AURORA ENERGY RESEARCH

eex group

Romanian PPAs – A new growth potential for renewables

Dec 8th 2021

Agenda

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I. About Aurora

II. Policy overview and upcoming changes

III. Key market drivers

IV. Renewables outlook

V. The potential and risks for PPAs

VI. Power Exchange Central and the EEX Group

Aurora provides data-driven intelligence for the global energy transformation

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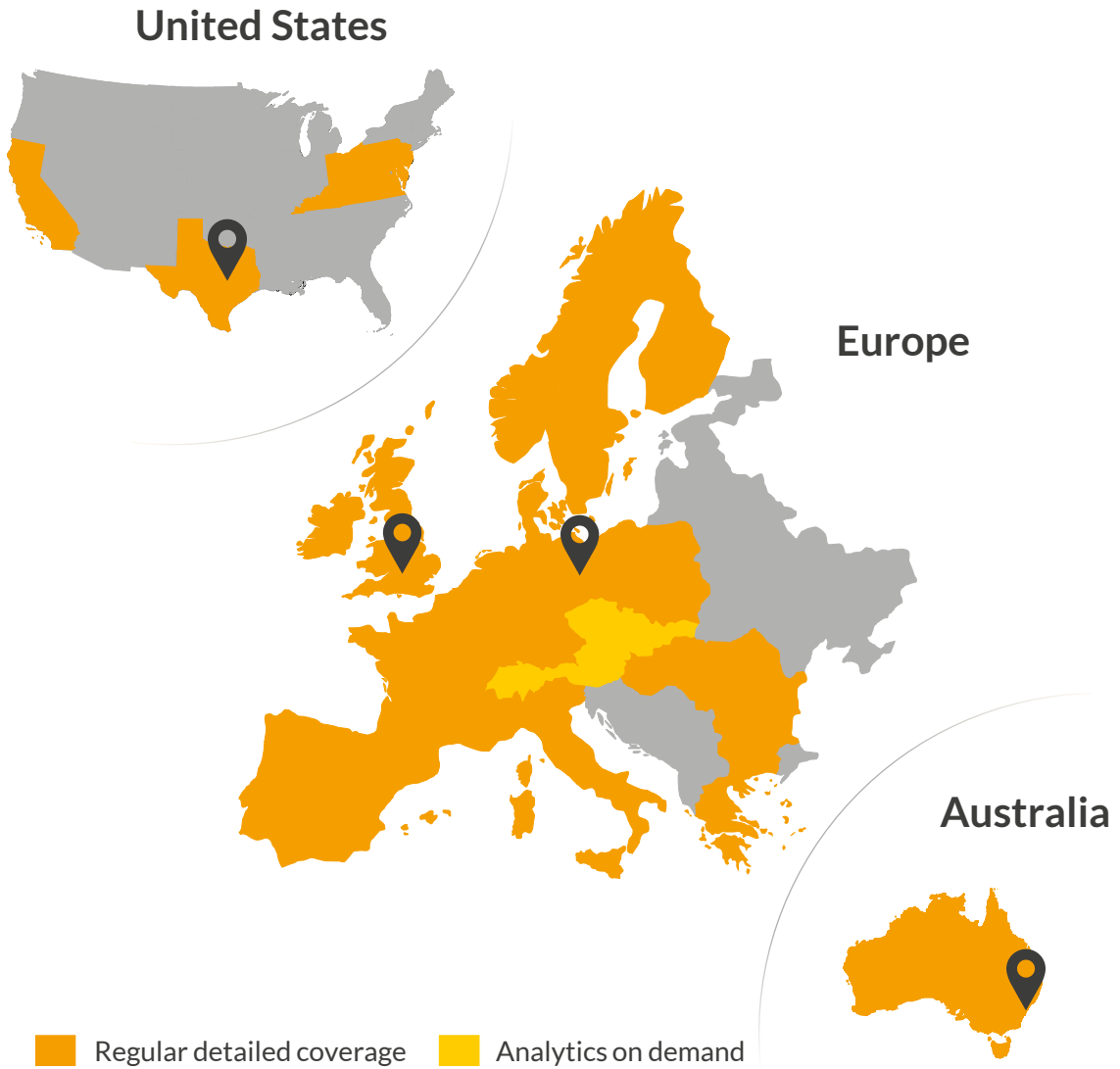
- Power markets
- Renewables
- Storage
- Electric vehicles
- Hydrogen H_2
- Carbon CO_2
- Natural gas



4 Offices
Oxford | Berlin | Sydney | Austin

200+
market experts

350+
subscribing companies

100+
transactions supported in 2020

Source: Aurora Energy Research

Aurora brings a sophisticated approach to the provision of analysis and insight to the energy industry

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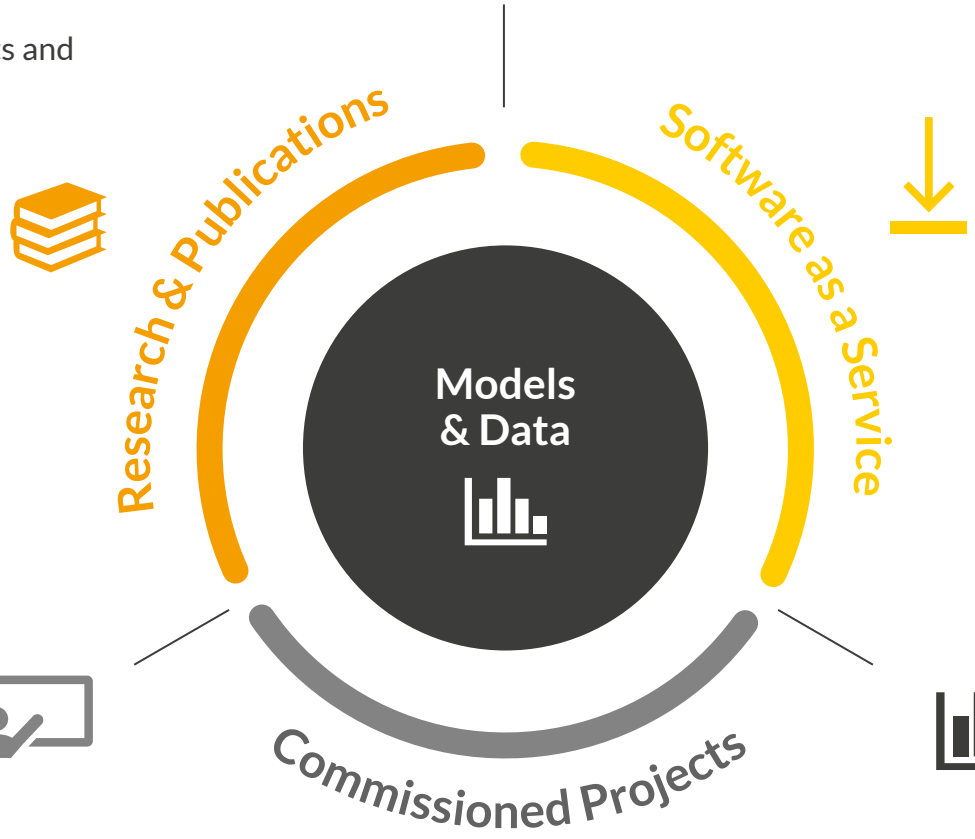
Research & Publications

- Industry-standard market outlook reports and bankable price forecasts for power, gas, carbon and hydrogen markets
- Strategic insights into major policy questions and new business models
- Read and constantly challenged by 350+ subscribers from all industry sectors



Software as a Service

- Out-of-the-box SaaS solutions, combining cutting-edge sophistication with unparalleled ease of use
- *Origin* provides cloud-based access to Aurora's market model, pre-populated with our data
- *Amun* automates asset-specific wind farm valuations for over 30 leading funds, developers and utilities

Commissioned Projects

- Bespoke analysis, drawing upon our models and data
- Trusted advice for all major market participants proven in 500+ projects: transaction support, valuations, strategy & policy engagement

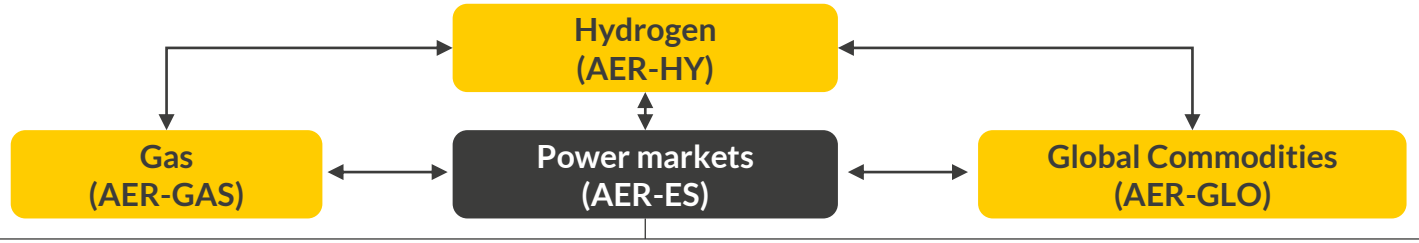
Models & Data

- Market-leading long-term models for power, gas, hydrogen carbon, oil and coal markets
- Continuous model improvements to reflect policy and market developments

Source: Aurora Energy Research

Unique, proprietary, in-house modelling capabilities underpin Aurora's superior analysis

4 Integrated Models



INPUTS

- Technology
- Policy
- Demand
- Commodity prices[1)]
- Weather patterns

Dispatch model

- ½ hourly or hourly
- Iterative modelling
- Dynamic dispatch of plant
- Endogenous interconnector flows

Continuous iteration until an equilibrium is reached

Investment decisions module

- Capacity market modelling
- Capacity build / exit / mothballing
- IRR / NPV driven
- Detailed technology assessments

OUTPUTS

- Capacity mix
- Generation mix
- Wholesale & imbalance prices
- Capacity market prices
- Profit / Loss and NPV
- Electric vehicle charging

Up to 70	c. 85k	~15k	30+
specifications modelled for each plant	investment hours on modelling capabilities	model runs per week	strength of modelling team globally

1) Gas, coal, oil and carbon prices fundamentally modelled in-house with fully integrated commodities and gas market model

Source: Aurora Energy Research

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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
- Transparent results
- State-of-the-art infrastructure
- Zero dependence on black-box third-party software (e.g. Plexos)
- Constantly up to date through subscription research
- Ability to model complex policy changes quickly

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The Romanian power market is mostly liberalised while the transmission and distribution systems are regulated

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	Generation / Trading	Transmission/ Distribution	Retail
Market design	▪ Liberalised market: The market is cleared by merit order ▪ Regulated segment: Suppliers of electricity of last resort are appointed by the National Authority for Energy Regulation (ANRE) ▪ Day-ahead market, intra-day market, balancing market ▪ Electricity producers can setup PPAs if that electricity is generated in electricity generation plants commissioned after 1 June 2020	▪ Regulated market ▪ ANRE calculates separately the distribution tariffs to be charged by each licensed electricity distribution company ▪ The distribution tariffs for the following year are published by ANRE by the end of the current year and are binding on each electricity distribution company	▪ Liberalised market, end-consumers have freedom to choose between power suppliers ▪ The supplier must ensure the labelling of the electricity, and must inform end-users about the structure, origin and environmental impact of the electricity supplied. ▪ The implementation of smart metering systems will be finalised by the end of 2028 by the distribution system operators
Key players	▪ Market operators: OPCOM[1] ▪ >75 %: CE Oltenia & CE Hunedoara, Hidroelectrica, Nuclearelectrica, OMV Petrom	▪ TSO: Transelectrica ▪ 8 DSOs by territory: 5 of which are privately owned and 3 are state-owned	▪ 59 retailers (2020) ▪ Main 5: ENEL Energie, E.ON Energie Romania, CEZ Vanzare, ENEL Energie Muntenia, Electrica Furnizare
Key regulatory bodies	▪ Ministry of Energy of Romania ▪ DG ENER (EU level)	▪ Transelectrica/ANRE ▪ ENTSO-E (EU transmission grid agency)	▪ ANRE

1) Romanian gas and electricity market operator.

