

AURORA
ENERGY
TRANSITION
SUMMIT WARSAW 2025

AURORA KEYNOTE:
EMERGING MARKETS FOR
RENEWABLE ENERGY
INVESTMENT IN CEE



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How will emerging challenges, such as curtailment and market saturation, impact renewable projects?

Renewables outlook

What is the outlook for renewables across CEE, and how does it vary across markets?

Challenges & Risks

Key Opportunities

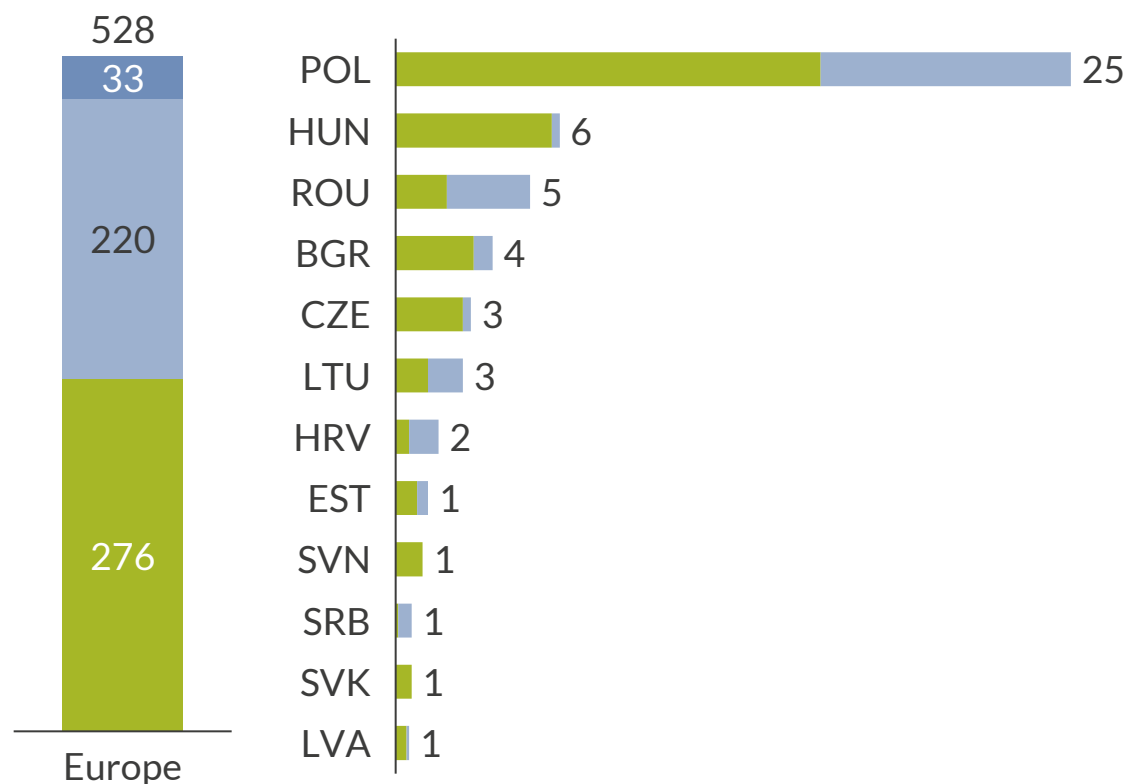
What are the available opportunities for renewables, and how can they facilitate project financing?

To date, Poland has led RES deployment in CEE, however significant future investment opportunities also exist in Romania, Czechia and Serbia



Current installed renewable capacity - GW

Operational renewables capacity in 2023 GW

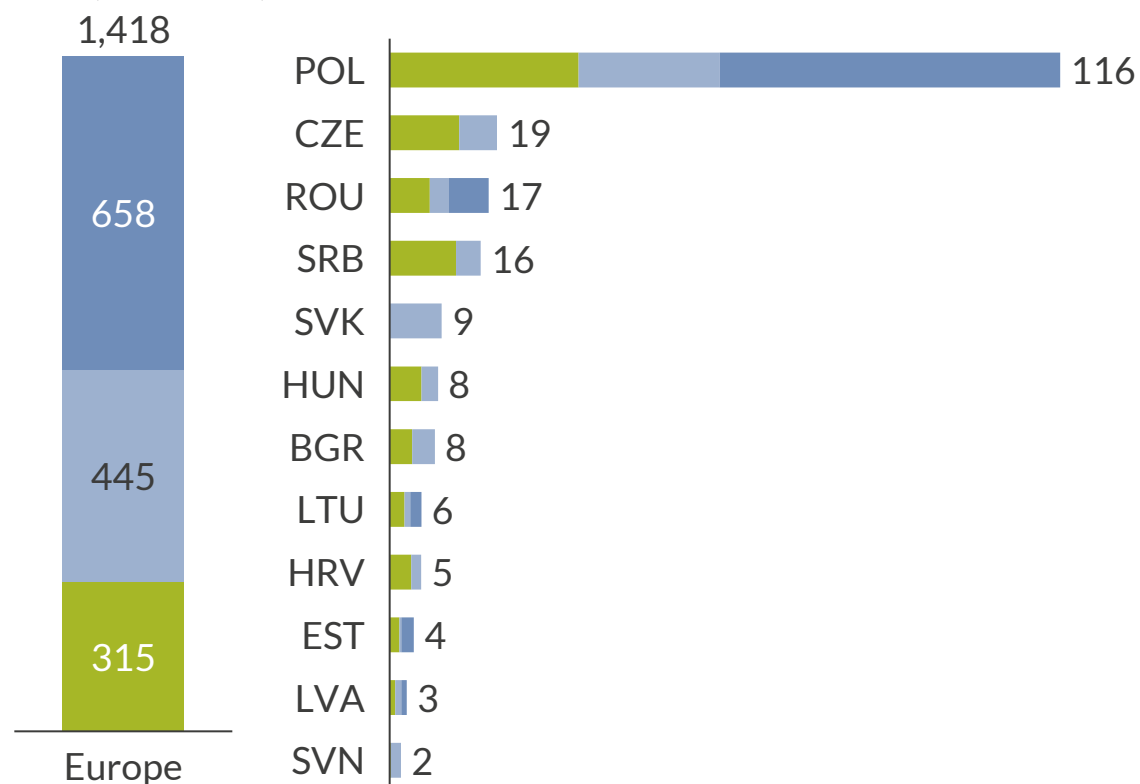


 Solar PV  Onshore wind  Offshore wind



Renewable investment opportunity 2025 – 2050 - €bn

CAPEX investments €bn (real 2023)



