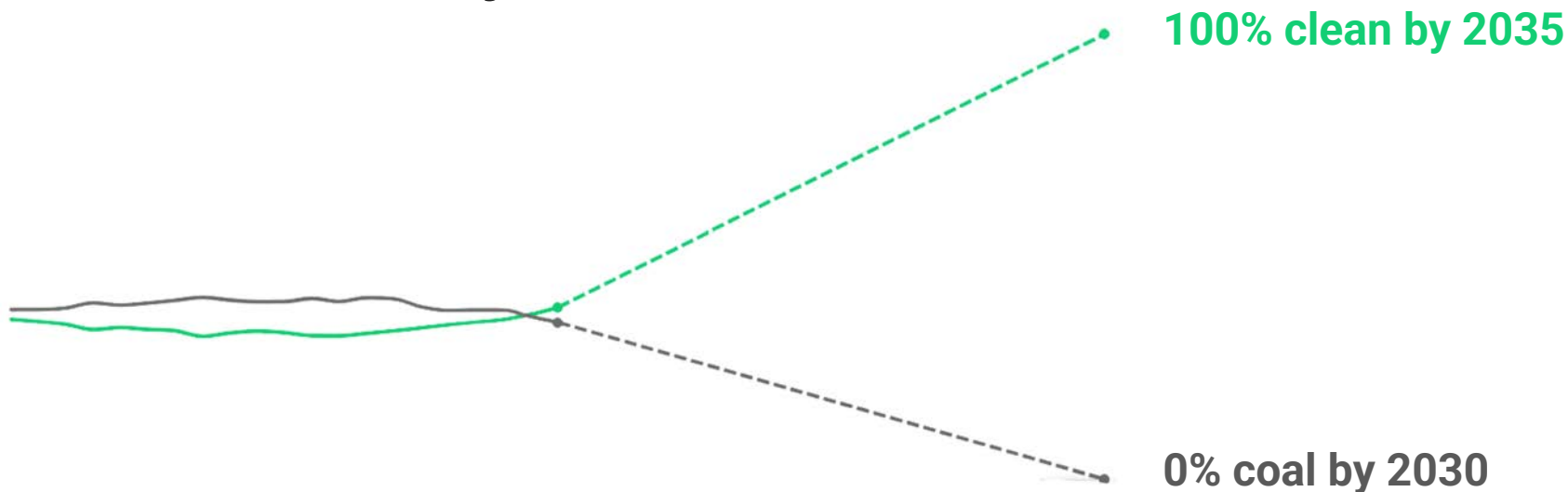


Renewable energy and power prices in Europe

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7/9/23



Ember is an energy think tank that uses data-driven insights to shift the world to clean electricity.



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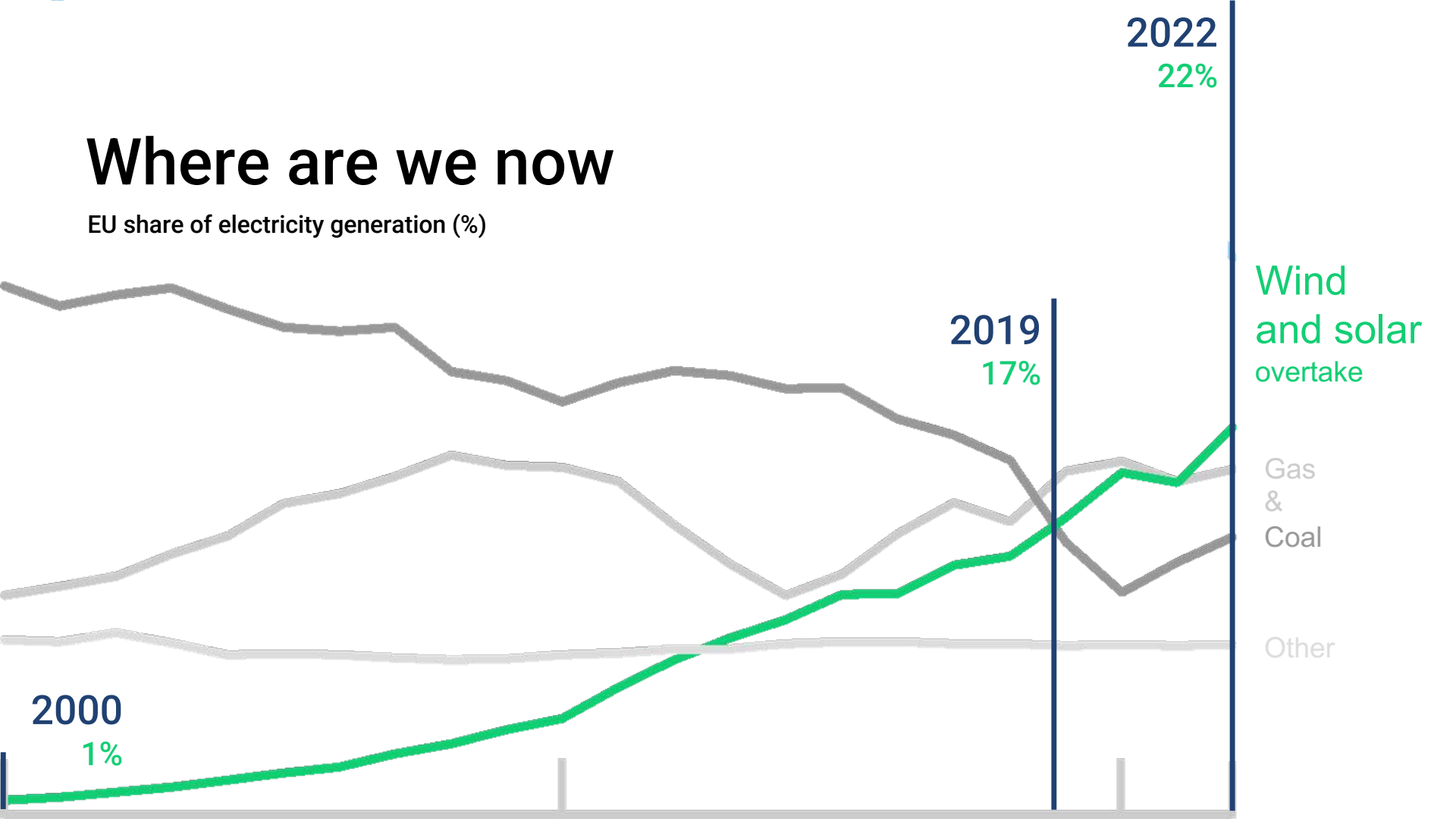
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Where are we now

EU share of electricity generation (%)