Sources: Aurora Energy Research, OMIE, CNMC, CEE, REE, Eurostat

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

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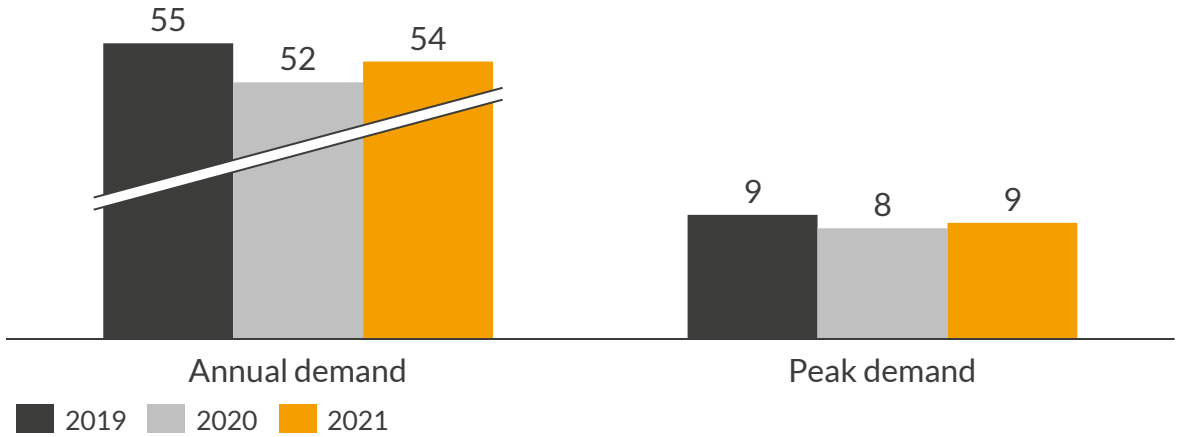
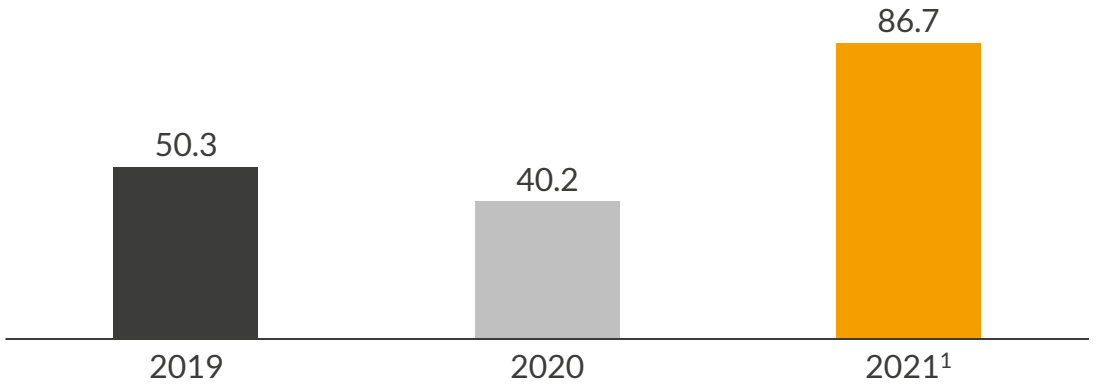
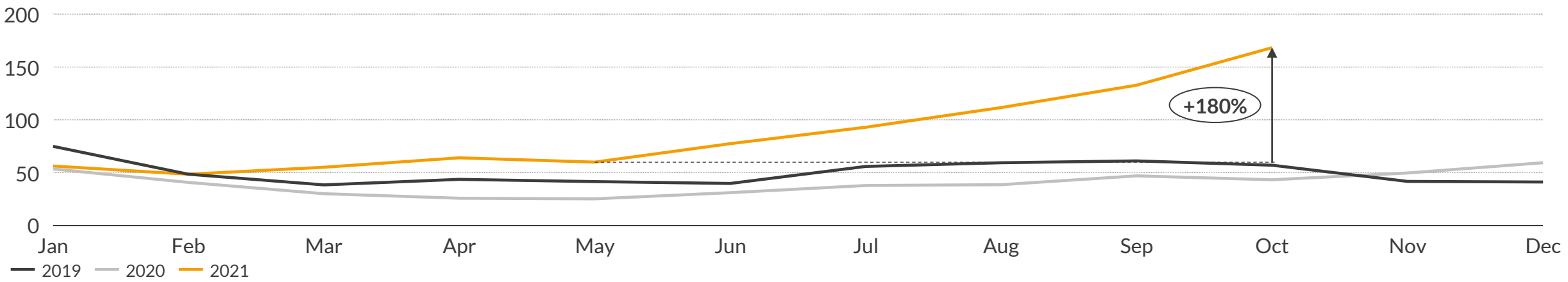
Annual demand and peak demand in 2020 and 2021[1]
TWh/GW



Annual average day-ahead prices
EUR/MWh (real 2020)



Monthly average day-ahead prices in 2021
EUR/MWh (real 2020)



1) Data until October 2021.

Sources: Aurora Energy Research, Romanian TSO, ENTSOE

Imbalance prices doubled in 2019 and 2020 compared to 2015-2018 average; the 15-min settlement interval initially reduced prices

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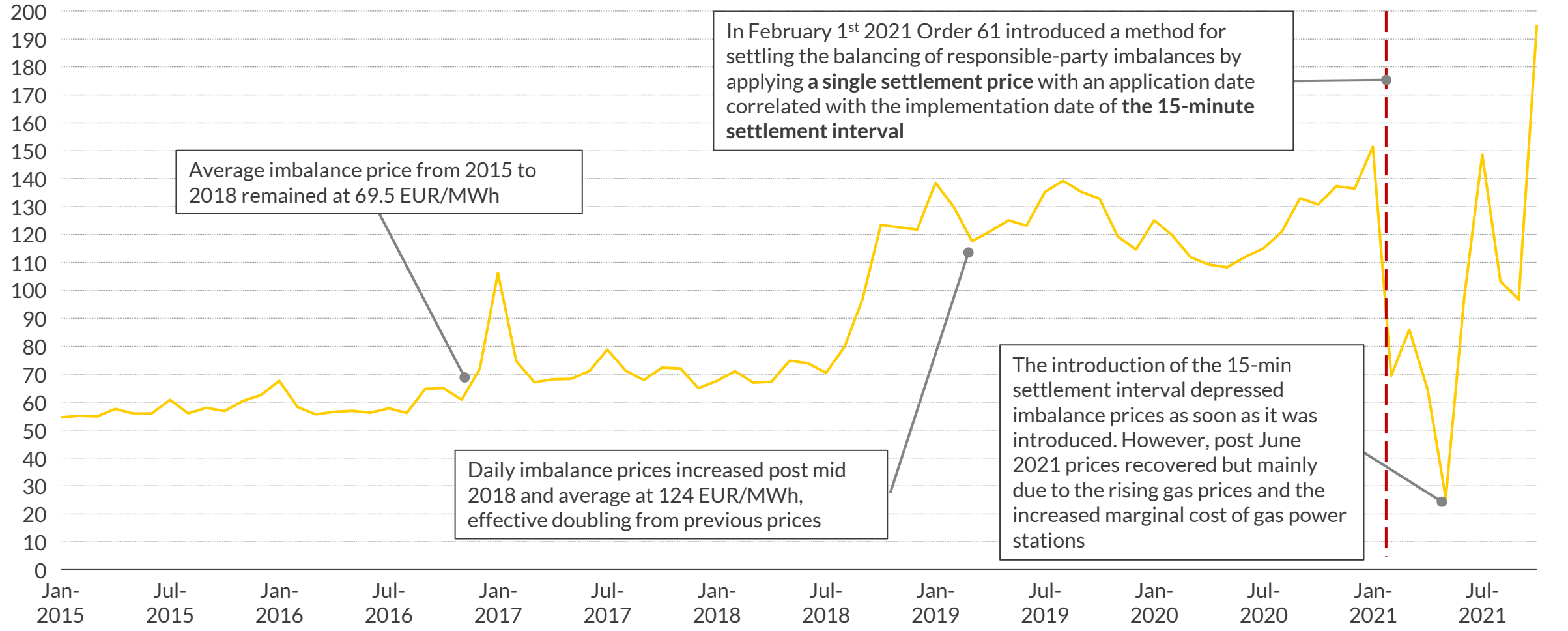
Daily negative[1] imbalance price in EUR/MWh since January 2015 in Romania



1) ENTSOe data available for negative and positive imbalance prices.

Sources: Aurora Energy Research, ENTSOe

A CfD scheme is under development with the potential to support up to 3.5 GW of onshore wind and solar by the end of 2024

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Time to delivery

CfD scheme introduction	Developments and consultations. Aiming to deliver in the next 16-18 months	Completion of legal framework for the introduction of a CfD scheme by **Q4 2022**	First auction in **late 2023?**

General information	Subsidy size	How much new capacity could come online?
▪ Electricity is sold in the market and the producer receives the difference between the market price and the strike price. If it sells power at a higher price, then it returns the amount exceeding the strike price. ▪ The RES support scheme is under development in conjunction with EBRD[1] and is expected to be notified to Brussels by mid 2022. ▪ 15 year support scheme. ▪ ANRE and the government expected to decide on auctioned volume for budget calculations.	▪ The ministry suggested EUR 125 million per year for renewable projects under the initial consultations back in 2019. ▪ The final annual budget will be determined at a later date with the introduction of the scheme and will depend on the capacity that ANRE and the government decide to auction in the first 2 years of the scheme.	▪ According to the latest announcements during the workshop with EBRD and the Romanian government, 1.5 GW could be auctioned by Q4 of 2023 and another 2 GW by Q2 2024 ▪ The final volumes have not been passed into law and therefore, official confirmation is pending

- Separately, according to guidelines from last year, nuclear and carbon capture and storage projects might be supported under different schemes, under a budget of EUR 215 million per year.
- There is a possibility to achieve the deals through direct negotiations, like in the case of the planned units 3 and 4 of the Cernavodă nuclear power plant.
- The support budget for nuclear and CCS would be sufficient to bring online nearly 1.5 GW of nuclear and CCS projects assuming that the difference between the wholesale price and strike price is 25 EUR /MWh and that nuclear takes 60% of the awarded auction volumes while CCS the remainder 40%[2].

1) European Bank for Reconstruction and Development. 2) Assuming a nuclear load factor of 85% and a CCS load factor of 60%.

Source: Aurora Energy Research

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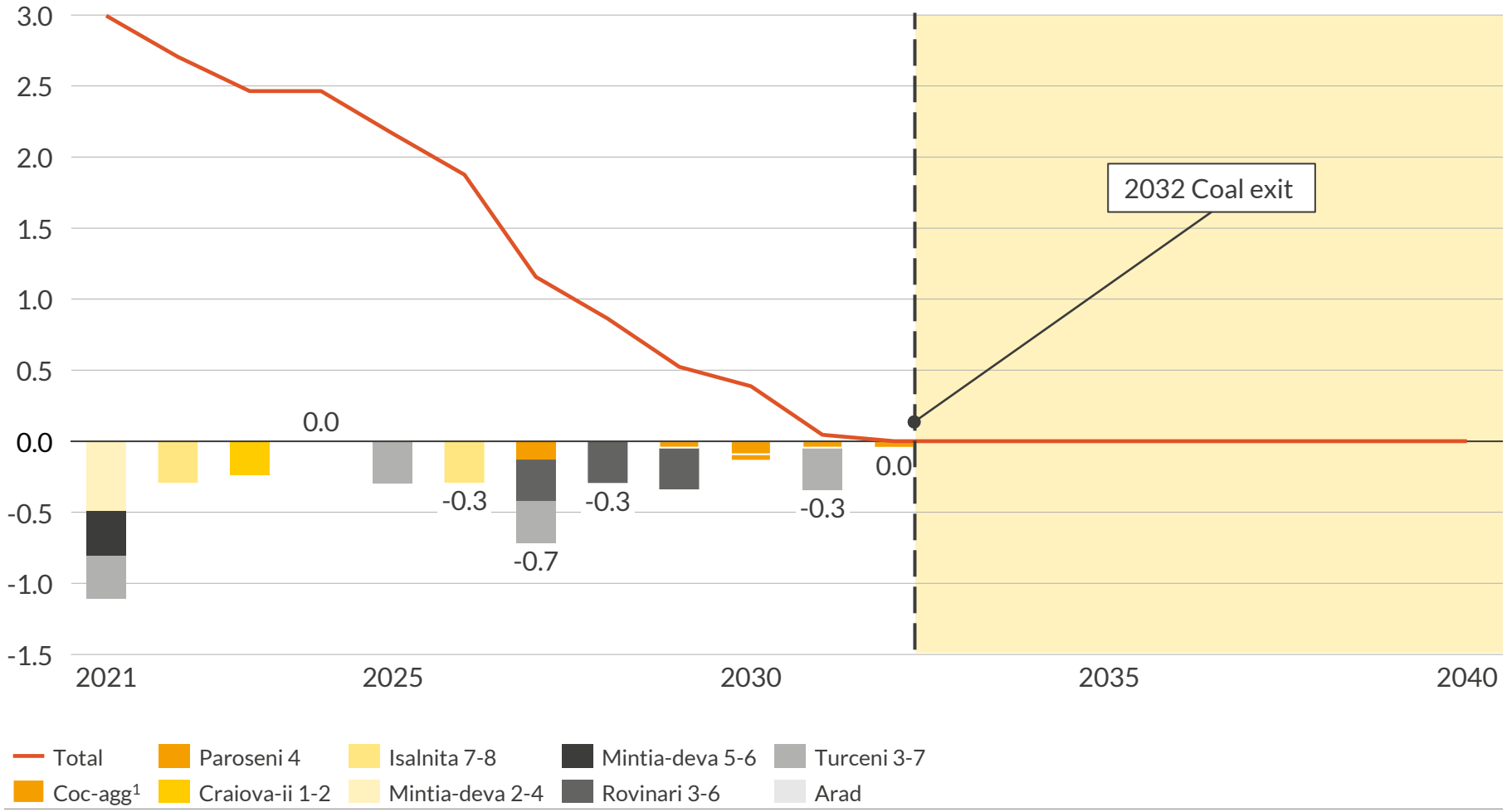
Romania's coal fleet is expected to be reduced by more than 50% by 2026 and eventually fully retire by 2032

Installed capacity
GW



1) Aggregate of remaining coal CHP capacity.