Government targets and subsidies are key policy drivers for short term growth, with two-sided CfDs implemented in Poland, Croatia and Romania

A U R  R A

Supply chains



Thermal phase out



Policy



Demand

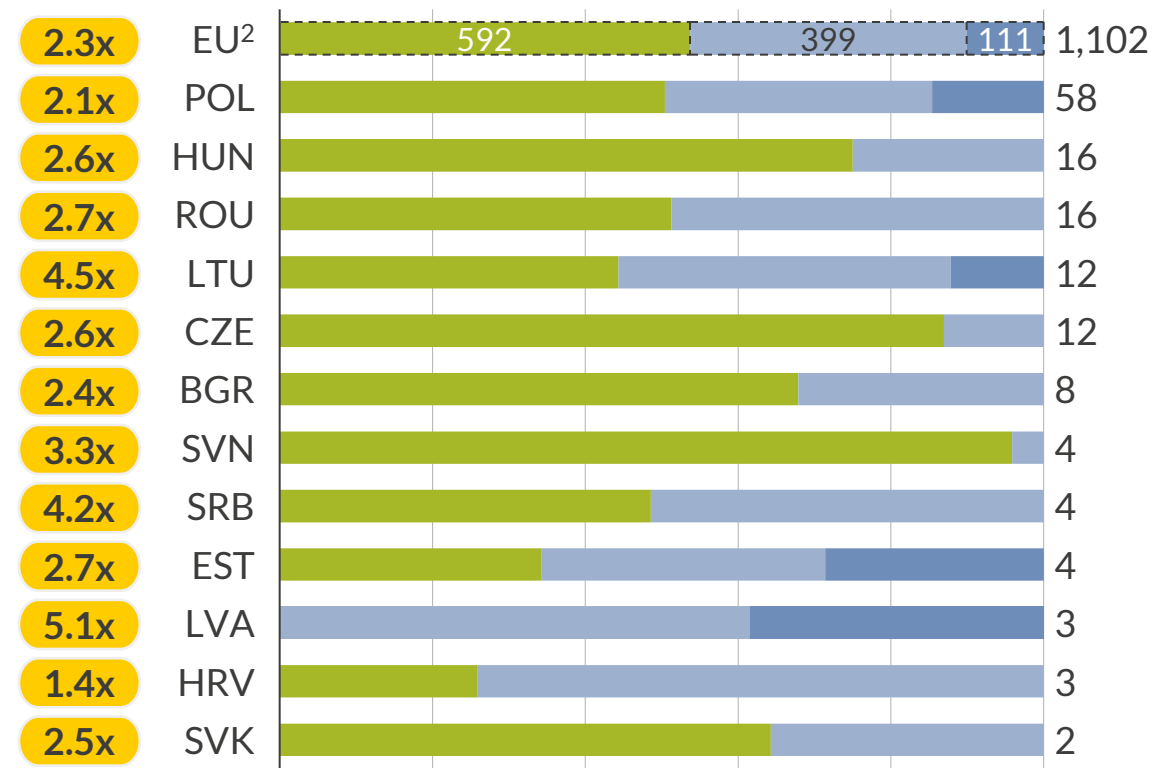


Economics

Target RES installed capacity by 2030
GW

X.Xx

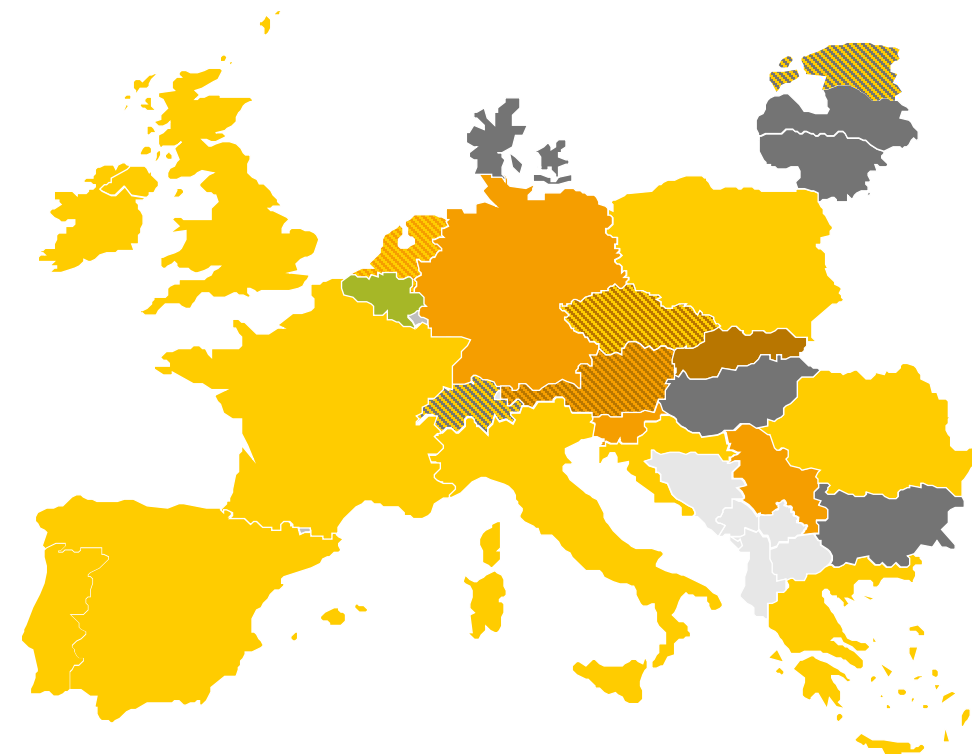
Targets, relative to
2024 capacity (GW)