2022

22%

2019

17%

Wind
and solar
overtake

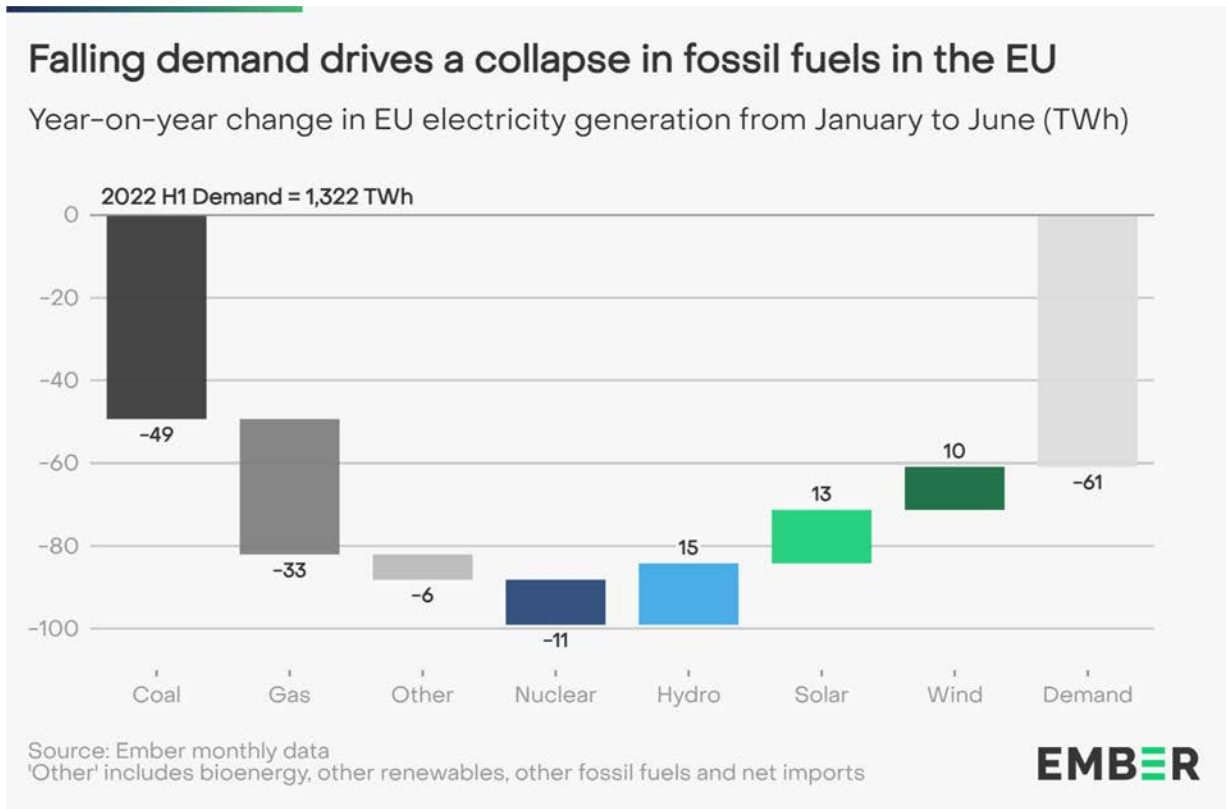
Gas
&
Coal

Other

2000

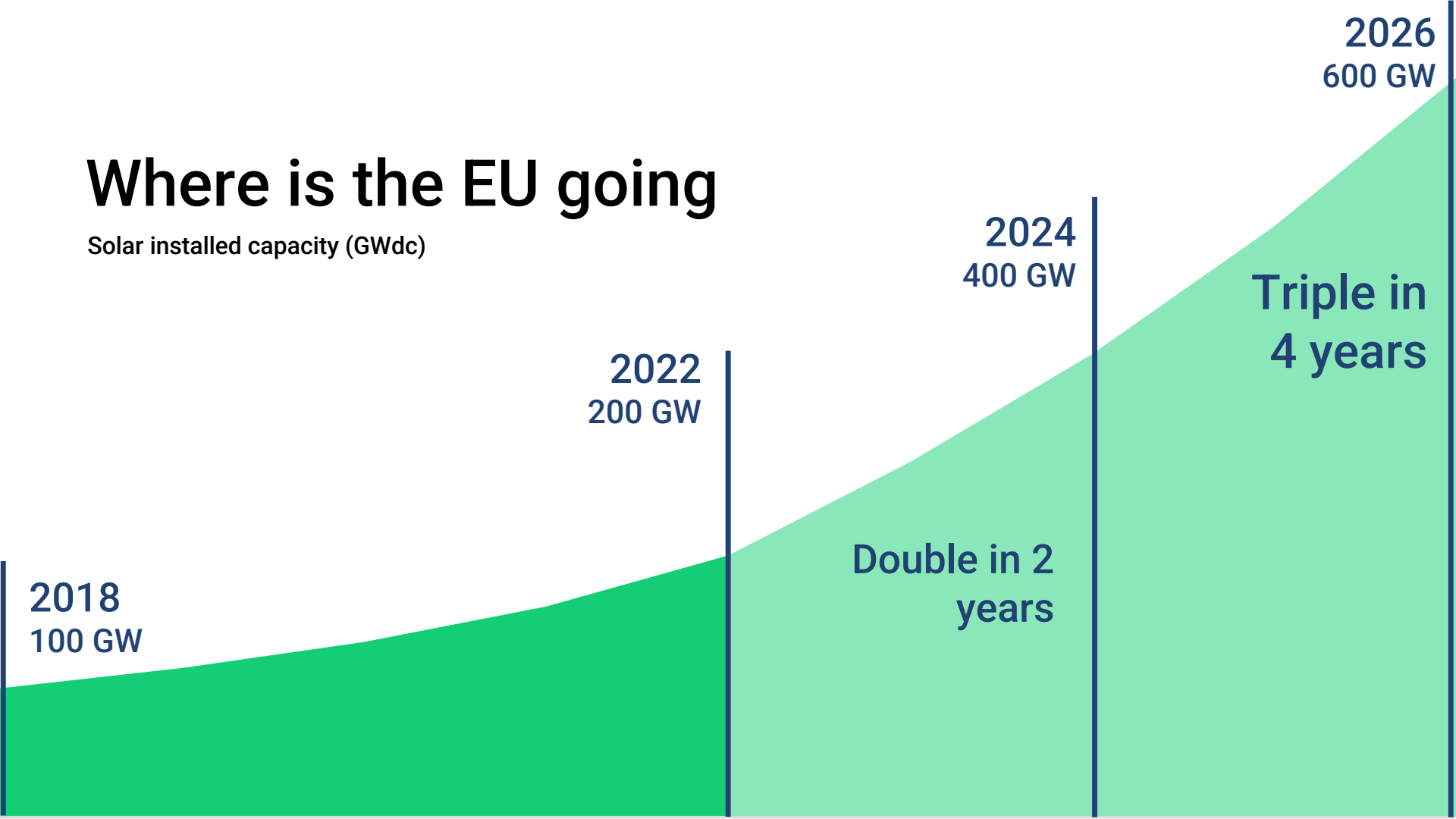
1%

How have things changed so far in 2023?