Sources: Aurora Energy Research, ANRE, Transelectrica, Eurostat

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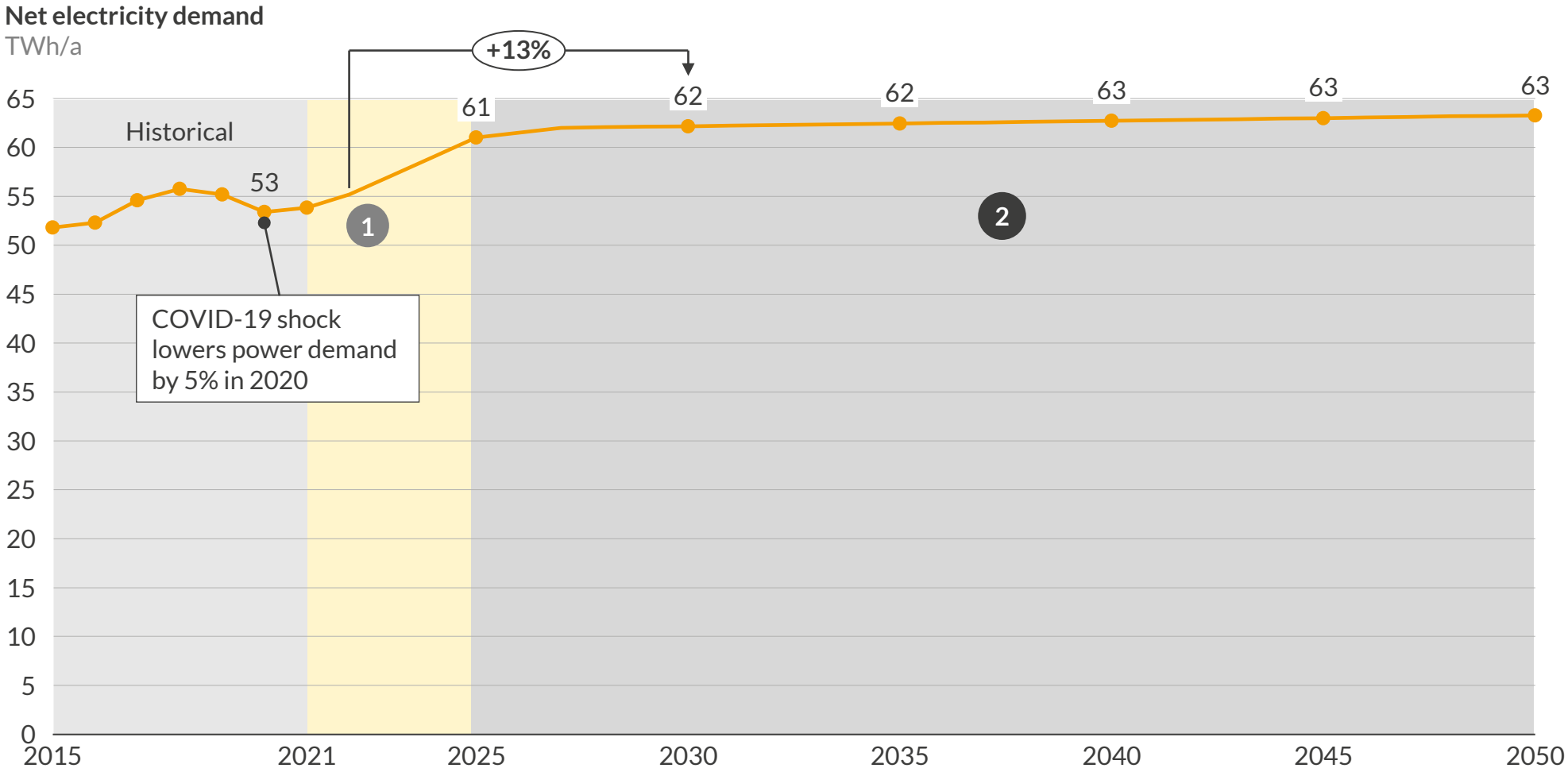
Comments

- 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

After recovery from COVID-19 crisis, Aurora projects a 13% demand increase from 2022 until 2030



1

Following recovery from COVID-19 crisis, demand increases moderately until 2025, as efficiency gains balance out GDP growth

2

The demand growth rate decreases post 2025

Aurora demand forecast in line with national TSO Transelectrica`s planning

Source: Aurora Energy Research

In 2019 and 2020, Romania was a net electricity importer caused by lower technical availability of plants and economic reasons

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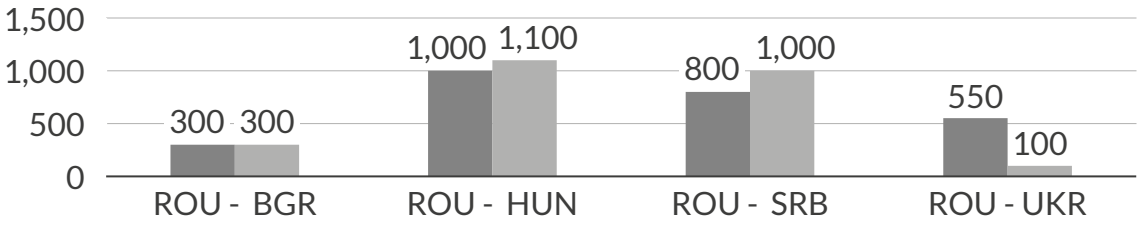
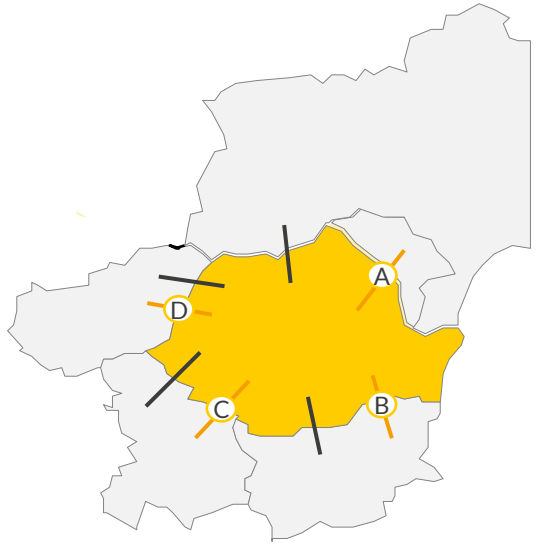
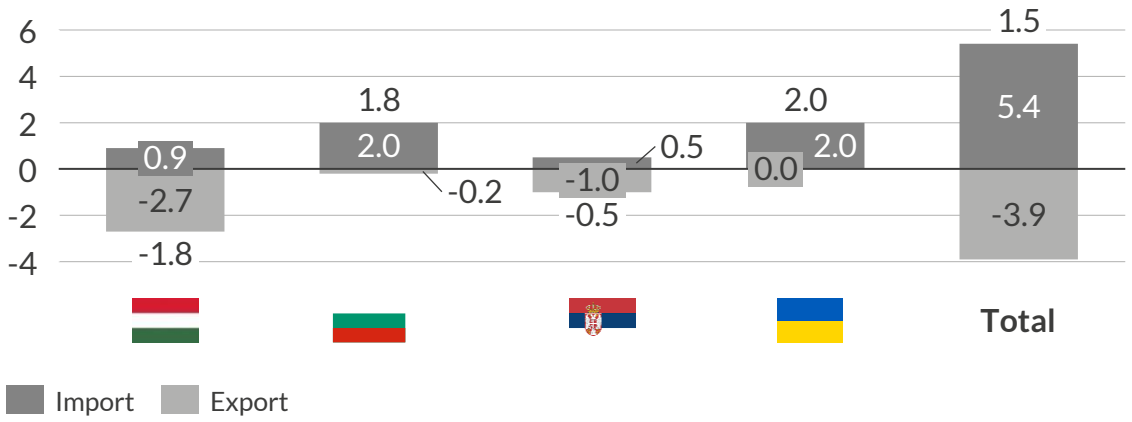
Interconnection capacity
MW



- 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 2019
TWh

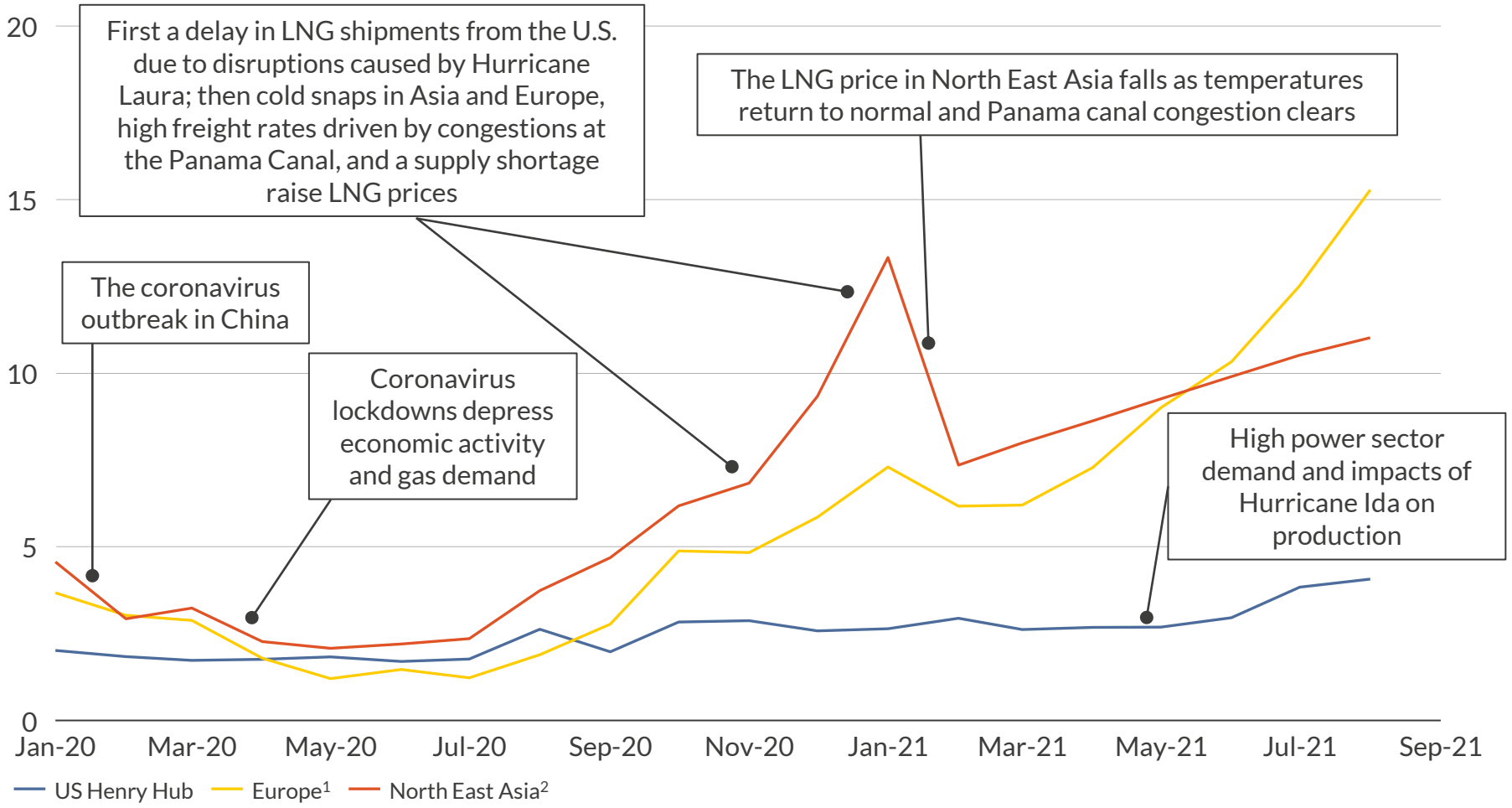


Interconnectors	MW	Status	Planned until
Aurora Central projects until 2030			
A ROU - MLD	600	Under construction	2024
B ROU - BGR	600	In permitting	2024
C ROU - SRB	1000	Under development	2026
D ROU - HUN	335	Under development	2027
Total additions	**2535**		

Sources: Aurora Energy Research, ENTSOe

Gas prices in Europe and Asia have increased significantly since Feb-21 due to economic recovery amid tight pipeline and LNG supply

Traded average monthly gas prices
$/MMBtu



1) The reference hub is TTF in the Netherlands. 2) The reference country is Japan.