Estimated Solar PV Onshore wind Offshore wind



Renewables support schemes for standalone utility-scale solar PV and onshore wind assets across Europe



Feed-in-premium CfD (implemented) Green certificates¹
CfD (planned) No subsidies Investment subsidy

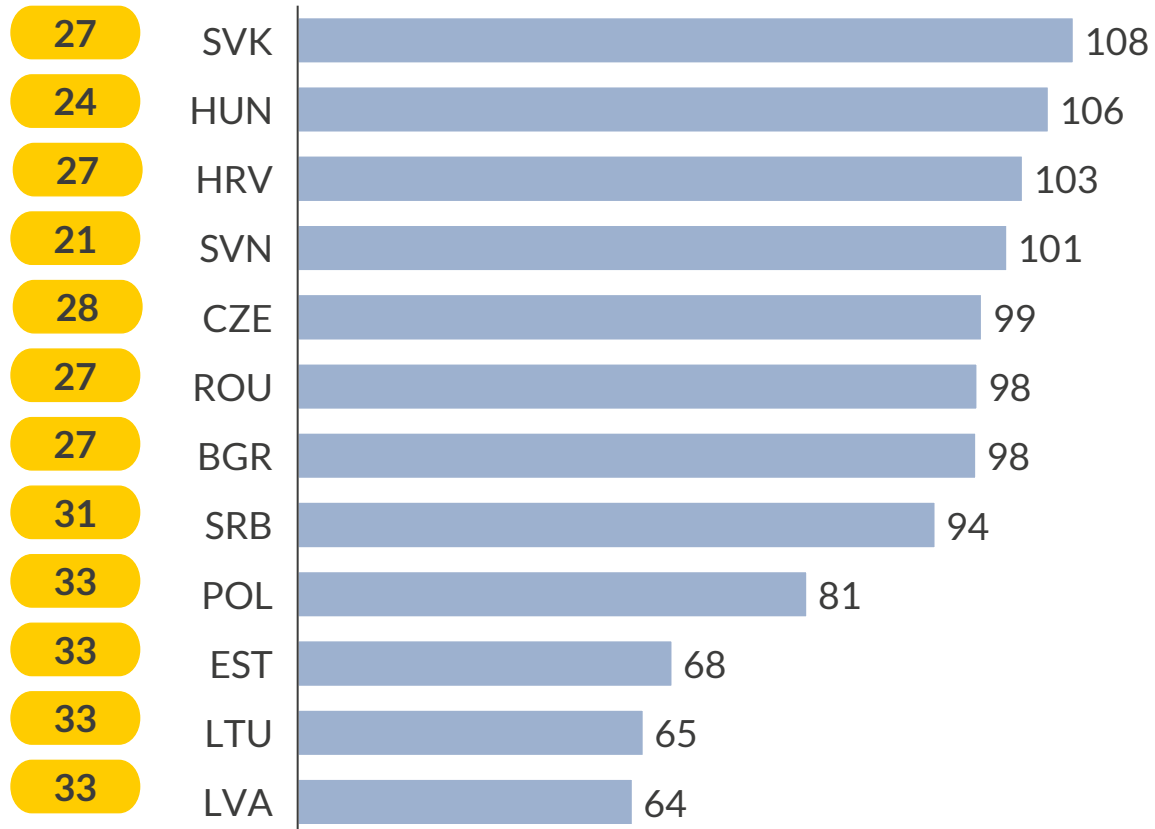
Economic drivers, such as load factors and capture prices, will impact merchant business cases, with highest IRRs in Czechia and Slovakia

A U R  R APowered by  AMUN Supply chains Thermal phase out Policy Demand Economics