Where is the EU going

Solar installed capacity (GWdc)



2018
100 GW

2022
200 GW

2024
400 GW

2026
600 GW

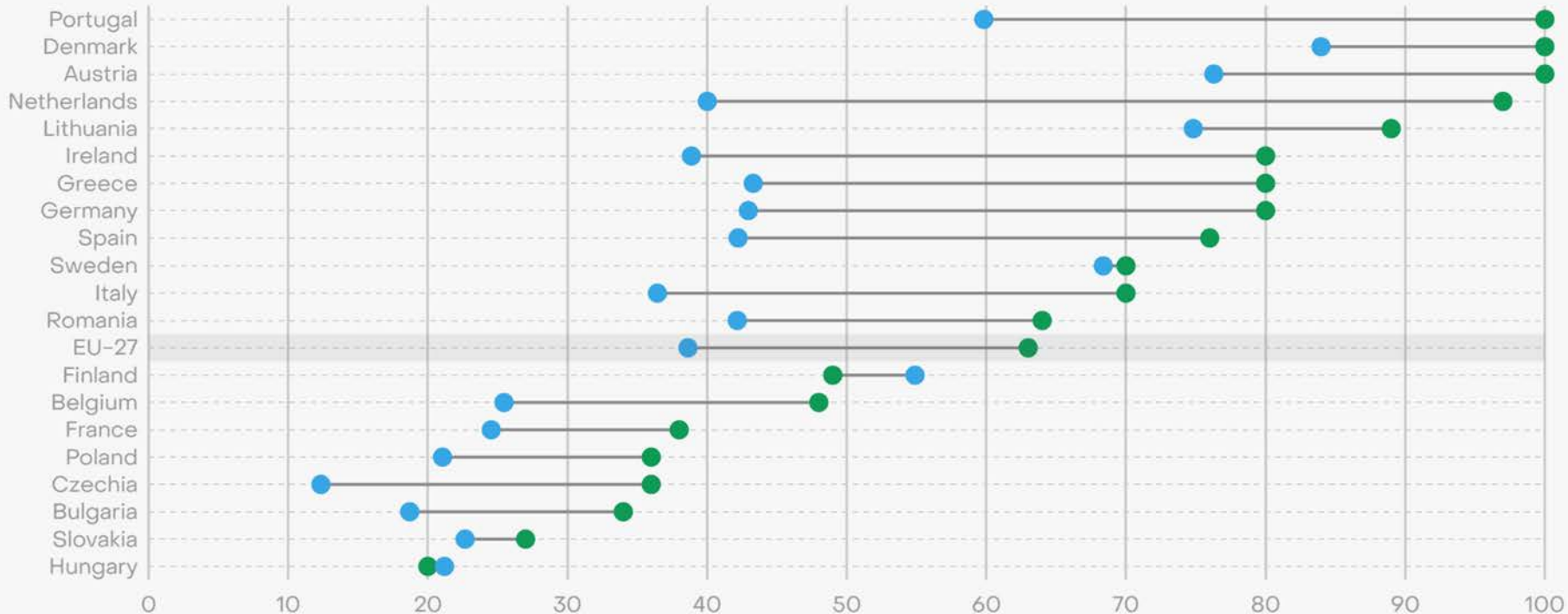
Double in 2
years

Triple in
4 years

EU countries accelerate renewable roll out

Current (2022) and 2030 planned renewable share in EU-27 electricity generation

● 2022 values ● Latest 2030 target



Source: Ember research
The countries displayed account for >97% of EU-27 electricity consumption. Updated: 16/05/2023

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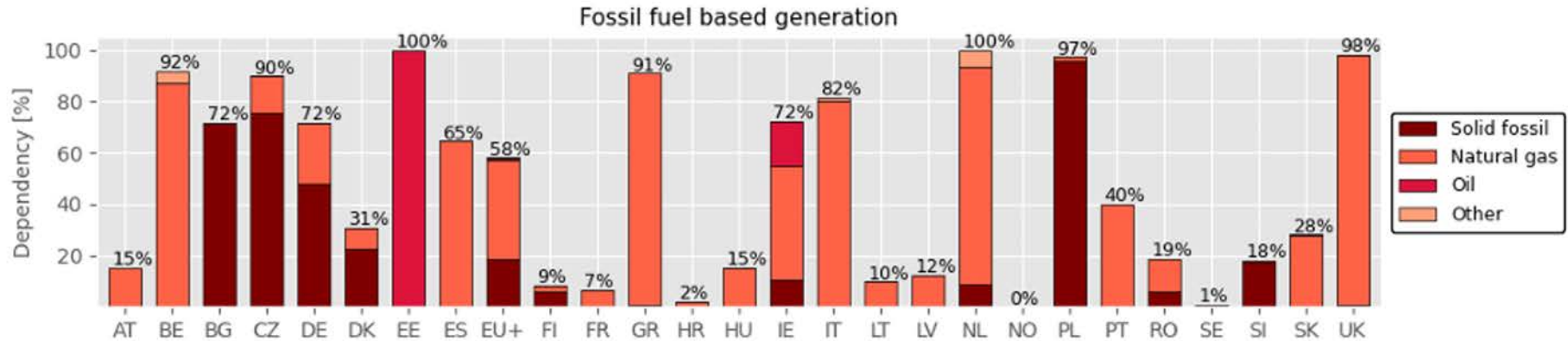
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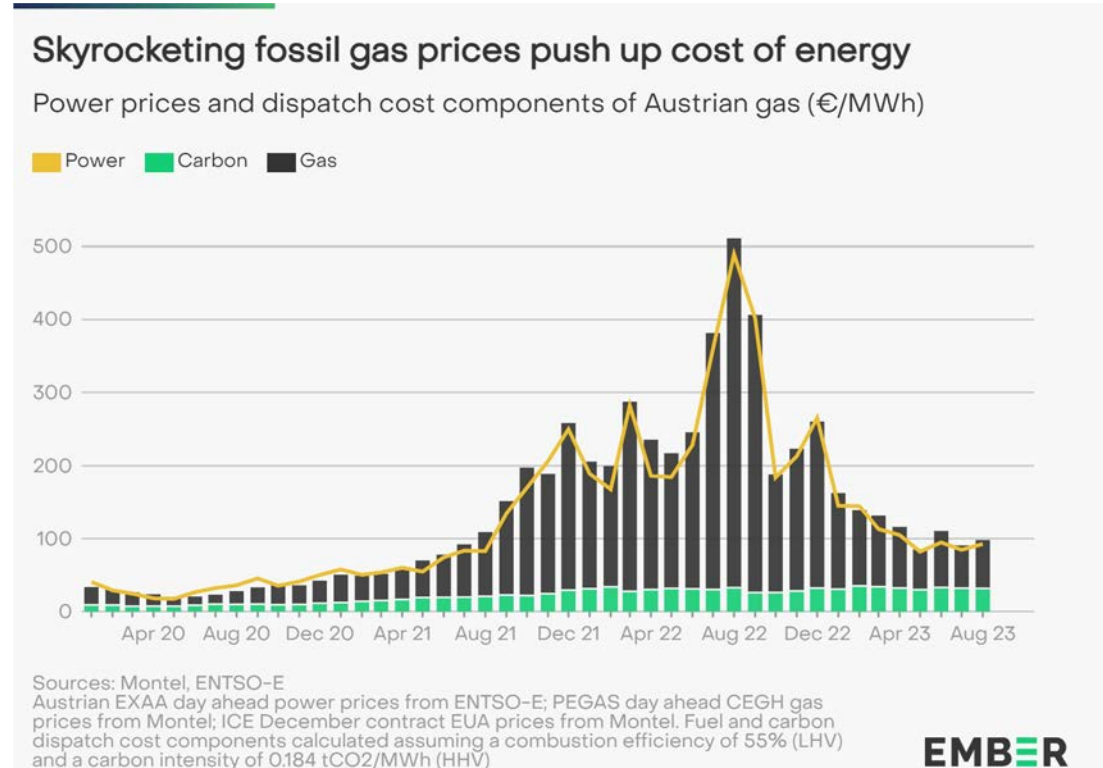
Fossil fuels determine wholesale prices much of the time in many EU countries