Sources: Aurora Energy Research EOS, EIKON

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- European and Asia gas prices have been on the rise since Feb-21. North East Asia gas price reached $11/MMBtu in Aug-21, growing by 49.8% in six months. TTF averaged $15.3/MMBtu in Aug-21, increasing 19.8% m-o-m on average since Mar-21, surpassing Asian price levels in May-21
- The surge in European gas prices was driven by a combination of
  1. High demand as Europe emerges from lockdown
  2. Asian demand driving a tight LNG market
  3. Fall in indigenous production
  4. Flat Russian pipeline supply
  5. Low inventories following colder-than-normal weather

Uncertainty about long-term prices is driven largely by underlying commodity price risks

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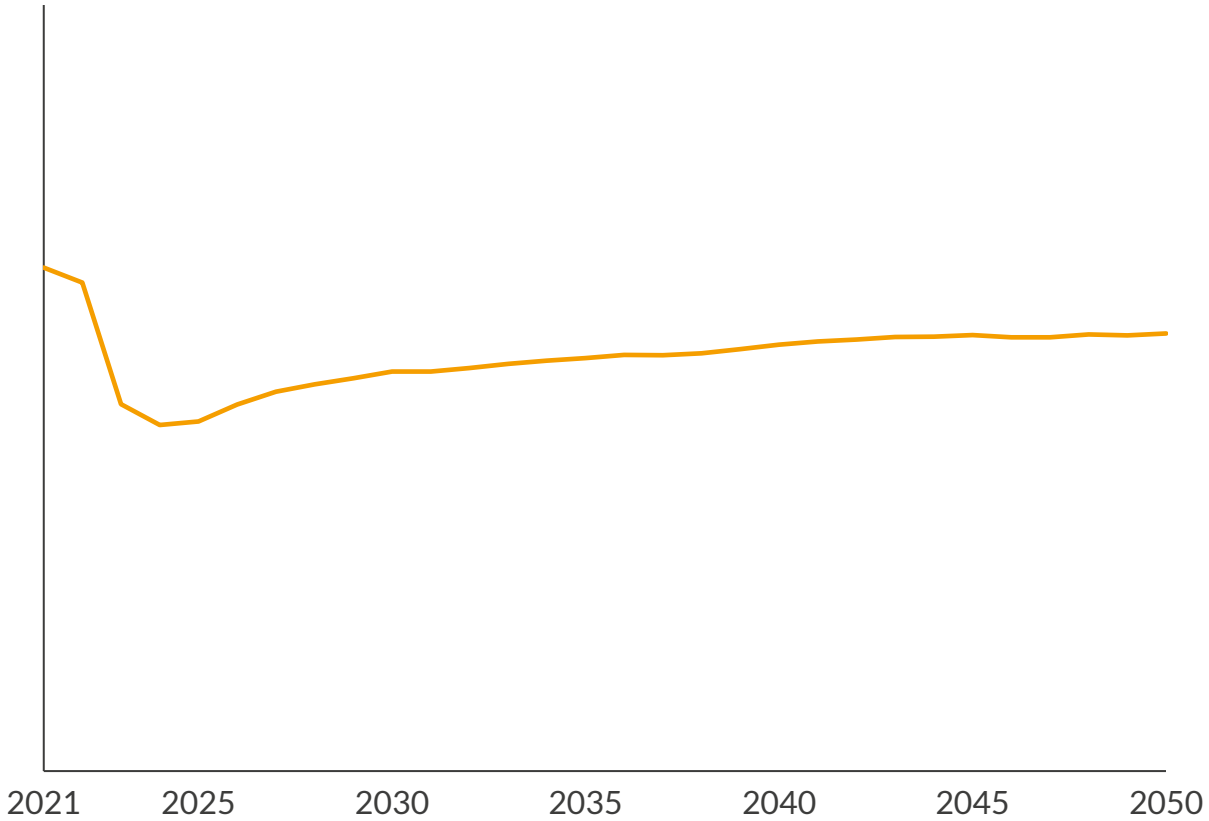
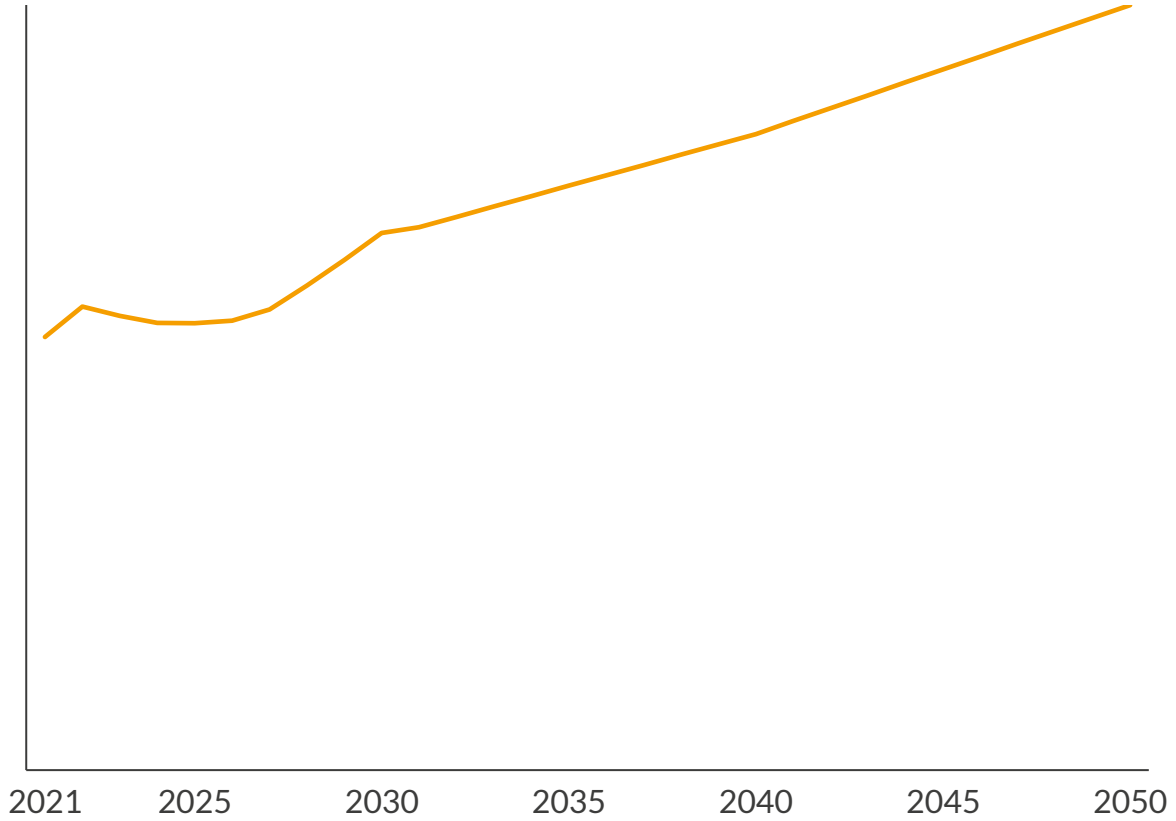
Natural gas prices
EUR/MWh (real 2020)



Carbon prices
EUR/tonne CO_2 (real 2020)



Source: Aurora Energy Research

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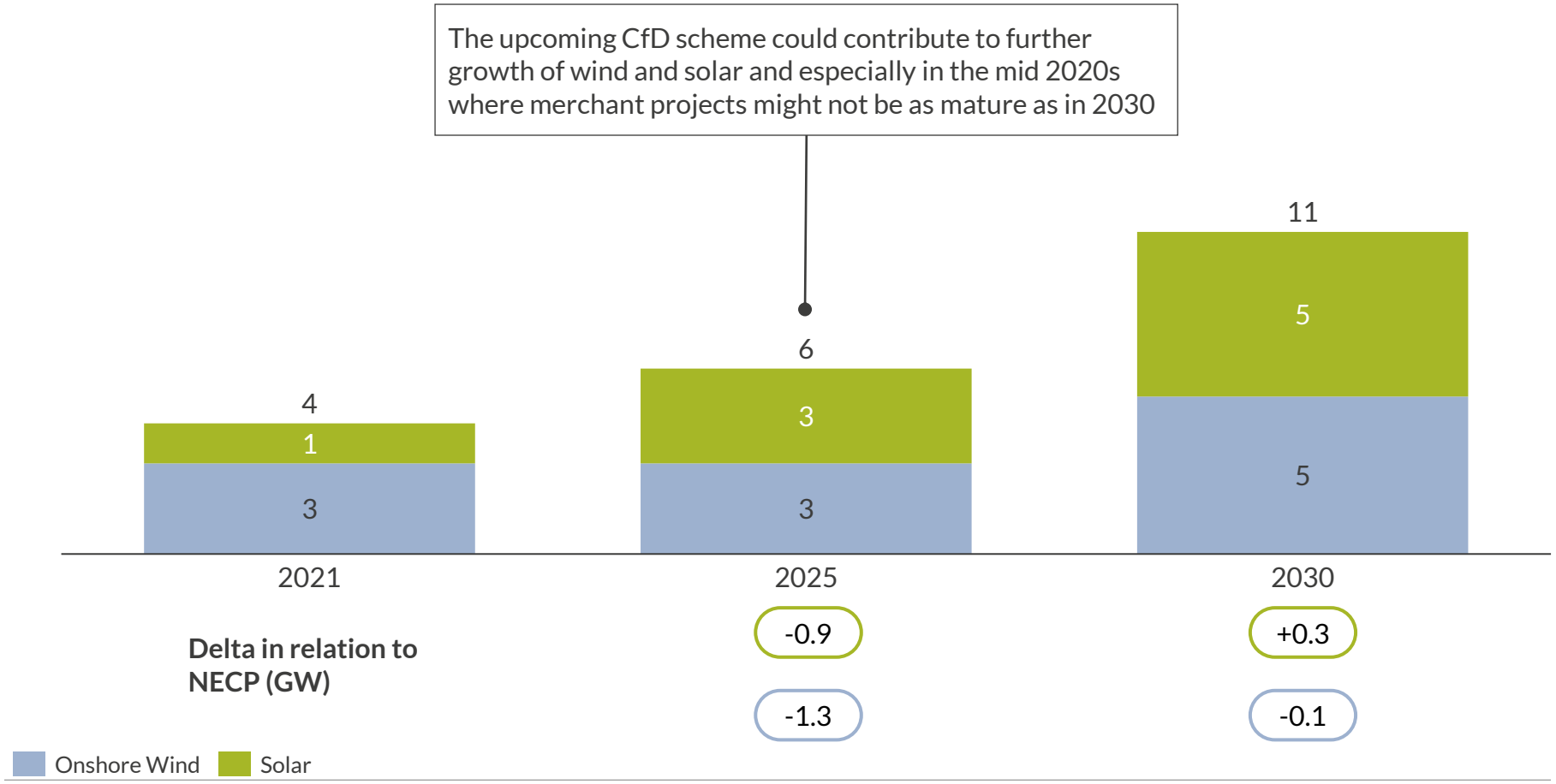
Fundamentals show over 6 GW of solar and wind capacity deployment by 2030; The upcoming CfD could boost this further