Onshore wind capture prices in 2030
%

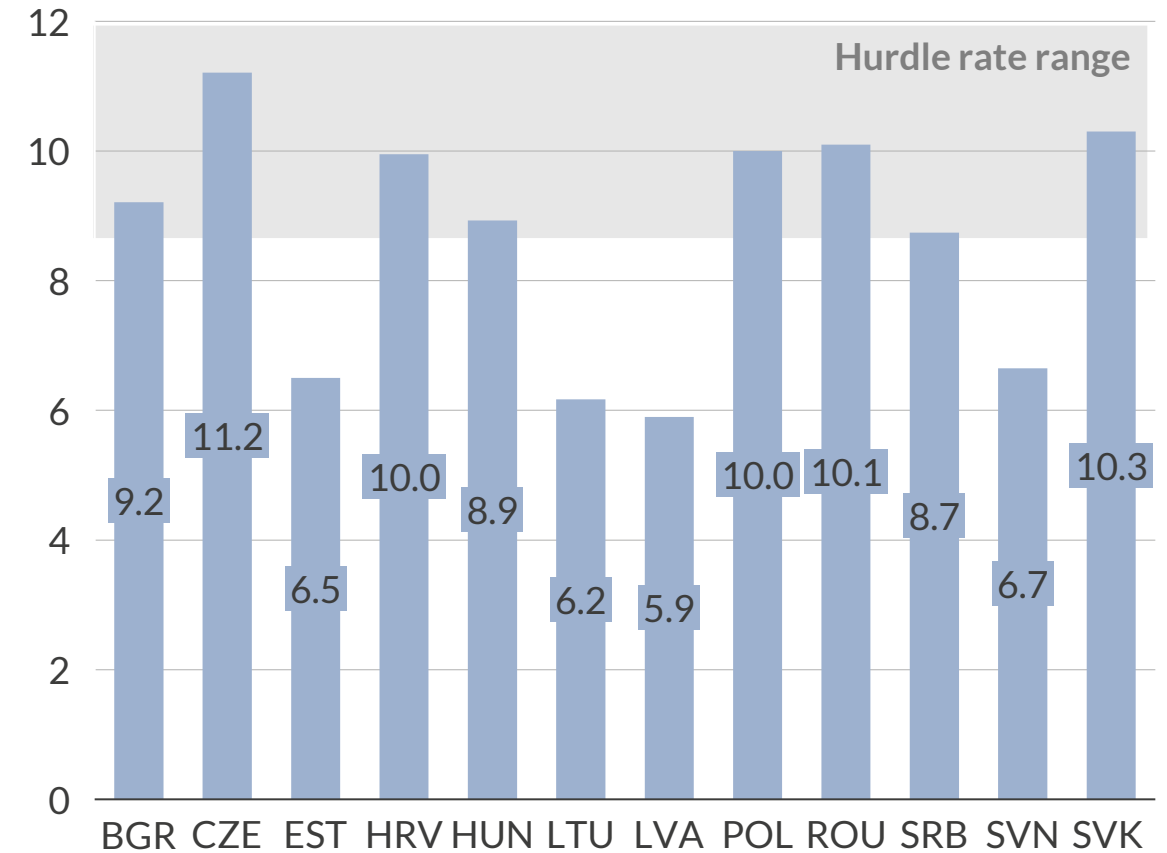
x

Load Factor
%



Project IRR, entry year 2028

%, pre-tax, unlevered, real 2023, Central scenario



How will emerging challenges, such as curtailment and market saturation, impact renewable projects?

**Renewables
outlook**



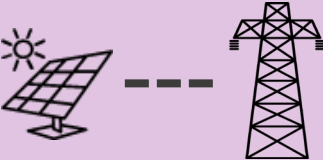
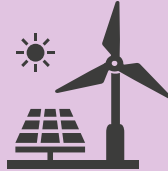


What is the outlook for renewables across CEE, and how does it vary across markets?

Challenges & Risks

Key Opportunities

What are the available opportunities for renewables, and how can they facilitate project financing?

Renewable projects are exposed to a variety of market, development and policy risks

Market	<div data-bbox="568 304 835 347">Negative prices</div> <div data-bbox="619 396 802 556"></div> <div data-bbox="886 304 1378 578"><ul style="list-style-type: none">▪ Increased (subsidised) RES generation and times of low demand cause negative price hours.▪ Most regions do not fully shield against these hours.</div> <div data-bbox="1421 271 1472 321">A</div>	<div data-bbox="1549 304 1854 347">Market saturation</div> <div data-bbox="1625 406 1778 556"></div> <div data-bbox="1893 304 2440 578"><ul style="list-style-type: none">▪ Strong RES buildout over Europe leads to higher correlated generation volumes.▪ This can lead to reduced capture rates and longer grid queues.</div>
Development	<div data-bbox="560 638 845 681">Grid connections</div> <div data-bbox="540 725 861 882"></div> <div data-bbox="886 659 1396 831"><ul style="list-style-type: none">▪ Long grid queues, sometimes spanning 10+ years, make it difficult to get connected to get projects online.</div>	<div data-bbox="1587 638 1816 681">Supply chains</div> <div data-bbox="1625 714 1791 882"></div> <div data-bbox="1893 638 2390 909"><ul style="list-style-type: none">▪ Supply chain constraints can increase costs and cause delays in development.▪ Permitting can take significantly longer than expected or be refused.</div>
Policy	<div data-bbox="568 972 835 1015">Grid congestion</div> <div data-bbox="649 1039 744 1225"></div> <div data-bbox="886 993 1421 1225"><ul style="list-style-type: none">▪ The increasing renewables penetration raises curtailment risks.▪ These can occur due to market prices or grid congestion.</div> <div data-bbox="1421 935 1472 985">B</div>	<div data-bbox="1612 972 1791 1015">Regulation</div> <div data-bbox="1638 1049 1803 1225"></div> <div data-bbox="1893 979 2415 1239"><ul style="list-style-type: none">▪ Examples include:<ul style="list-style-type: none">▪ Market access / reforms▪ Zonal markets▪ Regulatory technology requirements.</div>

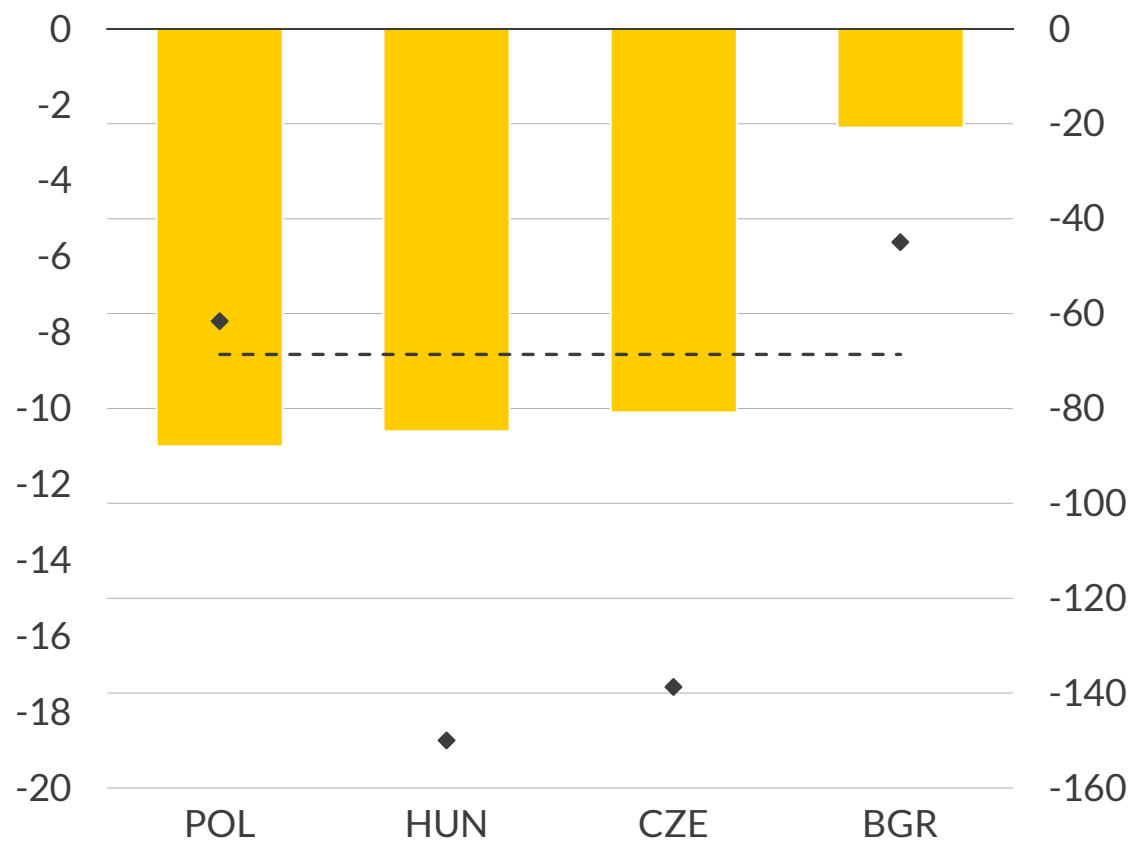
The magnitude and frequency of negative prices varies across Europe, with Baltics, Romania, Bulgaria and Croatia fully exposed currently