Dependency of wholesale electricity prices on different generation types in 2021

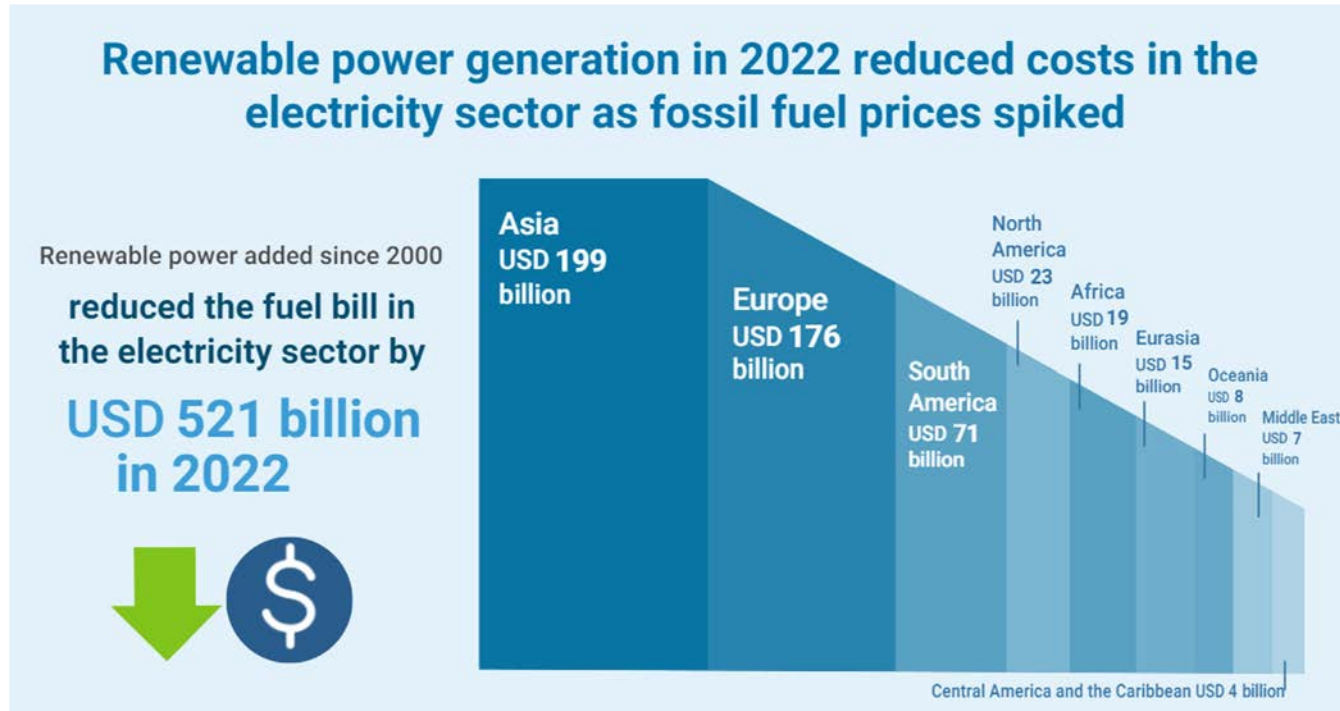


..during the energy crisis, this led to very high electricity prices

- Gas generation costs largely made up of carbon + fuel cost
- During peak of energy crisis cost of gas 27x higher than 2 years earlier



Meanwhile, renewable power is helping curb costs



Meanwhile, renewable power is helping curb costs

Growth in wind and solar has avoided €12bn in EU gas imports since Russia's invasion of Ukraine

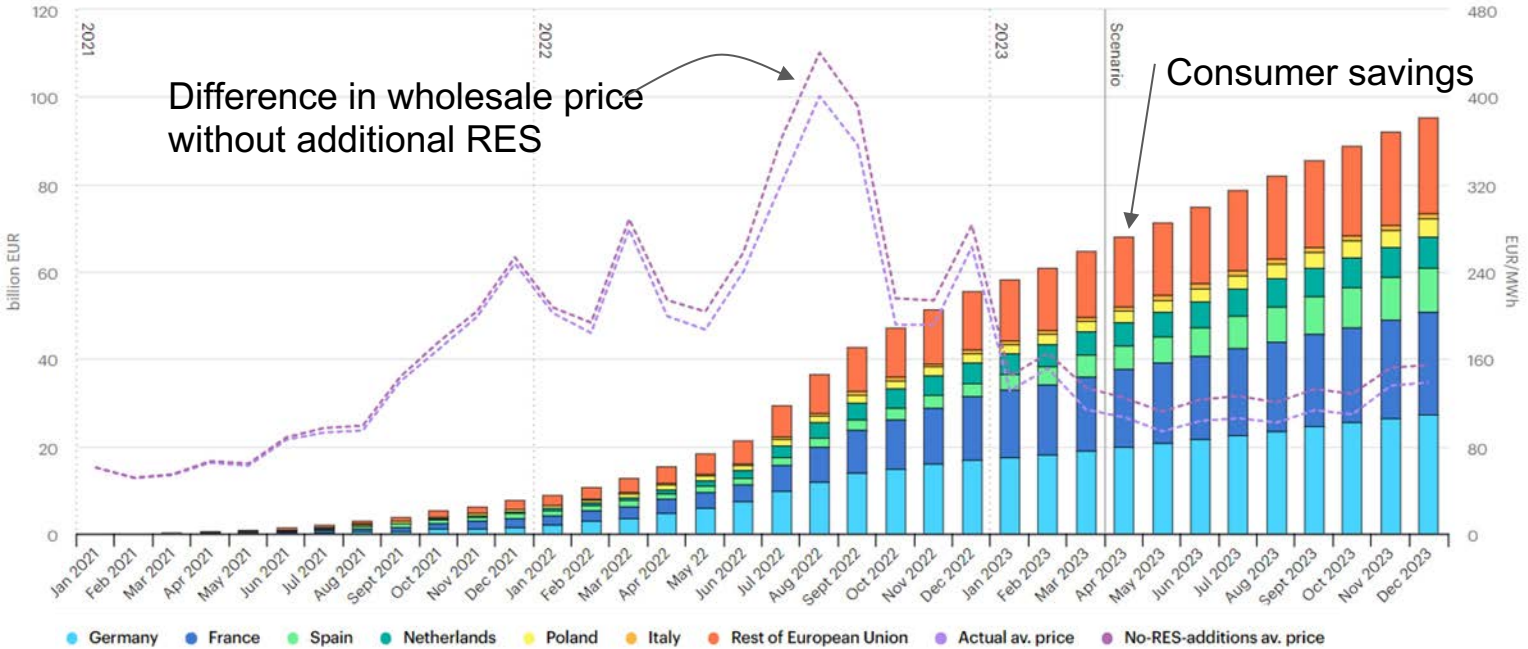
Figures relate to year-on-year changes for the period Mar 2022 - Jan 2023



