytime hours and high wind generation during low demand hours lead to a decrease in prices
 - In hours with high load and low RES generation, prices increase as hydro and gas-fired technologies are price-setting in those hours (against a backdrop of higher gas and carbon price)
- Aurora's projections are affected by amendments in NECP targets, the existence of financial incentives, supporting respective assets built out, as well as favorable economics related to battery energy trading

Bulgaria is a net electricity exporter and is interconnected with all of its land-neighbouring countries

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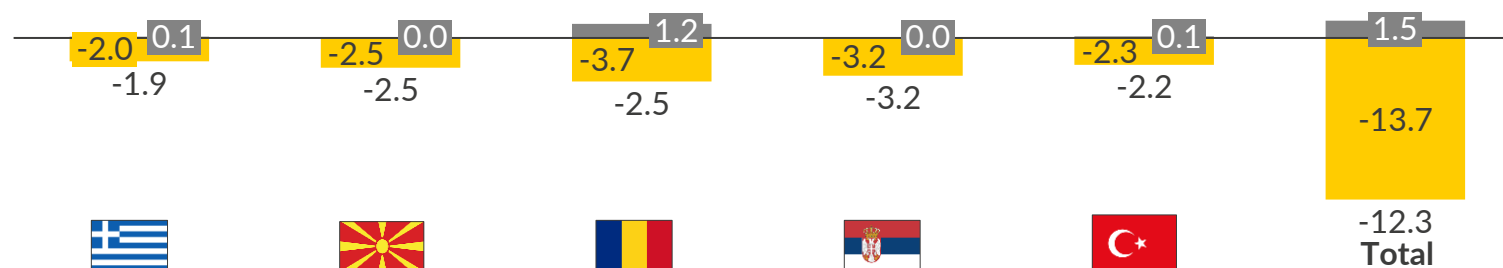
Interconnection capacity
MW



Interconnectors	Import/export capacity MW	Status	Planned until
Future capacity additions ¹			
(A) BGR - GRC	800/1350	Under construction	2023
(A) BGR - ROU	600/600	In permitting	2025
Total additions	1400/1950		

Import/export flows in 2022

TWh



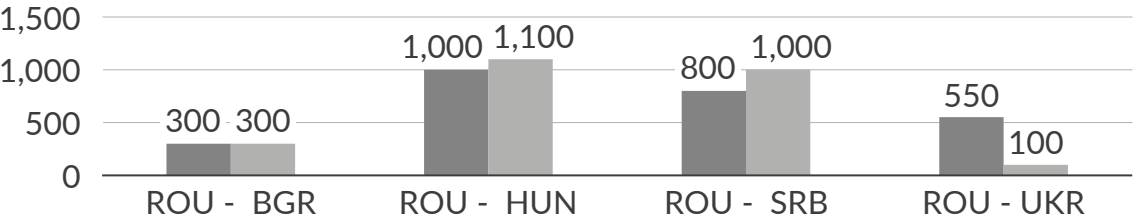
■ Import ■ Export

1) Interconnector capacity increase in line with entso-e 10-year network development plan

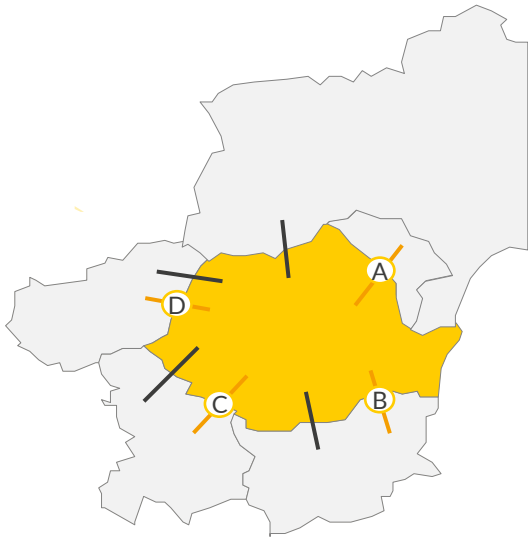
Since 2019, Romania has been a net electricity importer; growth in renewables could change this in next few years



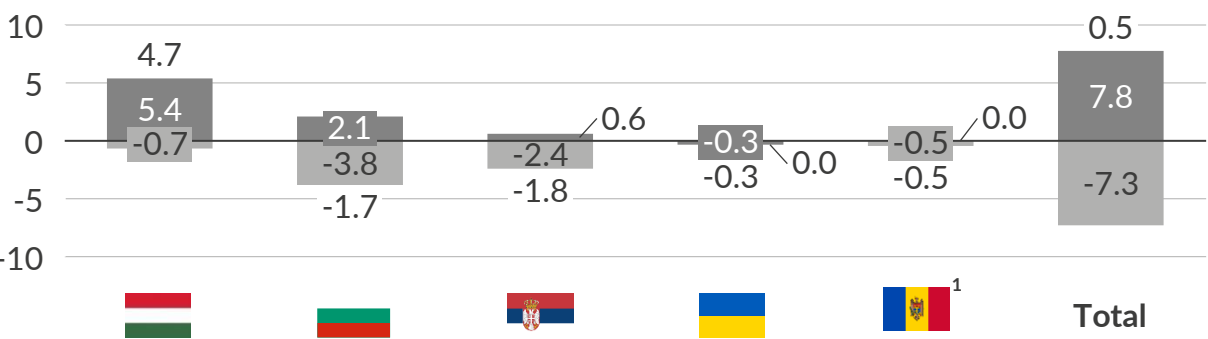
Interconnection capacity
MW



- Romania aims to reach the EU target of 15% interconnection capacity by 2030
- Romania plans to increase interconnection with its neighbours and is building a new link with Moldova



Import/export flows in 2022
TWh



Import Export

1) Romanian power producers started selling electricity to Moldova at a capped price in October 2022, through Ukraine.

Interconnectors MW Status Planned until

Aurora Central projects until 2030

A	ROU - MLD	600	Under construction	2024
B	ROU - BGR	600	In permitting	2025
C	ROU - SRB	1000	Under development	2026
D	ROU - HUN	335	Under development	2027
Total additions		2535		

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