A U R  R A

A Negative prices

Average DA³ price during negative price hours^{1,2}, €/MWh (nominal)

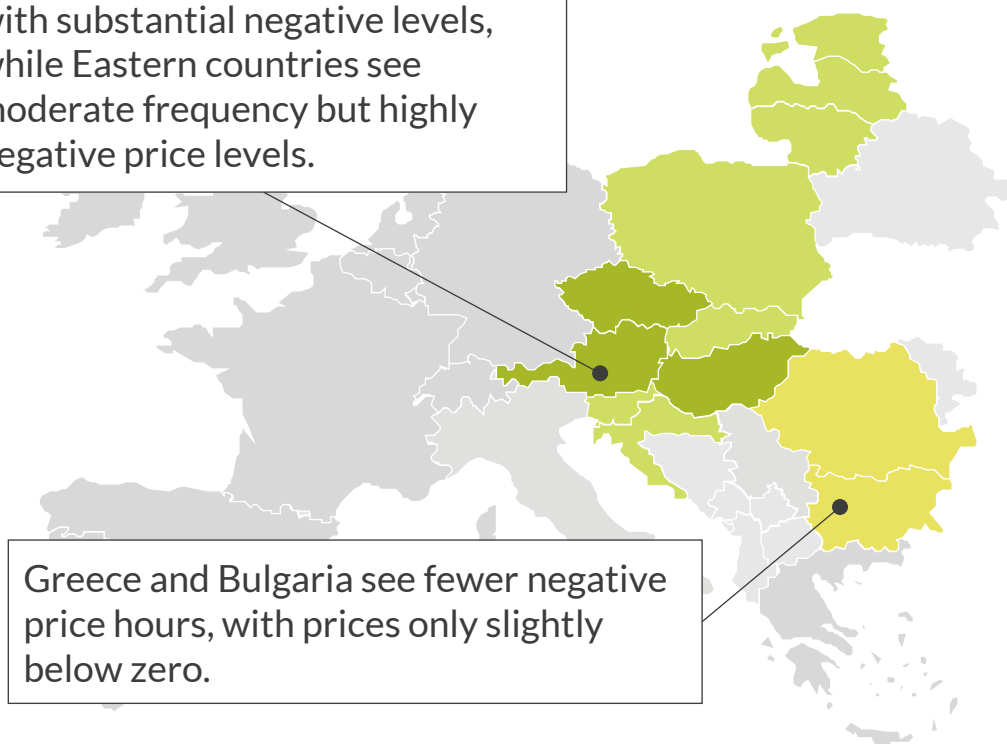
Lowest negative price^{1,2} €/MWh (nominal)



Number of negative price hours on the Day Ahead market^{1,2}

Number of negative price hours

Central European countries face a high frequency of negative prices, with substantial negative levels, while Eastern countries see moderate frequency but highly negative price levels.



Greece and Bulgaria see fewer negative price hours, with prices only slightly below zero.

■ Average DA price -- Average ♦ Lowest negative price 2024

■ 0-125 ■ 126-250 ■ 251-375

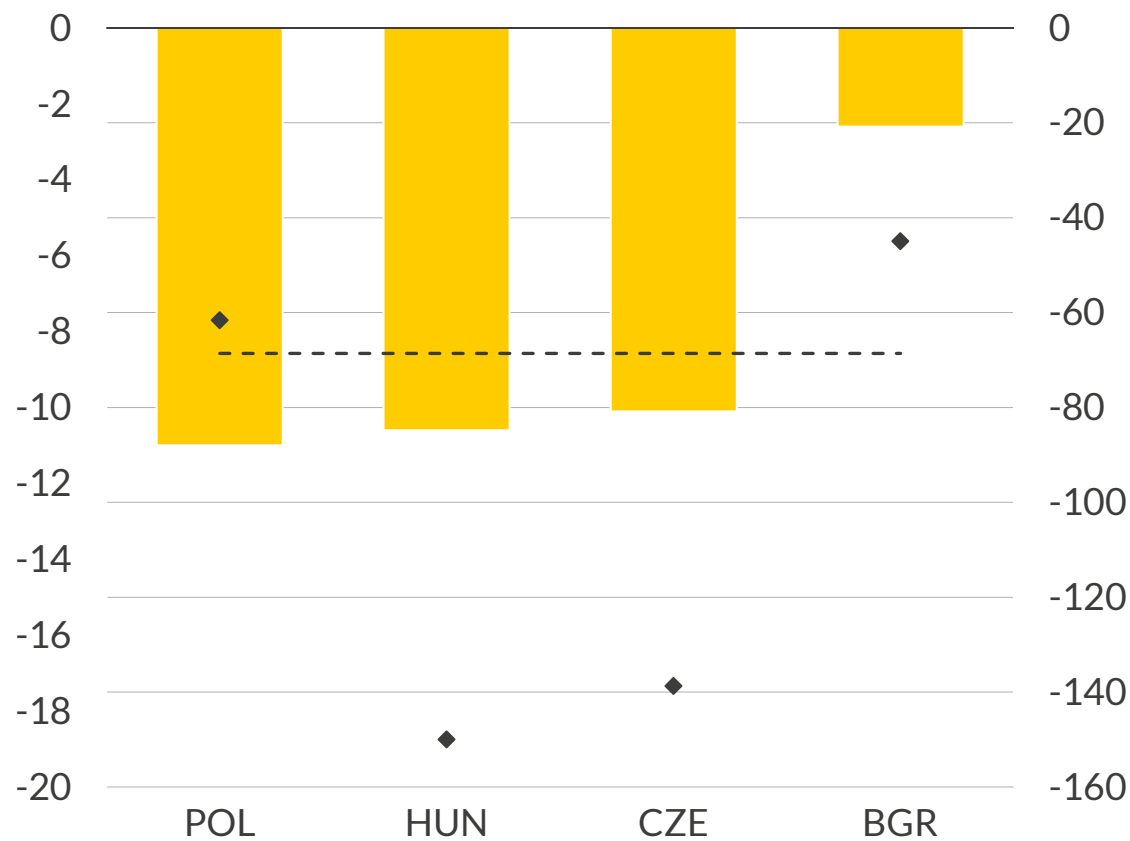
1) 2024 only, according to data from ENTSO-E up to November 2024 2) Italy's current regulation prevents power prices from falling below zero. 3) Day Ahead market.