Source: Monthly electricity data, Ember
Cost calculations based on TTF Day Ahead prices from Montel

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Between 2021 & 2023, additional wind and PV will save consumers €100 bn

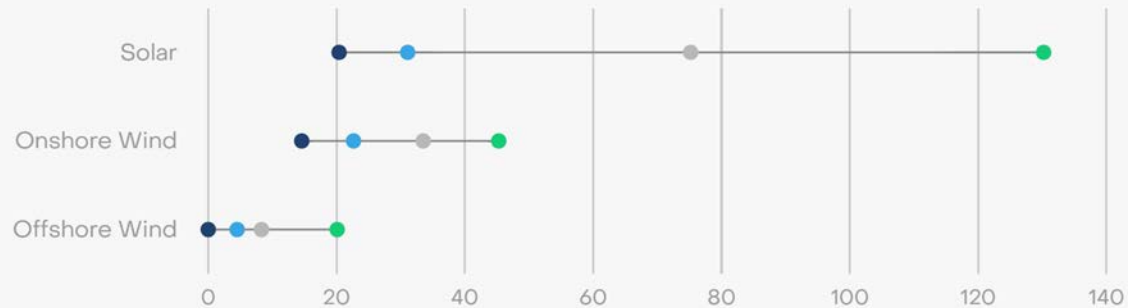


Higher renewable ambition in countries leads to lower modelled future power prices

CEE countries could increase wind and solar six times by 2030

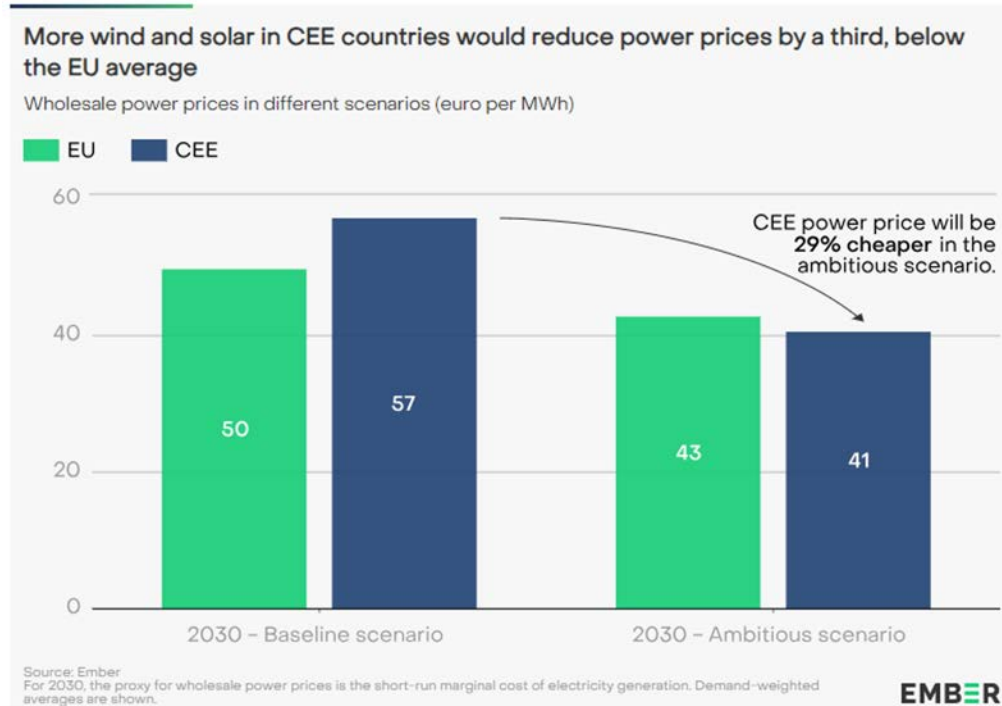
Installed renewable capacity in CEE region (gigawatts)

Scenario ● 2022 ● 2030 (NECP) ● 2030 (Baseline) ● 2030 (Ambitious)



Source: 2030 NECP = National Energy and Climate Plan targets, 2030 Baseline = latest national targets and low industry forecast extrapolation, 2030 Ambitious = national studies and high industry forecast extrapolation

Higher renewable ambition in countries leads to lower modelled future power prices



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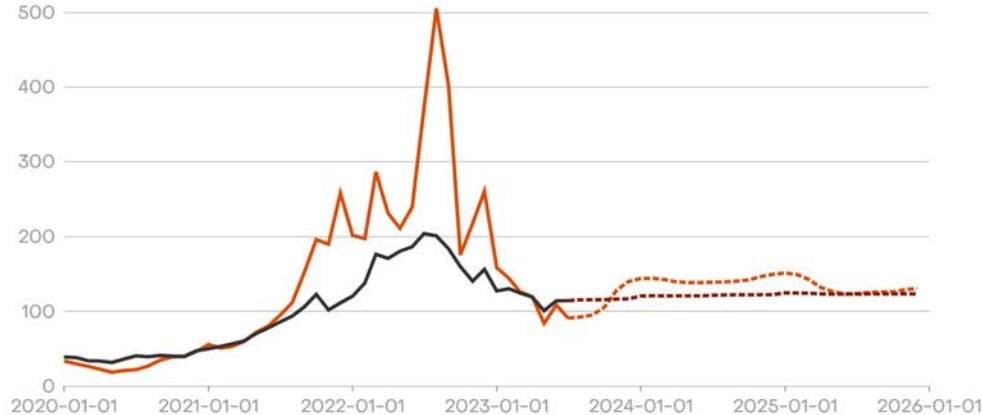