Installed capacity
GW



Sources: Aurora Energy Research, NECP

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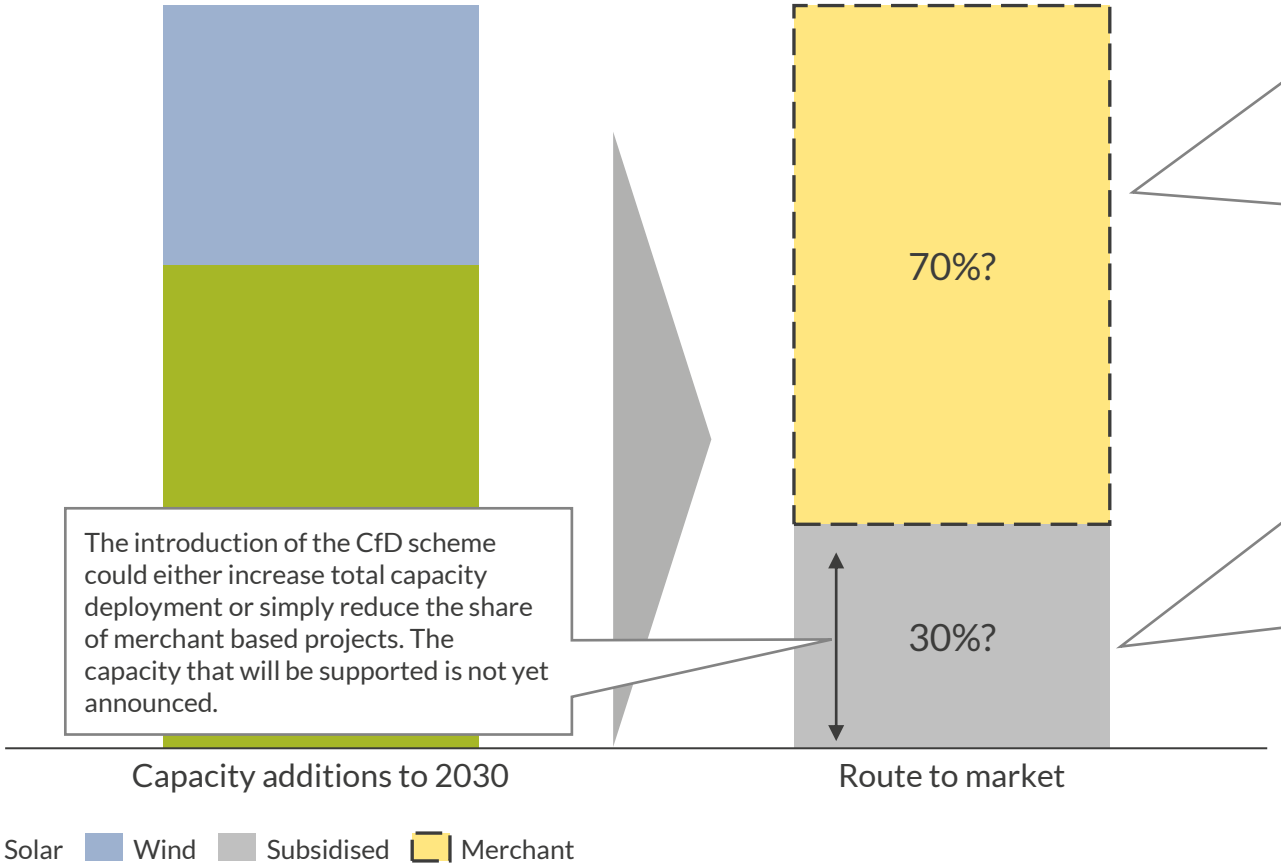
Comments

- RES buildout in line with NECP targets until 2030 with solar overpassing the target by 0.3 GW and wind missing it by only 100 MW
- The 6 GW of capacity expected by 2030, is forecasted based on fundamentals which implies this is the capacity that could come online via merchant projects (directly participating in the market or signing PPA contracts) given certain build out limitations
- Romania could have nearly 16 GW of wind and solar by 2050

A strong RES deployment is expected in Romania by 2030; Aurora provides intelligence for both merchant and subsidised assets

Wind and solar capacity additions from 2021 to 2030
GW



How can these merchant projects be financed and brought to market?

- What are the expected revenues/returns of merchant-based RES projects?
- What are the key risks and considerations for investors and financing banks?
- Are PPAs a viable alternative route to market, how attractive are they and what are key risks?

➢ **Aurora's analysis can provide crucial intelligence to understand and assess all different types of merchant risk**

How will the introduction of the CfD scheme (if successful) affect RES buildout?

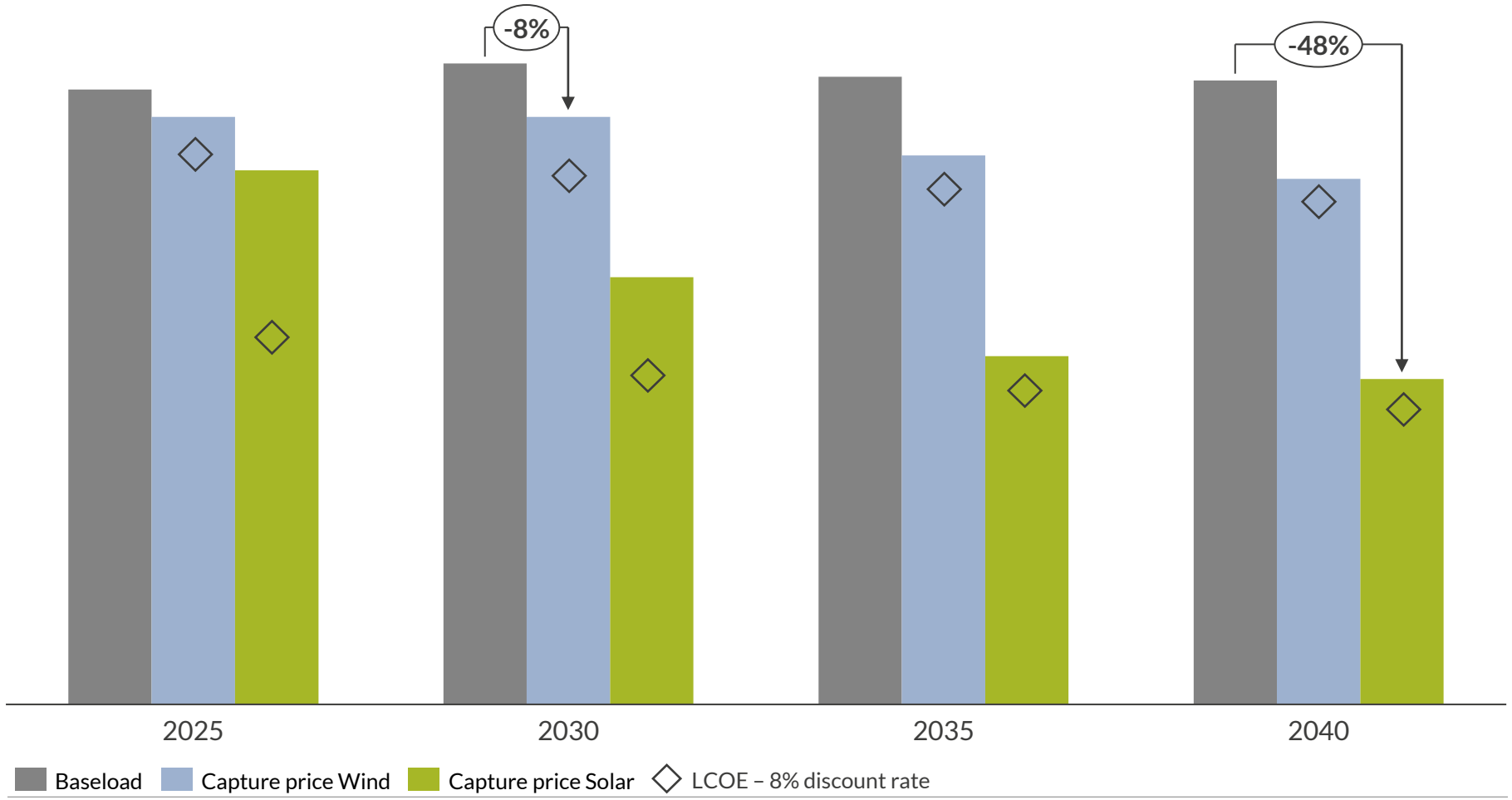
- What are the key parameters for evaluating auctions versus market driven projects?
- How important will the merchant tail of subsidised projects be?

➢ **Aurora's insights can be used to inform a bidding strategy which reflects the true value of RES assets**

Source: Aurora Energy Research

Capture prices for wind and solar appear attractive in comparison to the LCOE of each technology under an 8% discount rate

Baseload and uncurtailed capture prices[1]
EUR/MWh (real 2020)



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

Source: Aurora Energy Research

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Comments

- The largest difference between capture prices and the LCOE appears in 2025 for solar and in 2030 for wind
- In the future, the difference between capture prices and LCOE reduces over time, and especially for solar, due to the increased cannibalisation observed as more capacity comes online

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Unsubsidised renewables will exert downward pressure on PPA prices; The CfD scheme could reduce this impact

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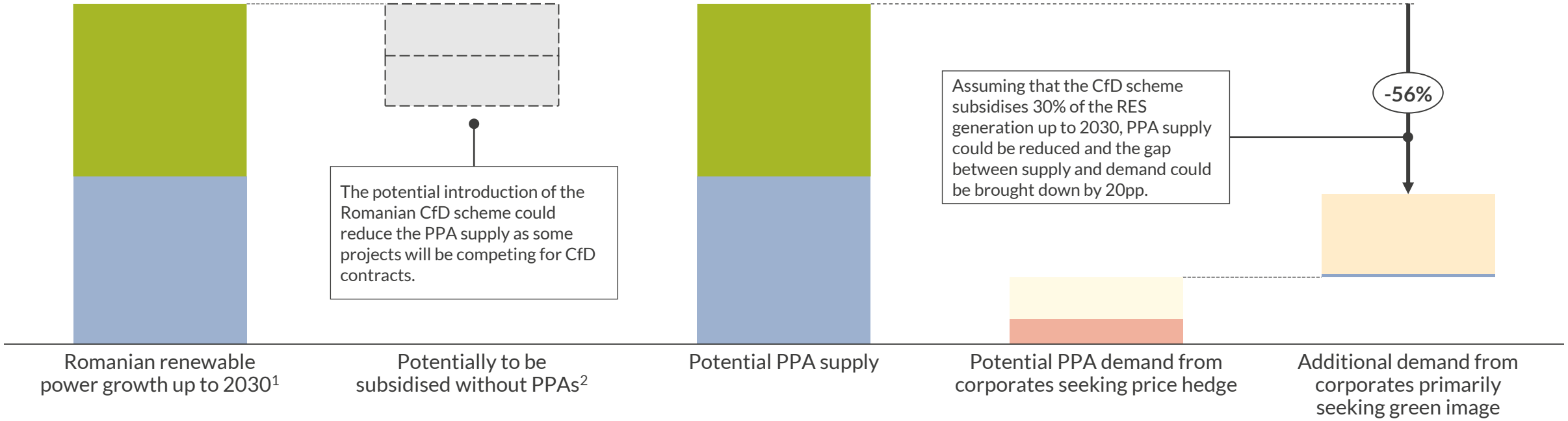
Cumulative total PPA potential supply and corporate demand up to 2030
TWh



Key takeaways

- Attractive RES economics lead to a large growth of merchant based projects in Romania
- Market will be a strong buyer's market - Corporate demand for long-term price hedges less than half of PPA supply potential, putting a downward pressure on PPA prices. Additional demand creates an opportunity for utilities to act as risk aggregators
- The upcoming CfD scheme could reduce the gap between PPA supply and PPA demand as many RES projects may find routes to market via subsidies

Solar Onshore Green Image seekers Green giants Price Hedgers Intermediates

1) Under Aurora Central, lists only renewable power generation added between 2021 and 2030. 2) A potential generation amounting to 30% of additional generation from 2021 to 2030 could be subsidised by the upcoming CfD scheme however, it is not counted toward the final PPA supply as the implementation of the scheme has not been officially introduced.