The magnitude and frequency of negative prices varies across Europe, with Baltics, Romania, Bulgaria and Croatia fully exposed currently

A U R  R A**A** Negative prices

Average DA³ price during negative price hours^{1,2}, €/MWh (nominal)

Lowest negative price^{1,2} €/MWh (nominal)



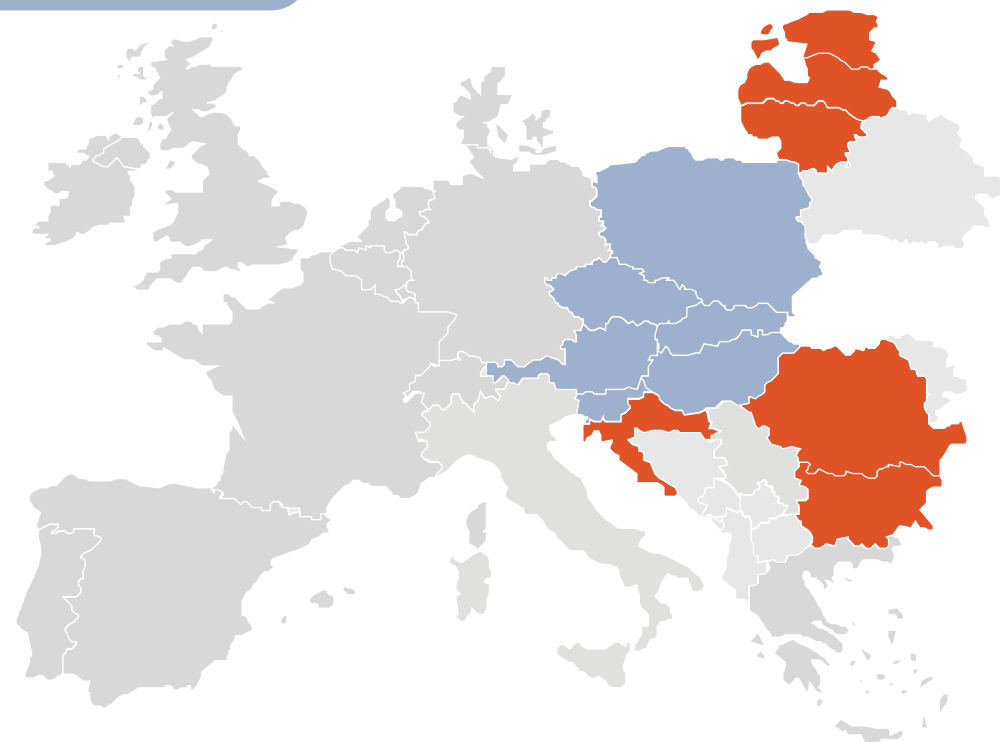
■ Average DA price -- Average ♦ Lowest negative price 2024

Number of negative price hours on the Day Ahead market^{1,2}

Number of negative price hours

Exposed

Partly Exposed



1) 2024 only, according to data from ENTSO-E up to November 2024 2) Italy's current regulation prevents power prices from falling below zero. 3) Day Ahead market.

The increasing renewables penetration raises curtailment risks, which can occur due to market prices or grid congestion

B Grid congestion

Economic

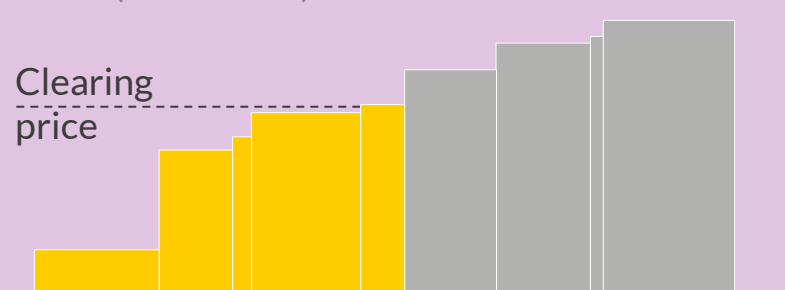
This occurs when the cost of generating electricity exceeds the market price.