Fossil fuel generation costs lower than peak, but set to remain high

Dotted lines are futures prices; solid lines are spot prices

■ Coal ■ Gas

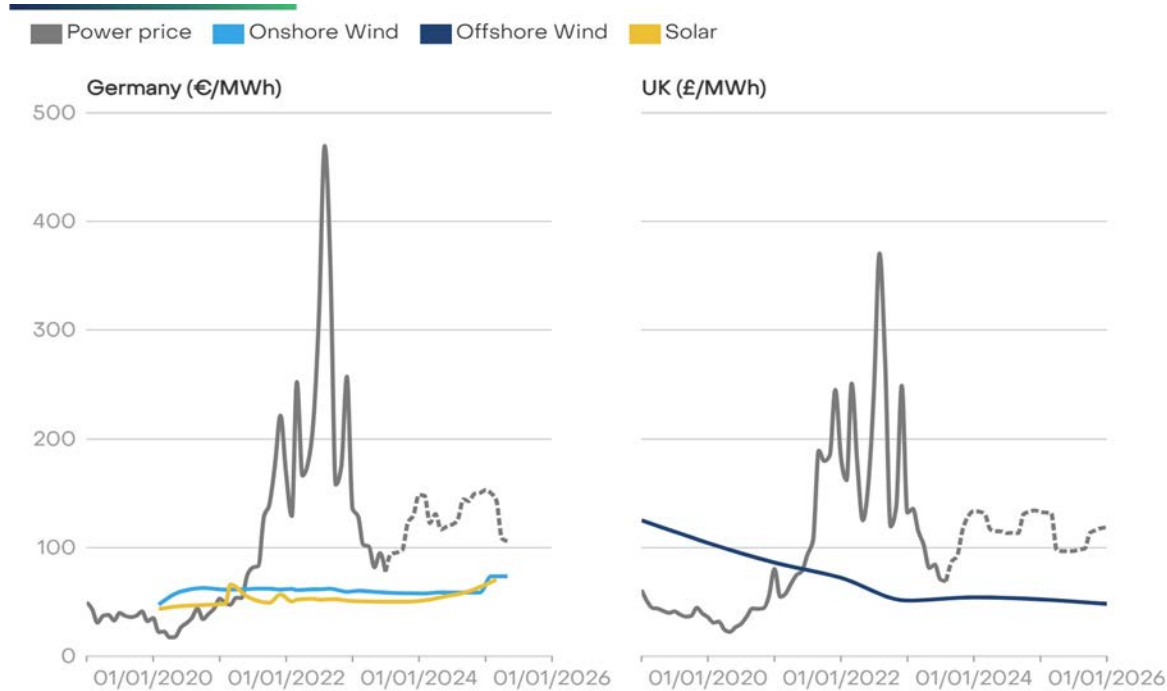
€/MWh



Source: Coal data is API2 from ICE. Gas data is TTF, using day ahead prices from PEGAS then future monthly prices from ICE.

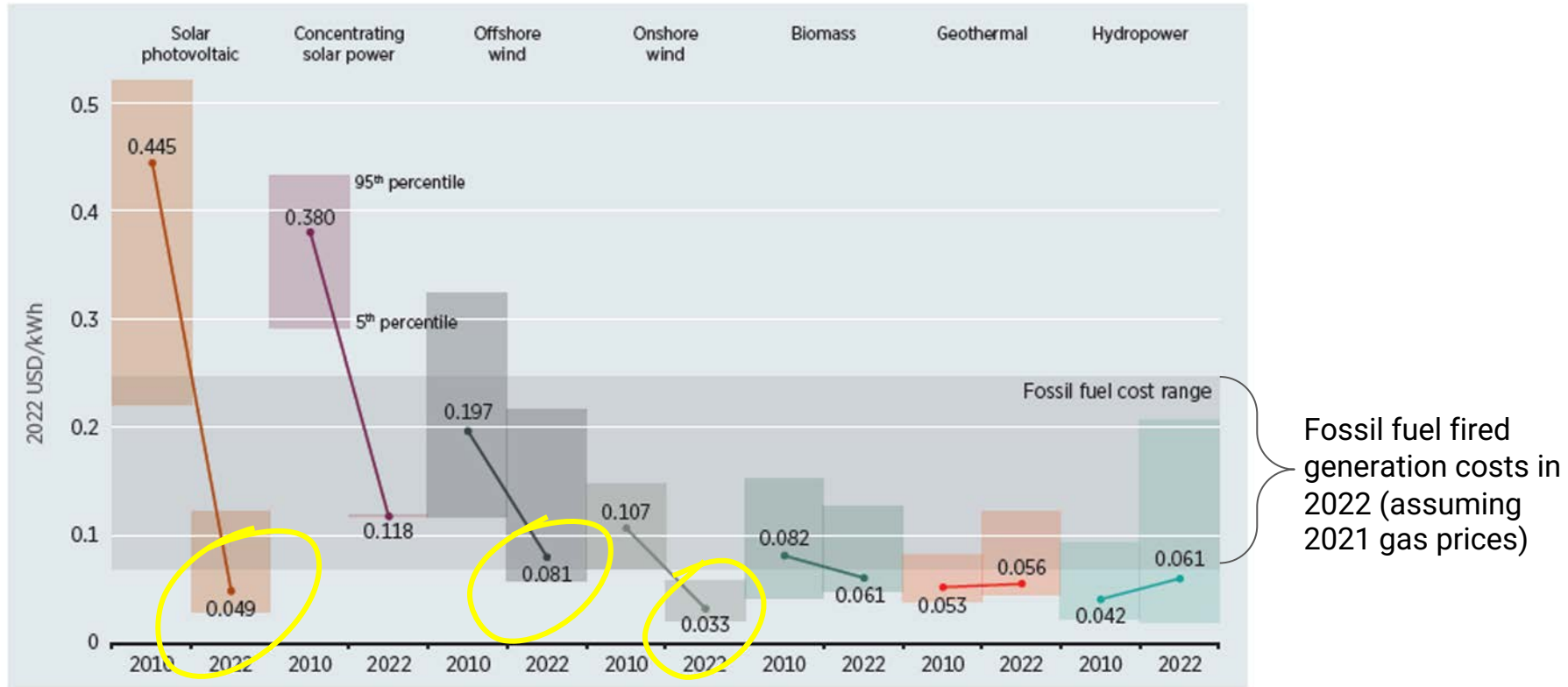
Power plant efficiency rates: Hard coal = 40%. Fossil gas = 50% (Gross Calorific Value).
Carbon intensity rates: Hard coal = 0.83 tCO₂eq/MWh. Fossil gas = 0.37 tCO₂eq/MWh.
Variable Operating and Maintenance costs for both hard coal and fossil gas = €2/MWh

Renewable auction results below future power prices



Source: German day ahead power price data from ENTSO-E, futures from ENDEX (via Montel). UK prices from NordPool, UK auction results - Carbon Brief, German auction results - BNetzA
Dotted lines are power futures prices.