Sources: Aurora Energy Research, Eurostat

Commercial contract clauses determine the risk distribution and the fair value of the PPA

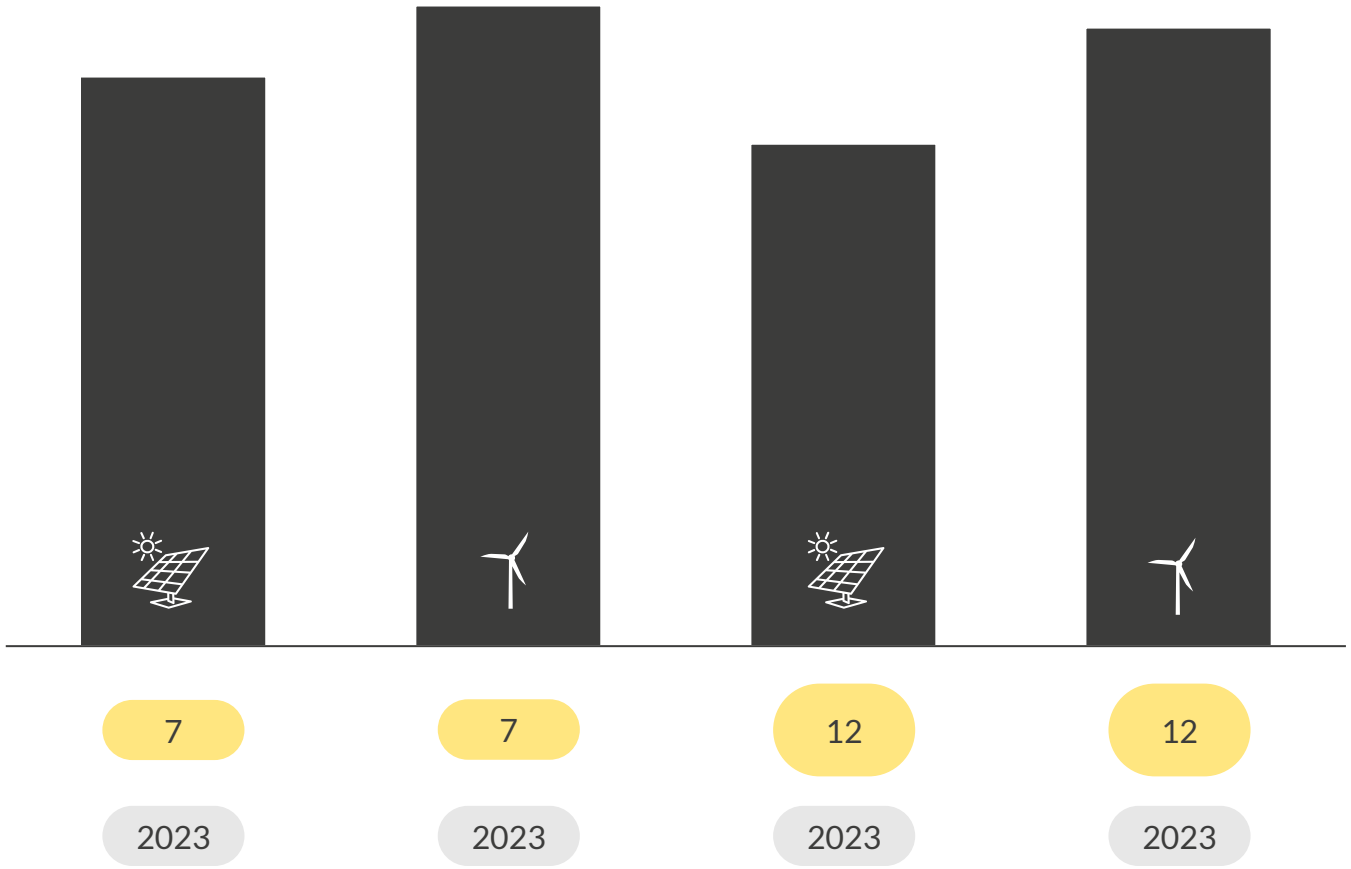
Commercial clause		Description	Who holds the risk? Offtaker ... Developer
Price clauses			
Fixed price		Fixed long-term price, offtaker takes on full price risk	
Collared		Price follows capture price, contract guarantees a max/min price	
Floating/Indexed price		Price linked to baseload index, offtaker only takes on capture price cannibalisation risk	
Tenor clauses			
Short term (<=5 years)		Not suitable for price hedging as futures liquid, suitable if no debt financing required. E.g. Onshore / solar > 20 yrs COD (out of EEG)	
Medium term (6 - 9 years)		Allows debt financing for smaller new build projects. E.g. solar and onshore merchant	
Long term (>9 years)		Allows for highly debt-leveraged finance required for high risk projects, e.g. offshore wind (zero bids)	
Volume clauses			
As produced		Offtaker receives asset generation profile	
Monthly % of P90		Asset(s) guarantees minimum pattern	
Fixed pattern/ baseload		Asset delivers power at a pre-agreed fixed pattern	

Common Few cases Uncommon

Source: Aurora Energy Research

The fair value of typical fixed price PPA contracts range between the low 50s and the low 60s EUR/MWh for volume as forecasted

Fair value of PPAs[1]
EUR/MWh (real 2020)



1) The fair value is calculated assuming as forecasted volume clause and fixed price clause.

Source: Aurora Energy Research

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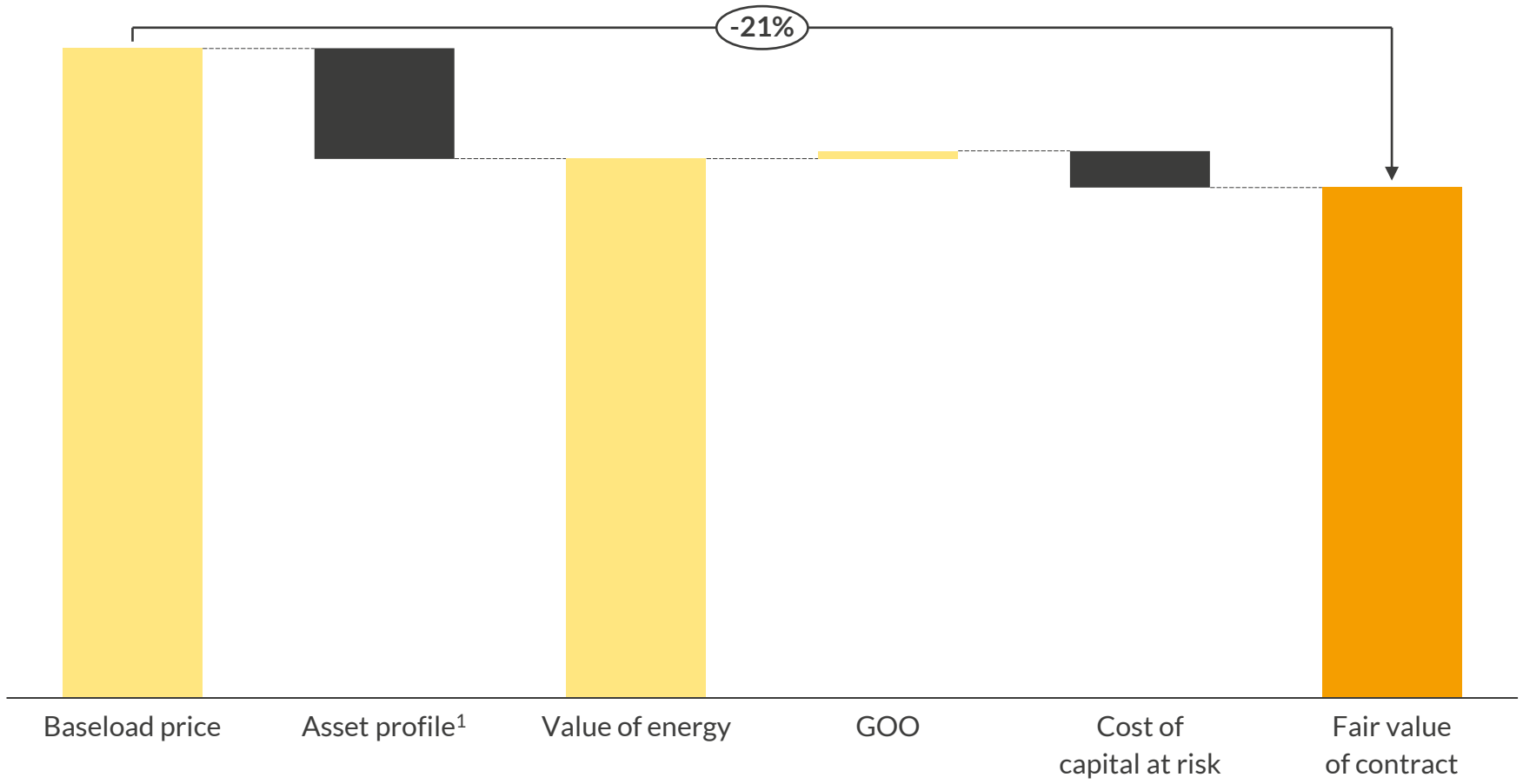
Fair value of PPAs

- The fair value of PPA contracts differs, with the most important factors being:
  - Renewable technology
  - Price clause
  - Volume clause
  - Tenor
  - Starting date of contract
- A fair value for a 7-year PPA starting in 2023 is in the high 50s for solar and low 60s EUR/MWh for onshore wind
- For a 12-year contract , a fair PPA value for delivery starting in 2023 is in the low 50s for solar and low 60s EUR/MWh for wind

The fair market value of a solar PV fixed price 7-year PPA starting in 2023 is in the mid 50s EUR/MWh for volume as forecasted

Decomposition of price components for a 7-year solar PV PPA with as forecasted volume clause and fixed price clause
EUR/MWh (real 2020)



1) Asset profile is calculated based on the technology-specific capture price and includes interannual variability.

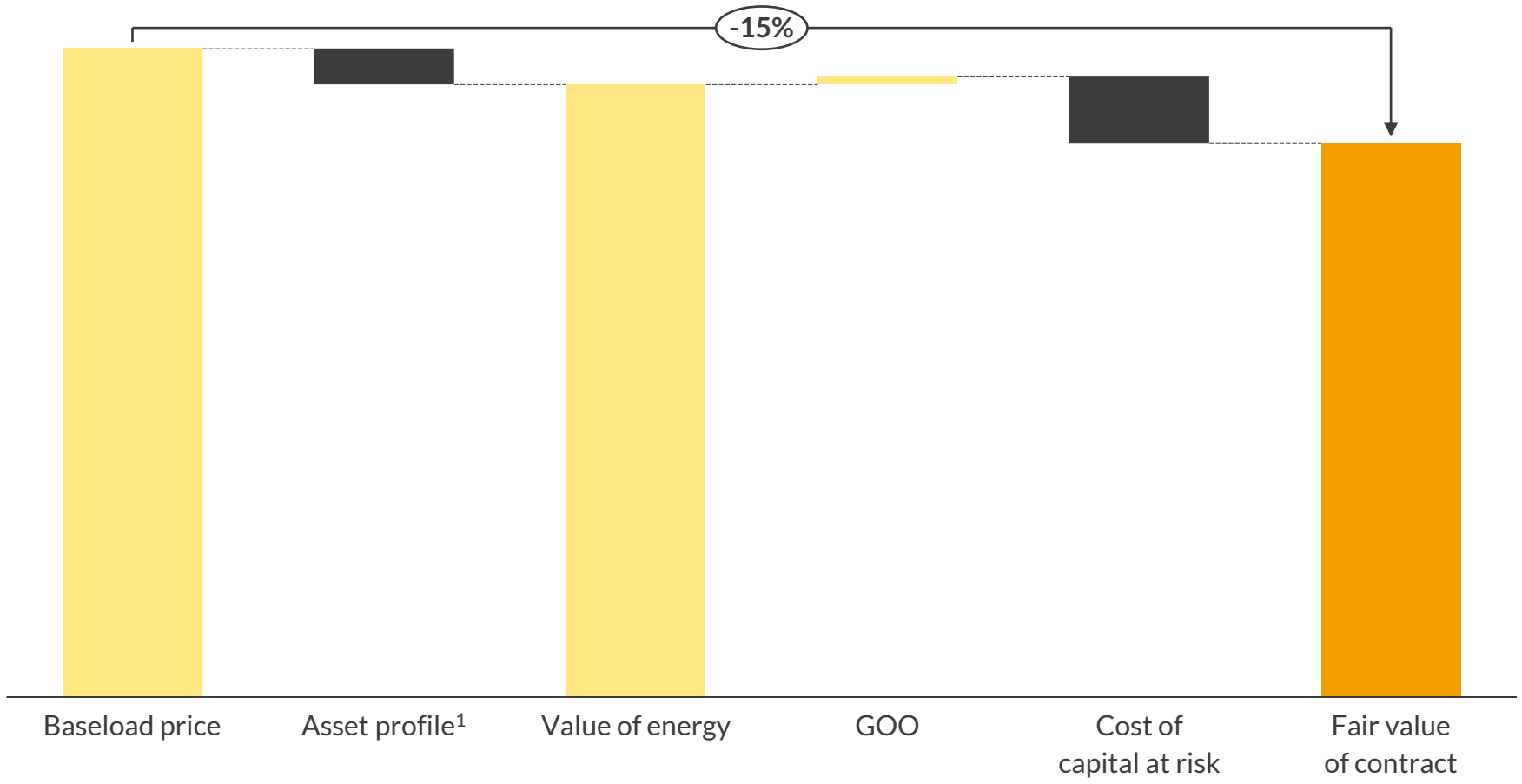
Source: Aurora Energy Research

Fair value of a 7-year solar PV PPA

- Between 2023 and 2028, the average value of energy from onshore wind generation is in the mid 50s EUR/MWh, given the price projections in our Central scenario

The fair market value of an onshore wind fixed price 12-year PPA starting in 2023 is in the low 60s EUR/MWh for volume as forecasted

Decomposition of price components for a 12-year onshore wind PPA with as forecasted volume clause and fixed price clause
EUR/MWh (real 2020)



1) Asset profile is calculated based on the technology-specific capture price and includes interannual variability.