Bid price

€/MWh (illustrative)

Clearing price

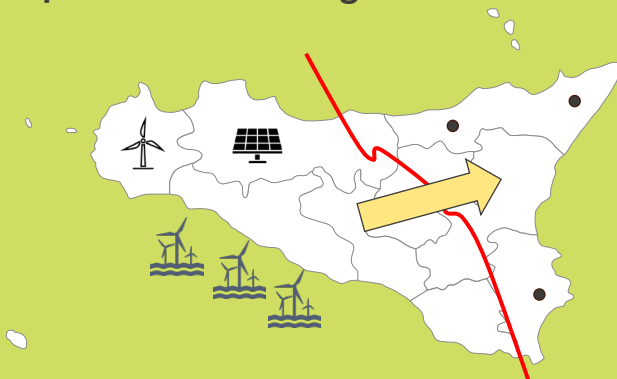
Volume, MW



Technical

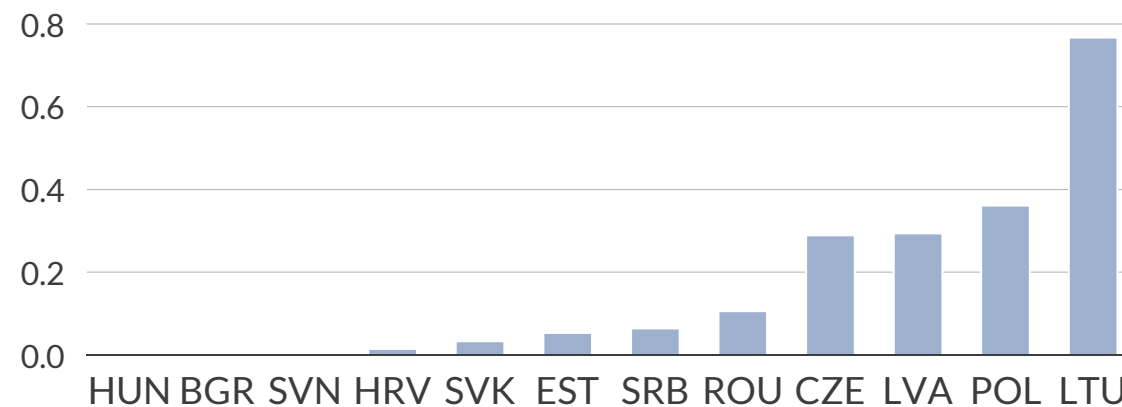
This occurs when network operators curtail RES to ensure the safe operation of the power system,

Illustrative limitations of electricity transported across the grid to demand



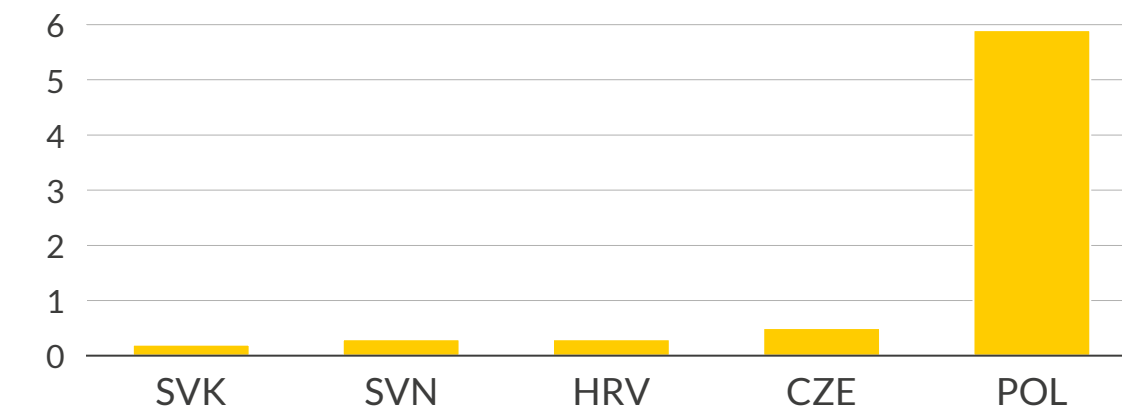
Onshore wind economic curtailment¹ over generation by region - 2030

%



Volume of remedial actions as a percentage of demand - 2023

%



How will emerging challenges, such as curtailment and market saturation, impact renewable projects?

**Renewables
outlook**

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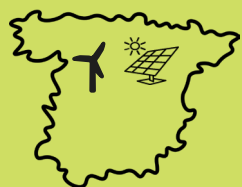
Key Opportunities

What are the available opportunities for renewables, and how can they facilitate project financing?

Co-location and siting decisions help manage the risks of uncompensated curtailment, but the key mitigations are grid expansion and market reforms

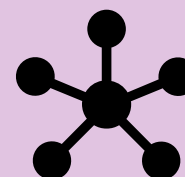
X Deep-dives

Portfolio diversification



- Adding assets with different generation profiles.
- Driven by assets' location, technological setup or combining different technologies.

Market Access



- Intermittent RES assets can access more markets than the Day Ahead and the Intraday market
- This offers the ability to diversify revenue streams.

Co-location



- Co-location enables renewables to shift their generation to less constrained times
- The battery may be able to participate in other ancillary markets