86% of newly commissioned renewable energy in 2022 cheaper than fossil fuels

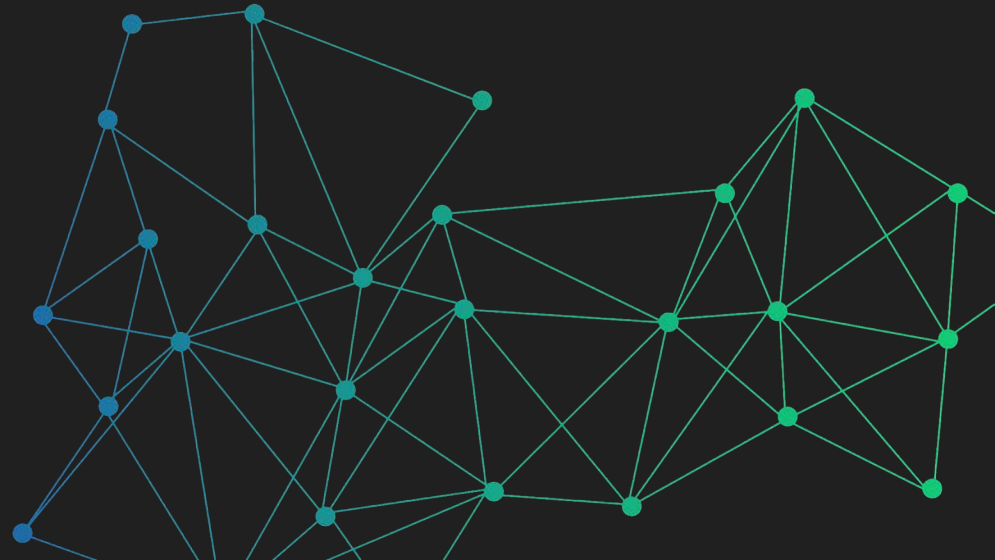


Challenges ahead

- Price cannibalisation/increased negative pricing
- Renewable curtailment
- How to pass savings onto consumers?
- Deployment of renewables faces problems including:
 - Permitting & grid connection delays
 - Grid expansion
 - Unlocking storage capacity
 - Supply chain issues
 - Sufficient financial support
 - Skills shortage

Thank you

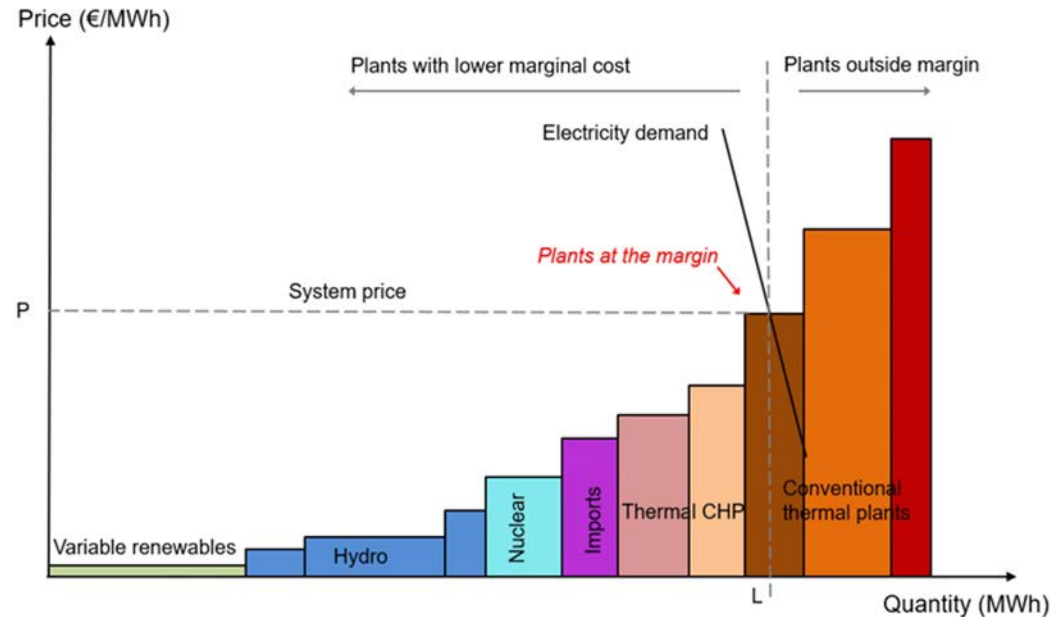
harriet@ember-climate.org



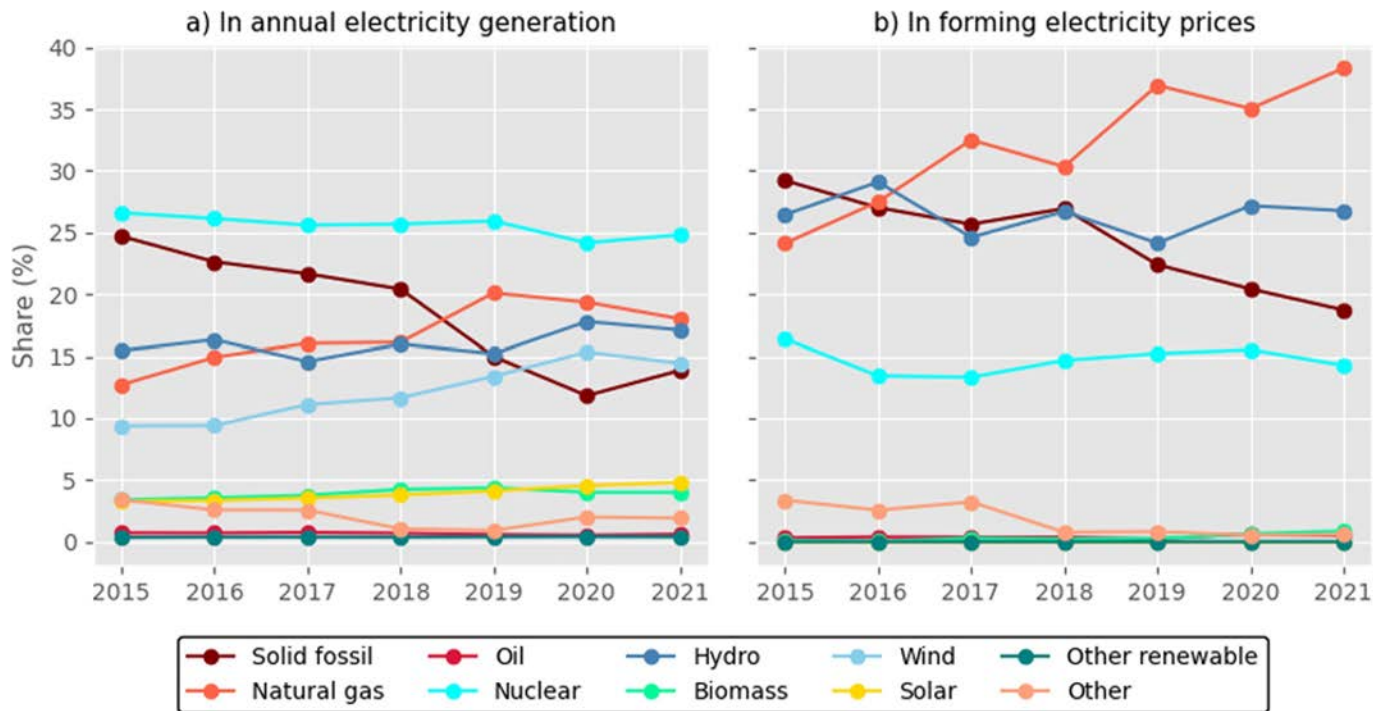
Annex

In formation of electricity prices, plants with lower marginal cost of generation are dispatched first with system price set by most expensive