Source: Aurora Energy Research

Fair value of a 12-year offshore wind PPA

- Wind experiences less cannibalisation than solar which leads to a much smaller price reduction due to the asset's profile, keeping the value of energy higher
- The delta between our Central and Low scenario increases over the years. Consequently, the longer contract period of 12 years leads to an increased cost of capital at risk

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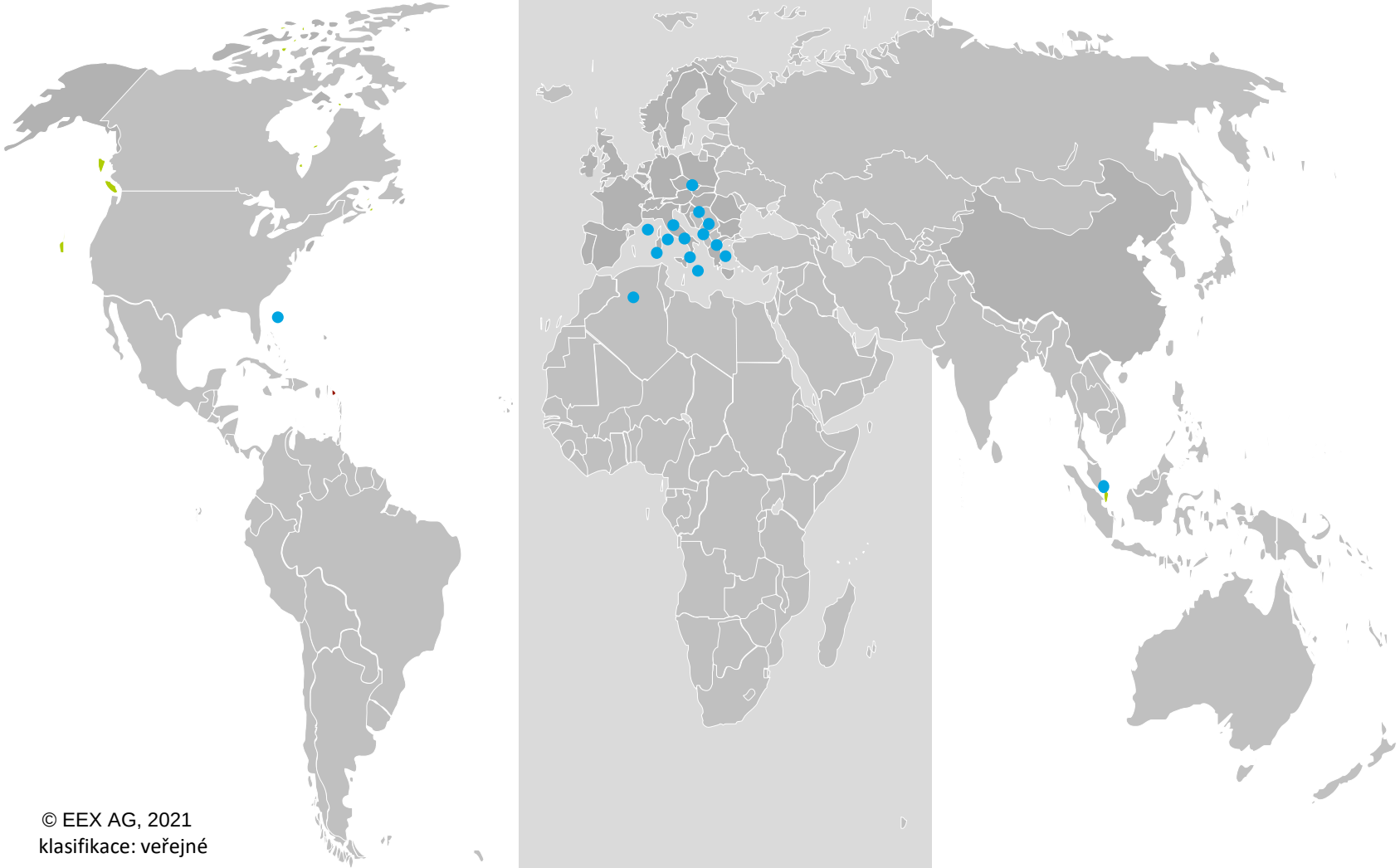
Romanian PPAs – A new growth potential for renewables

Webinar, December 8, 2021

Introduction EEX Group

A Global Commodity Exchange

US	Europe	Asia	#GoingGlobal

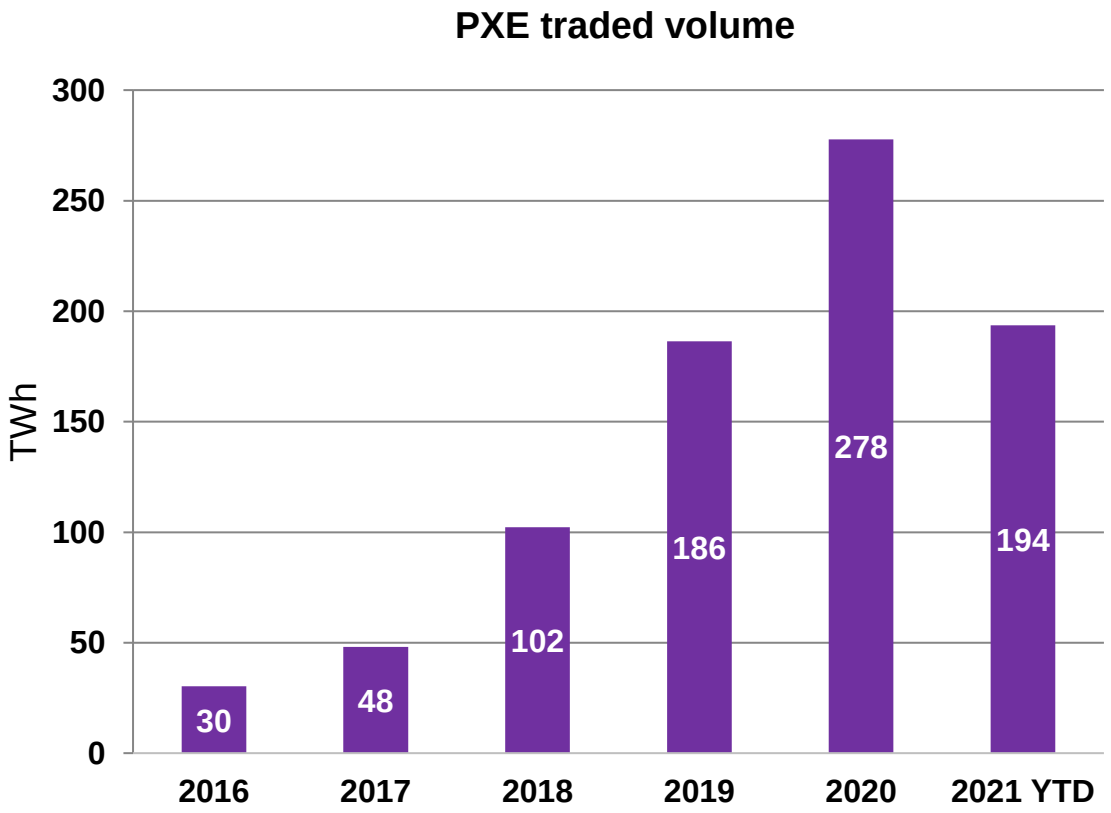


1
in Power Trading Worldwide

More than
750
Trading participants
from 40 countries

17 locations worldwide

PXE as part of EEX Group



PXE role:

- PXE became an integral part of EEX in June 2017
- PXE is responsible for CEE/SEE markets
- PXE acts as a local help to clients in the region
- PXE is responsible for CEE/SEE products

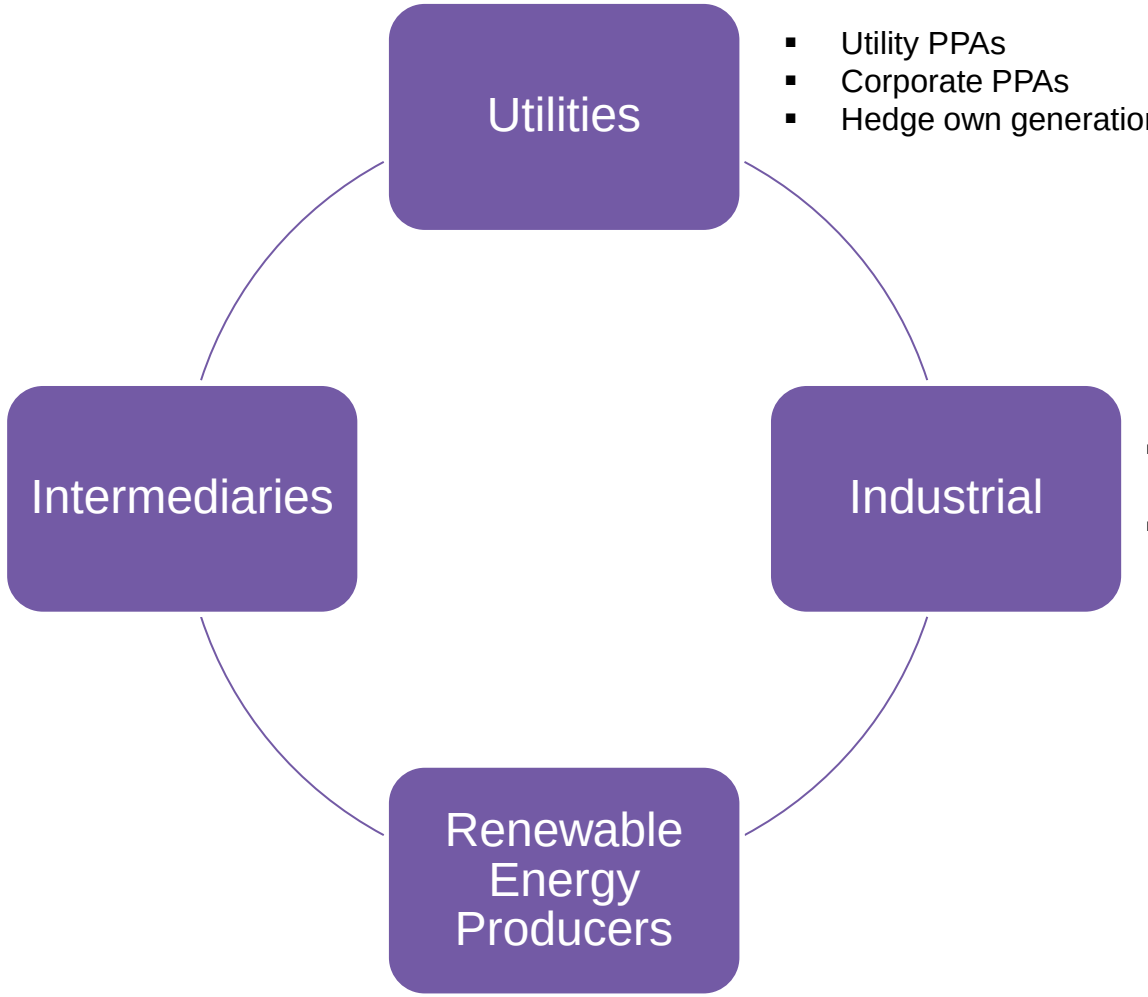
How do EEX Power Derivatives help to mitigate Renewable Energy Price Risk (PPAs)

- Market participants who enter into long-term PPAs can **register a strip of cash-settled calendar futures out to Cal+6 (+10)** for clearing with EEX.
- This means that **sellers can lock in a secure cash flow for up to 6 (10) years**, for the sale of electricity in the respective market area
- Buyers lock in a **guaranteed price of purchase** for up to 6 (10) years, providing **certainty** on their future electricity price and **protecting against upswings**
- Therefore the purchase or sale of electricity derivatives provides **long-term price risk hedging** together with **counterparty risk mitigation** through the ECC clearing house.

Production is sold at the Spot market, offtaker procures via wholesale market, no physical delivery via balancing accounts

Long term hedge: multiple OTC trades of sequential expiry => these trades mimic the profile of the PPA and mitigate the price risk exposure

Who are the PPA Hedgers on EEX?