A

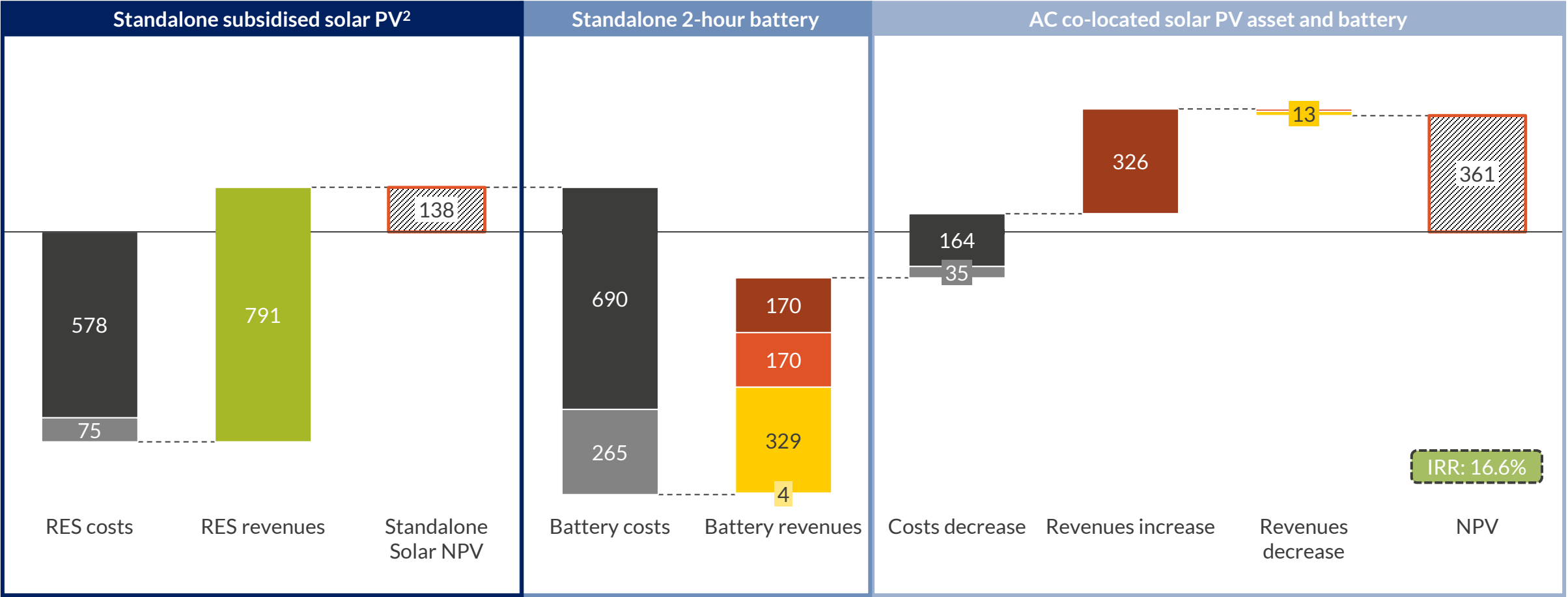
Exchange Hedging



- Using financial instruments, such as futures and options.
- This allows shielding against potential price volatility on electricity markets.

Cost savings and additional revenues can help improve the overall project economics of co-located assets compared to standalone

Economics for new-build PV+BESS co-located asset in Hungary - 2h storage duration / 1.5 cycles per day / entry year 2026
Net Present Value¹€/kW (real 2023)



■ CAPEX ■ OPEX ■ Grid charges³ ■ Energy arbitrage ■ FCR ■ aFRR capacity⁴ ■ RES revenues ■ EOL⁵ ■ Net revenues

1) Discount rate of 11%; 2) Assuming standalone assets; 3) Variable grid charges. Fixed grid charges are included in the OPEX; 4) CM = Capacity market; 5) EOL = End-Of-Life.

Key takeaways

- 1 Growth in Renewables:** Europe's renewable energy capacity has grown to 528GW¹ over the last decade, driven by increasing power demand, strong policy support, elevated commodity prices and the phase-out of thermal power.
- 2 Investment Opportunities:** Substantial investment opportunities exist in new renewable energy capacity, with a potential cumulative investment requirement for solar PV and wind of over €1,400 billion in Europe by 2050.
- 3 Risks:** Markets are moving away from shielding assets under subsidies from negative market prices. Total remedial actions reached 57.28TWh in 2023, with assets only fully shielded from constraints under a firm grid connection.
- 4 Opportunities:** Co-location of RES with BESS can provide cost savings, reduced risk, better grid integration and additional revenue streams.

AMUN The true value of your wind site

Amun delivers bankable asset-specific revenue forecasts for wind assets in minutes

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Supporting the worlds largest transactions: Amun is used on the wind industries biggest transactions and financings

Relied on and used by industry leaders: Amun enables you to identify the hidden bankable value in wind assets

Save time: Amun does everything consultants do, instantly, whenever you need

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- Select your wind data
- Select your turbine data
- Select your scenario
- Analyse your result

What can Amun be used for?

- Transactions
- Site Selection & Optimisation
- Portfolio Valuation
- PPAs

Trusted by industry leaders:



European Renewables Market Overview Report

The report is divided into 4 key sections and includes 100 slides of data, charts, and analysis:

- Market outlook
- Policy & Regulation
- Project Economics
- Risks & Opportunities

Database

Our comprehensive database is an indispensable resource, providing detailed metrics such as:

- LCOE, CAPEX, OPEX, load factors, and WACCs
- Capture prices, curtailment, and historical strike prices
- Installed capacity and reference merchant project IRRs

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For more information, contact Bea at bea.dunlop@auroraer.com

Market Outlook

Gain clarity on key trends in electricity demand, renewable generation, and investment needs across Europe through 2050. Based on Aurora's robust, bankable modelling.

Project Economics

Understand key drivers for LCOEs and gain comparative insights into capture prices, curtailment, GOs and imbalance costs. Explore merchant project IRRs for solar PV and onshore (2028) and LCOE analysis for offshore (2030).

Risks and Opportunities

Navigate the key risks to renewable projects - market saturation, negative prices, and grid congestion. Uncover opportunities for mitigation through portfolio diversification, market access, and colocation strategies.

CHRONOS Battery valuations, perfected

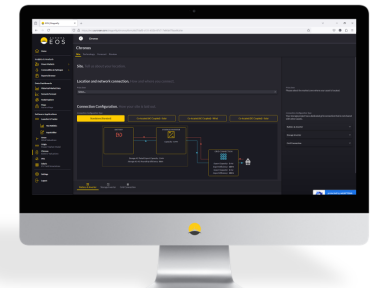
CHRONOS allows you to evaluate any storage asset or project using Aurora's cutting-edge proprietary battery dispatch engine

- Accounts for all site-specific value drivers
- Backed by Aurora's trusted forecasts and team of experts
- Bankable methodology with reliance available
- Intuitive interface that empowers user-driven analyses

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Transactions Project Design Optimisation Portfolio Valuation Benchmarking



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