- Renewables have lowest operating costs and are dispatched first
- Carbon price and fuel cost dictate fossil fuel generation cost



Share of each electricity generation type in Europe

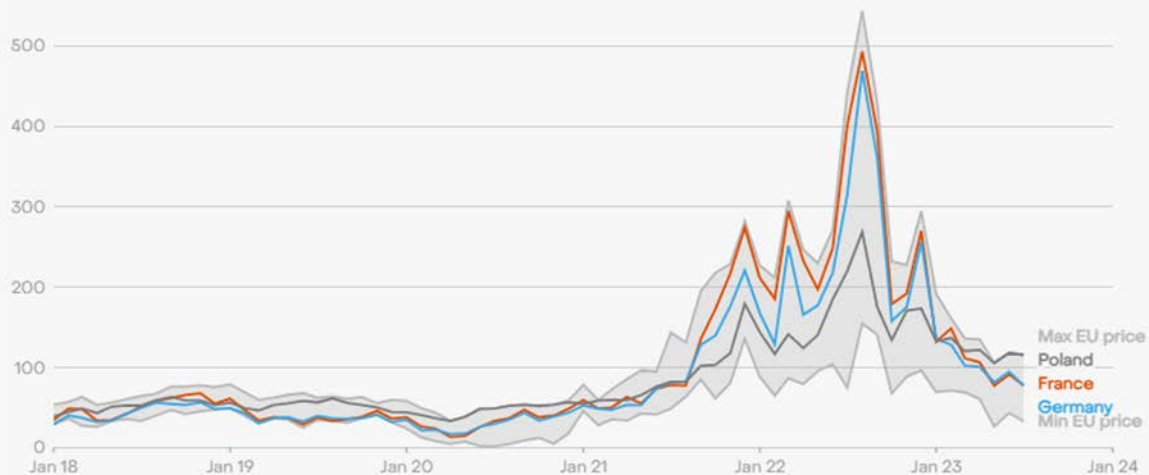


Wholesale electricity prices in Europe

€ per megawatt hour

Monthly Daily (1 year) Daily (3 months)

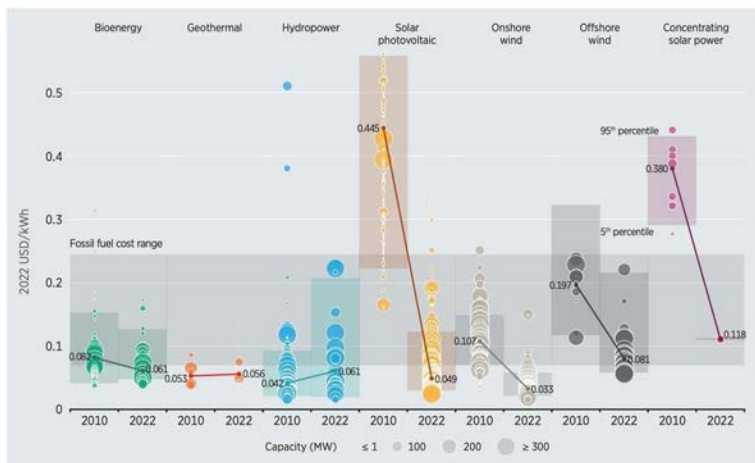
Min EU price | Max EU price | France | Germany | Poland | Enter countries to show



Source: ENTSO-e - Prices are average day-ahead spot prices per MWh sold per time period; Max and min prices refer to the highest and lowest average values of any country in the EU in that period

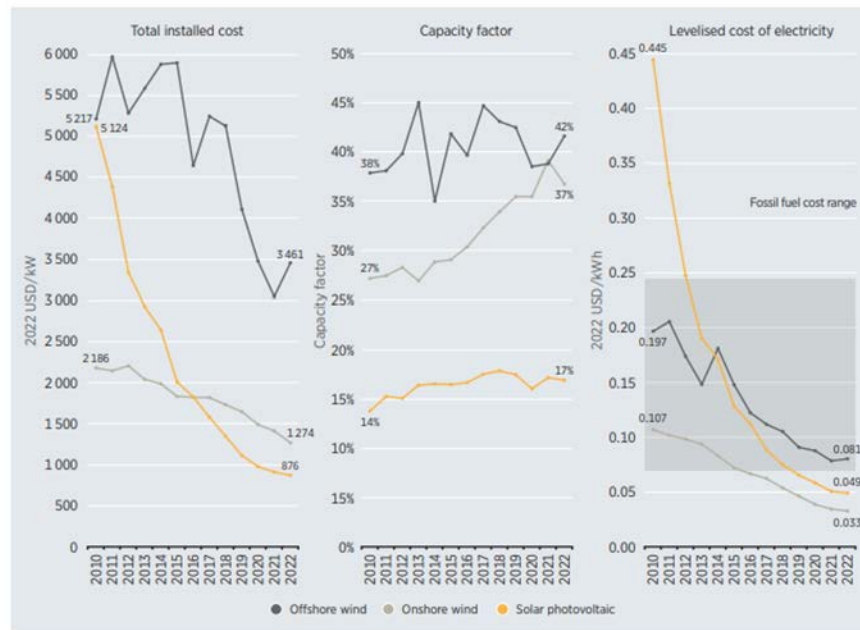
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Figure 1.2 Global weighted average LCOE from newly commissioned, utility-scale renewable power generation technologies, 2010-2022



Note: These data are for the year of commissioning. The thick lines are the global weighted average LCOE value derived from the individual plants commissioned in each year. The LCOE is calculated with project-specific installed costs and capacity factors, while the other assumptions, including WACC, are detailed in Annex I. The grey band represents the fossil fuel-fired power generation cost range (USD 0.069 to USD 0.244/kWh), while the bands for each technology and year represent the 5th and 95th percentile bands for renewable projects.

Figure 1.3 Global weighted average total installed costs, capacity factors and LCOE from newly commissioned solar PV, onshore wind power and offshore wind power, 2010-2022



Dependency of wholesale electricity prices on different generation modes in 2019