- Utility PPAs
- Corporate PPAs
- Hedge own generation

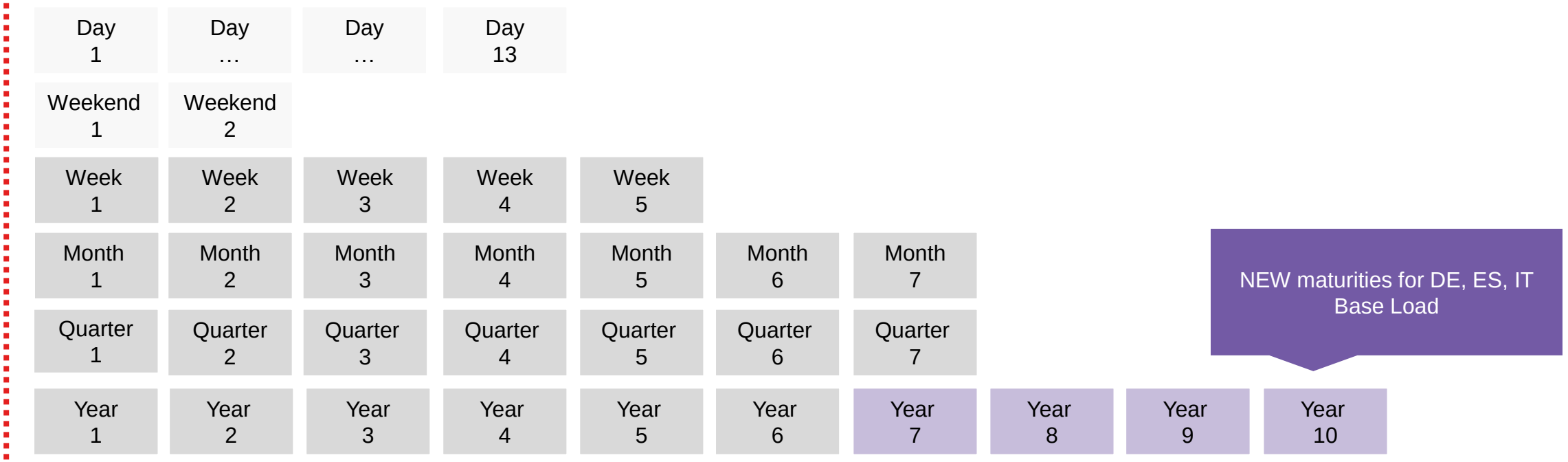
- Oil companies pivoting to renewables
- Offtakers of RE to power industrial sites

- Solar IPP hedging PPAs

- Banks providing access to market for Renewable Energy developers
- Market players offering hedging services

EEX Power Derivatives Markets and Cal+10

- EEX **extended Base Load Yearly Futures to Cal+10** on 27 September 2021 in markets with high potential of PPA activity: **Spain, Germany and Italy**, to facilitate long-term hedging and more PPA development.
- This extends the standard Power product setup of EEX.*
- Each product has as its underlying the Spot index for the respective market (ie. for Romanian power, the day-ahead price published by OPCOM).



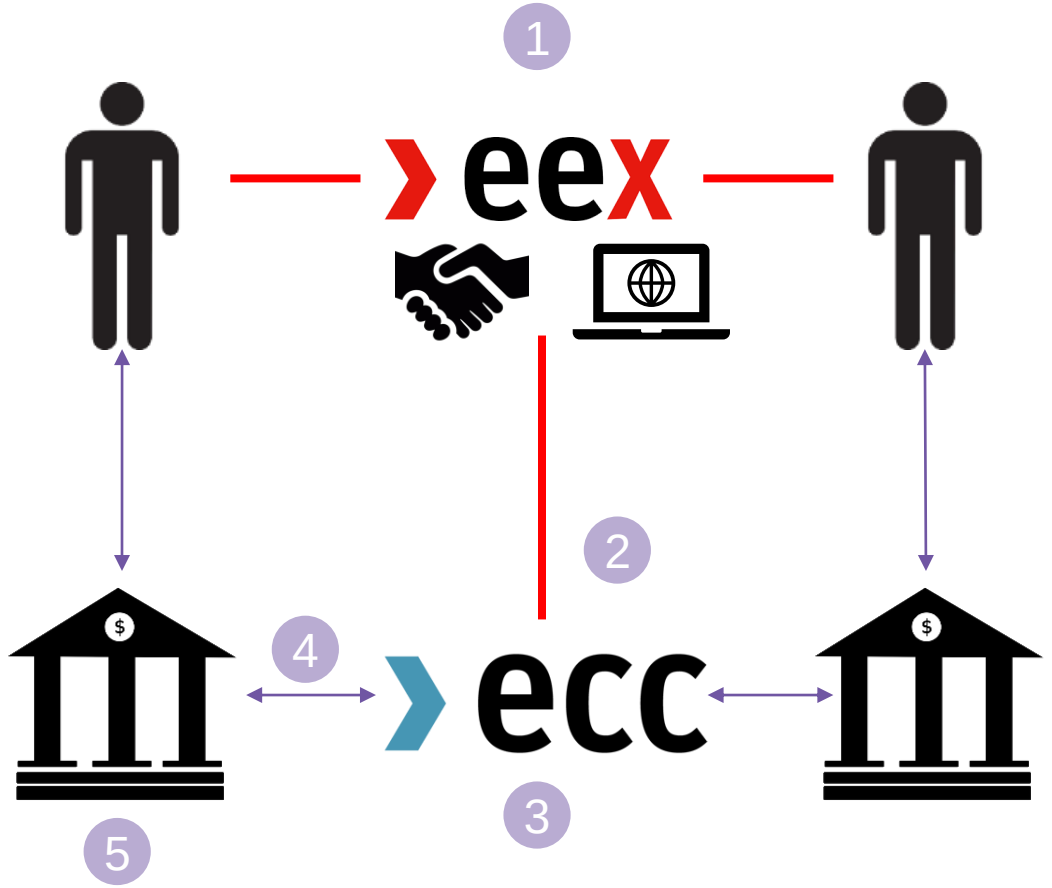
*The full list of markets and products can be found on the EEX website.

EEX Power Derivatives Markets

Transaction lifecycle

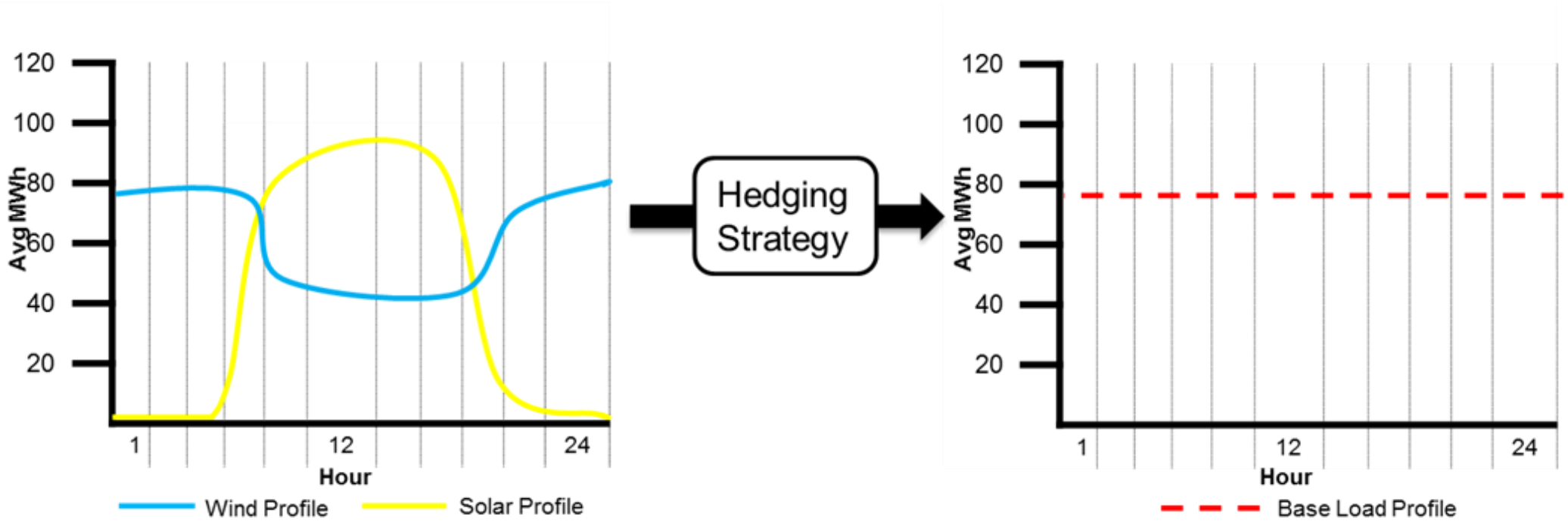
1. Transaction concluded between two counterparties via order book or trade registration.
2. Transaction is submitted for clearing to ECC.
3. Once cleared at ECC the counterparty risk is removed.
4. ECC collects collateral and margins from the Clearing Member, and settles the contract in cash at expiry on behalf of its client.

   The Clearing House performs daily settlement (mark-to-market) of all open positions, netting between related positions, and guarantees settlement in case a counterparty defaults.
5. The Clearing Member manages the cash flows and collateral required by trading participants.



When a contract is cleared, ECC becomes the counterparty to both trading participants

Managing Renewable Energy Price Risk with Base Futures requires a Hedging Strategy



- Base Futures are a **best-fit product** and attract the most liquidity, creating a **strong price signal** and opportunities for trading at fair market prices
- To use the Base Futures to manage the risk of a wind or solar profile, a **Hedging Strategy needs to be designed** to translate the variable generation profile into a constant Base load profile
- Different Hedging Strategies can be employed, such as a **value-neutral hedge**

Example: Long-term hedge on Polish Power

Trade Date	Product	Expiry Year	Expiry Month	Type	Trade Price	Initial Margin per Contract	Lots (in MW)	Initial Margin (in EUR)	Trade Volume (in M Wh)	Notional Value
03.02.2021	Polish Power base year	2022	12	TOB	58,50 €	40 033,20 €	5	200 166,00 €	43 800	2 562 300,00 €
04.02.2021	Polish Power base year	2022	12	OTC	58,80 €	40 033,20 €	20	800 664,00 €	175 200	10 301 760,00 €
05.02.2021	Polish Power base year	2022	12	TOB	59,10 €	40 033,20 €	10	400 332,00 €	87 600	5 177 160,00 €
05.02.2021	Polish Power base year	2023	12	TOB	58,30 €	29 083,20 €	10	290 832,00 €	87 600	5 107 080,00 €
08.02.2021	Polish Power base year	2024	12	TOB	58,75 €	23 277,60 €	5	116 388,00 €	43 920	2 580 300,00 €
SUM						**172 460,40 €**	**50**	**1 808 382,00 €**	**438 120**	**25 728 600,00 €**

- 50 MW of long-term products were traded on Polish Power market in the beginning of 2021, with an **initial margin requirement of 1 808 382 EUR**
- The **Initial Margin percentage** of the notional value of the trades was 7%

EEX Power Futures and Renewable Energy

Role of the Exchange in the PPA Market

Price Transparency

- EEX's market prices provide reliable price references.
- Project developers and buyers of PPAs can assess their valuations against EEX wholesale prices.

Price Risk Management

- Manage power price risk for renewable energy assets.
- Reduce the overall risk exposure for the largest risk element in RE portfolios.

Counterparty Risk Management

- Trading and hedging on EEX alleviates counterparty risk for trading participants.
- This is especially important for long-term risk management.

Enabler of Renewable Energy Growth

- **Price and counterparty risk is offloaded** onto the clearing house, freeing internal risk capacity within trading participants.
- This enables them to take on more PPAs and facilitate growth of renewable energy capacity in Europe.

Thank you for your attention

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Discussion - Q&A

Romanian Power Market Service: Key market analyses and forecasts for all participants in the Romanian power market

Key information on Aurora's new Romanian subscription service

- **Up-to-date report available (November 2021)**
- **Next update in May 2022**
- **Regular updates thereafter (Biannualy)**
- **Introductory workshop,** with insights on market and policy status quo, policy and market outlook, price curves, market scenarios and PPA analysis
- **Subscriber webinar,** Aurora's experts will be organising a webinar for each bi-annual update where we highlight key market developments as well as their impact on our modelling

Biannual data and market reports to assess business models

- **Yearly forecasts of wholesale market prices along three scenarios** (High, Low, Central) until 2050
- **All the latest trends and forecasts,** recent market and policy developments
- **Price distributions**, capture spark spreads, peak prices
- **Capacity development**, generation mix, interconnector capacity, capacity buildout, exports
- **Capture prices** of key technologies (onshore, solar), load factors
- **Corporate PPA market analysis and valuation**, example of fair price valuation
- **Data in Excel,** all forecast data easily downloadable in Excel format
- **EU ETS carbon price & gas price** forecasts

Interaction through workshops and ongoing support

- **Bilateral workshops** at your offices to discuss specific issues on the Romanian market
- **Ongoing availability** (calls, access to market experts, modellers) to address any questions across European power markets
- Discounted invitations to Aurora's annual **Spring Forum**

All intelligence for a successful business, based on bankable price forecasts

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